Final Environmental Assessment/Finding of No Significant Impact

PROPOSED RELOCATION OF LAHAINA BYPASS SOUTHERN TERMINUS

(TMKs (2) 4-7-001:026, 030, and (2) 4-7-013:002, 005, 008, 010, and 011)

Volume II of II
(APPENDICES)

State of Hawaii
Department of Transportation

Approving Agency:

State of Hawaii, Department of Transportation

December 2015

VOLUME II OF II

LIST OF APPENDICES

APPENDIX A.

Pali to Puamana Master Plan Alignment

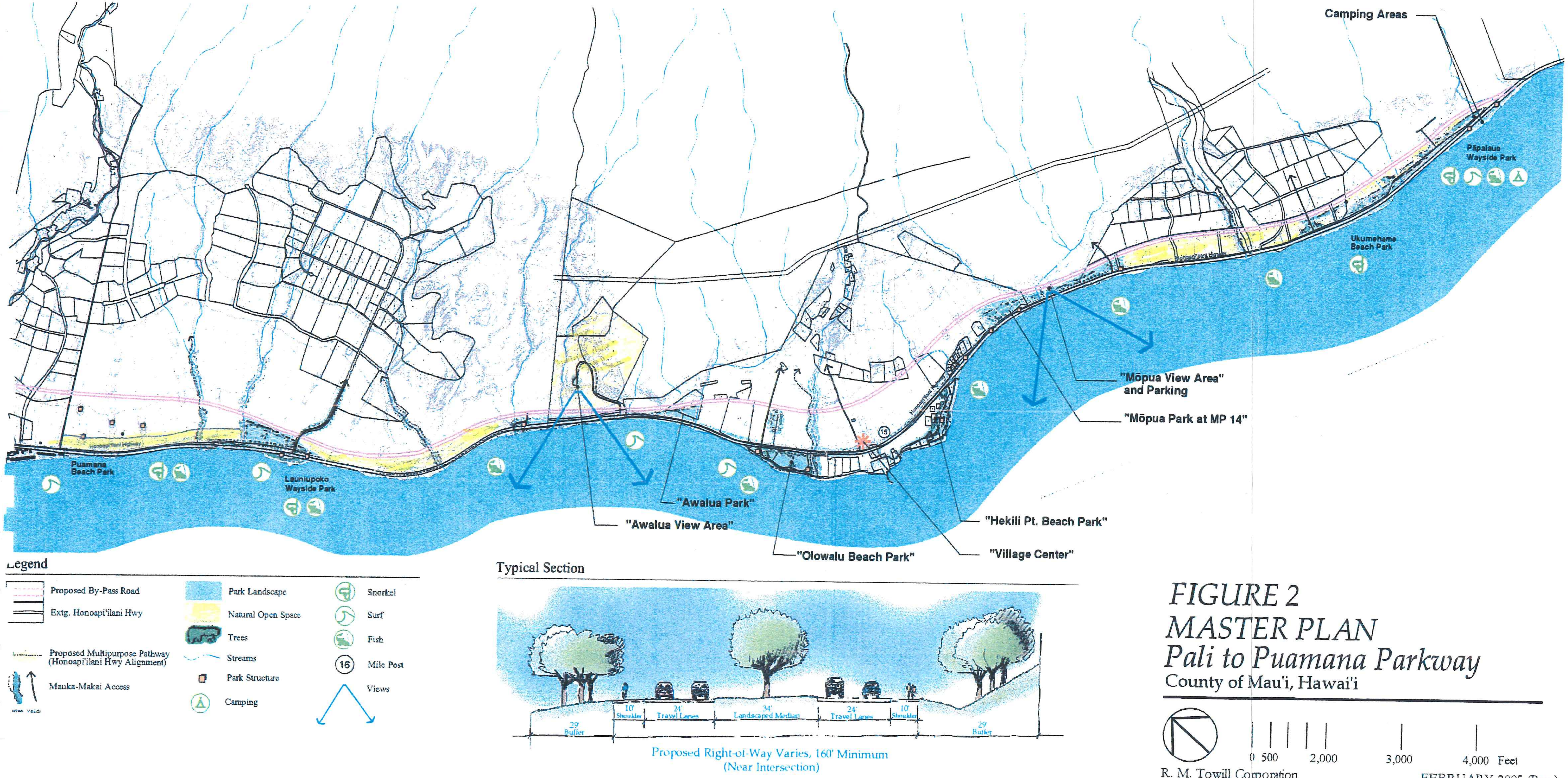


FIGURE 2
MASTER PLAN
Pali to Puamana Parkway
County of Mau'i, Hawai'i

R. M. Towill Corporation

FEBRUARY 2005 (Rev.)

APPENDIX B.

Drainage Report

Established 1969

Drainage Report for

The Proposed Lahaina Bypass Southern Terminus Relocation Project

Prepared For: Makila Land Company
305 East Wakea Ave., Suite 100
Kahului, Hawaii 96732

ALAN L. UNEMORI
NO. 9354-S

Date: January 2009
Revised: April 2012
Revised: August 2013
Revised: September 2013
Revised: March 2014
Revised: April 2014
Revised: May 2014

WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers – Land Surveyors
Wells Street Professional Center – Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

V:\Projdata\06proj\06058\Reports\Drainage Report\Cover000.docx

Table of Contents

DRAINAGE REPORT for
THE PROPOSED LAHAINA BYPASS
SOUTHERN TERMINUS RELOCATION PROJECT
Phase I-B-2

I. INTRODUCTION

This report has been prepared to examine the existing drainage conditions and the Improvements that may be required to comply with Code of Federal Regulation - CFR 650.

II. PROPOSED PROJECT

A. Site Location

The Lahaina Bypass Project extends from Honokowai to Launiupoko. Construction of Phase I-A between Lahainaluna Road and Keawe Street has been completed. Construction of Phase I-B-1 between Lahainaluna Road and Hokiokio Place has also been completed. Design of subject project, Phase I-B-2 is expected to begin upon approval of the Environmental Assessment.

B. Project Description

Three (3) alignments are being evaluated for the project. All three alternatives begin at Hokiokio Place and end at the Launiupoko/Olowalu boundary as shown on Figure 1.

Alternative 1: (See Exhibit A.)

This alternative begins at the southern end of Phase I-B-1 at Hokiokio Place and extends in a southerly direction to a point approximately 1,000 feet south of Launiupoko Park where it intersects with Honoapiilani Highway. It then follows the existing highway to the Launiupoko/Olowalu boundary on the north side of the now closed Olowalu Landfill.

Alternative 2: (See Exhibit B.)

This alternative follows an alignment ranging between 300 to 500 feet inland of Alternative 1. It is generally located midway between Alternative 1 and 3.

Alternative 3: (See Exhibit C.)

Alternative 3 is located farthest inland and ranges between 700 to 1500 feet mauka and east of the existing Honoapiilani Highway.

III. EXISTING CONDITIONS

A. Topography and Soil Conditions

The existing topography across all three alternatives range between 7 and 8 percent. Grades along the profile varies between 0.5 and 3.0 percent.

According to the *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, prepared by the United States Department of Agriculture, Natural Resource Conservation Service, most of the project site is classified as Stony Alluvial Land (rSM). This soil is comprised of stones, boulders, and stream deposited soil. The remainder of the project site is classified as Wainee extremely stony silty clay (WyC) sloped 7 to 15 percent and Wainee very stony silty clay (WxB) sloped 3 to 7 percent. The Wainee Series is characterized as having moderately rapid permeability and slow to medium runoff, with a slight to moderate erosion hazard.

B. Drainage

This report identifies the location of floodplains within the project limits. It also discusses the hydraulic design of drainage structure with supporting documentation to minimize the impact of encroachments, all in accordance with the provisionsof CFR 650.

1. Definition (CFR 650.105)

As defined in this section of the CFR, *base flood* refers to flood or tide that have a 1 percent chance of being exceeded in any given year, comparable to a 100-year recurrence storm.

Base floodplain are areas subject to flooding by the base flood.

Encroachment means any action within the limits of the base floodplain.

2. Applicability of CFR 650.107

There are no regulatory floodways established by the Federal Emergency Management Agency (FEMA) for administration of the National Flood Insurance program within the project limits. However, since all three alternatives do encroach on base floodplains, the provisions of CFR 650.105 will be applicable. Base floodplain refers to areas that are subject to 100-year storm or a storm event that have a 1 percent chance of being exceeded in any given year.

Since none of the drainage basins have stream flow gauging stations or gage data, the Soil Conservation (NRCS) Method was used to determine runoff in areas greater than 200 Acres in accordance with State of Hawaii, Department of Transportation's (HDOT) *Design Criteria for Highway Drainage*. For drainage basin less than 200 Acres the rational formula was used.

3. Location of Hydraulic Study (CFR 650.111)

Although there are eight (8) contributory drainage areas located above, or upstream, of the proposed realignment project, only three (3) of them, areas 1, 2 and 3 are greater than one square mile. These three basins are contiguous and extend up the slopes of the West Maui Mountains (See Figure 2). Drainage basins 1 and 2 straddle Luakoi Ridge approximately 3.9 miles northeast of the project area. Drainage basin 3 encompasses Launiupoko Gulch and extends about 4.6 miles inland of the project site. These floodways will be bifurcated by all three alternative alignments being considered. By definition any such action would be considered an encroachment.

Since the three drainageways generally flow from the mountain slopes to the ocean normal to the natural contours and highway corridors, there is no practical alternative to avoid encroachment. To mitigate any adverse impact, the status quo will be maintained. The existing water surface elevation will be used to set the water surface elevations in the drainage structure. Major drainage structures will be sized not only to convey the design flood across the highway but also to prevent overtopping. To establish the height of drainage structures and channels its depth will be measured from the existing water surface elevation down to the invert of the structure or channel. This is to maintain the existing water surface elevation or to ensure that it will not rise more than one (1) foot above the existing water surface elevation in the drainageway in accordance with the regulations established by FEMA. The size of these larger drainage structures must also be high and deep enough for access by maintenance equipment.

The capacities of these major drainage structures can also be increased substantially by installing side-tapered and slope-tapered transitional inlets to the box culverts. With the installation of these transitional tapered inlets and allowance for freeboard in the box culverts, these structures can serve as open channels, thereby increasing their capacities substantially as indicated in the last column of Table 5.

4. Design Standards (CFR 650.115)

The existing flood inundation limits are shown on Exhibits A, B and C. These exhibits show the existing floodways and sizes of culverts that will be needed at each crossing to maintain the status quo. Although Section (a) - (2) of these design standards state that design flood encroachments by through lanes of interstate highways may be sized to handle floods that have a 2 percent chance of being exceeded in any give year, (50-year storm), culverts for drainage areas 4 through 8 inclusive will be oversized to pass 100-year storm at a maximum headwater-to-depth ratio (HW/D) of 1.2 instead to reduce the probability of overtopping. Size and material of culverts shall be designed in accordance with HDOT's *Design Criteria for Highway Drainage*.

5. Content of Design Studies (CFR 650.117)

The results of our studies are tabulated in Tables 4 and 5 respectively.

According to our studies, the water level in the drainageways at the highway crossings will remain the same or where there is an increase, the increase will not be greater than one foot consistent with standards established by FEMA.

Supporting calculations for Tables 4 and 5 are included in Tables 1, 2, and 3, and also in Appendix A.

IV. SUMMARY AND CONCLUSION

All three base floodways identified within the project limits will be affected by the project. There is no practical alternative to avoid encroachment by the project. These encroachments are not significant and can be mitigated by sizing and designing the drainage structures to maintain the status quo.

With the installation of side-tapered and slope-tapered transitional inlet structures in the drainageways that are being lowered and channelized, these structures could function as open channels. Open channels would have much greater capacities than inlet control structures.

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

The degree of encroachments by all three alternatives are generally the same. Encroachments can be mitigated readily during the design phase to maintain the status quo in compliance with the provisions of CFR 650.

Desilting and retention basins will also be installed to capture the additional runoff generated by the impermeable pavement structures on the new highway to maintain the current peak runoff during a 100-year (1%) storm. Energy dissipaters will also be installed at outlets of drainage structures where necessary to maintain the existing velocities in the drainageways.

V. REFERENCES

1. *Soil Survey of Islands of Kauai, Oahu, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

2. *Code of Federal Regulation CFR 650 - Bridges, Structures and Hydraulics.* Federal Highway Administration, Department of Transportation.

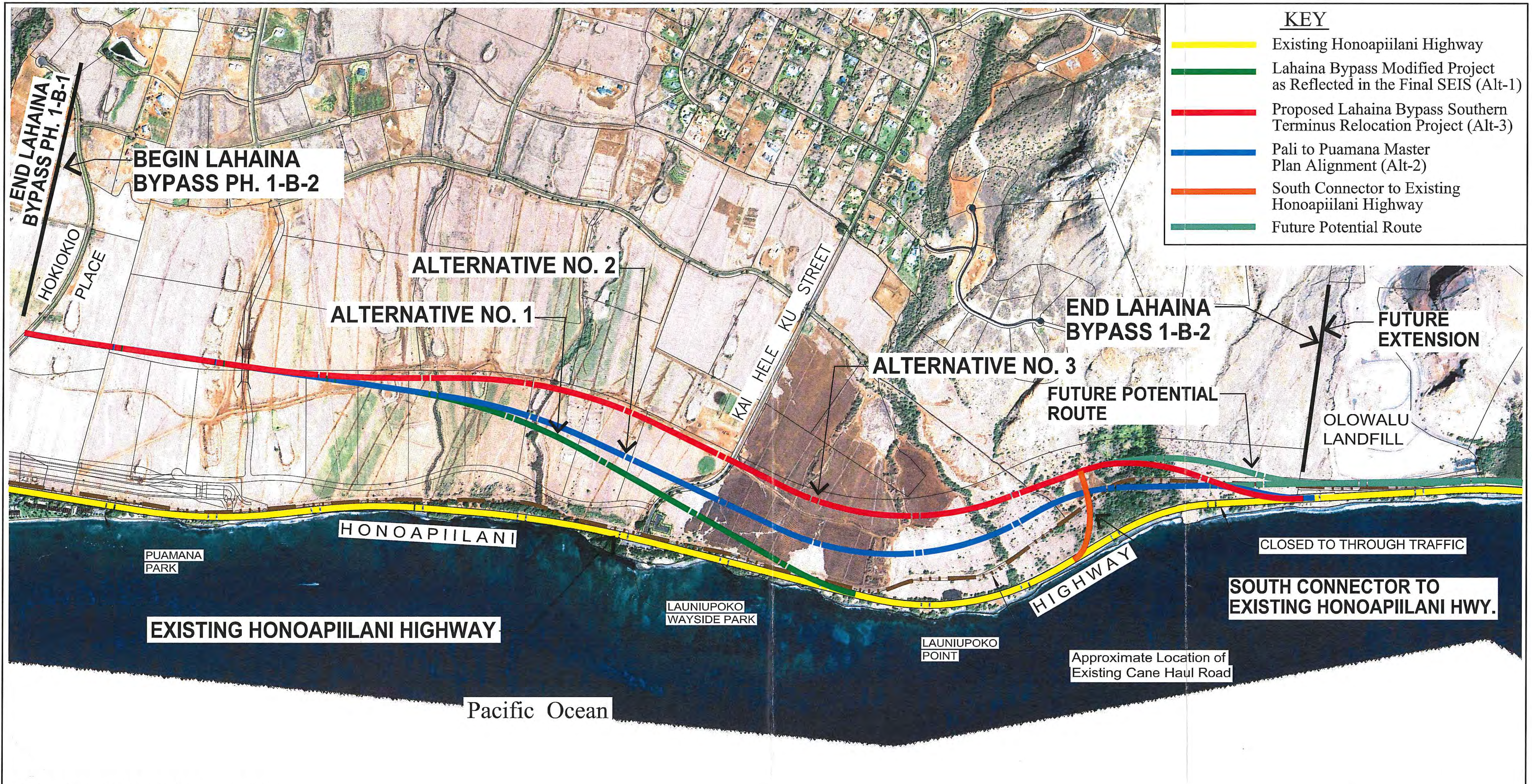
3. *Design Criteria for Highway Drainage.* State of Hawaii, Department of Transportation Highways Division.

4. *Highway Drainage Guidelines.* 1992. American Association of State Highway and Transportation Officials.

5. *Storm Water Permanent Best Management Practices Manual.* State of Hawaii, Department of Transportation Highways Division.

6. *Hydraulic Design of Highway Culverts.* Federal Highway Administration, Department of Transportation.

7. *Flood Insurance Study.* August 1998. County of Maui, Federal Emergency Management Agency Community Number 150003.



Source: Warren S. Unemori Engineering, Inc.

0 1000 2000 3000 4000

Scale: 1 in. = 1000 ft.

Prepared For: State of Hawaii, Department of Transportation

Proposed Lahaina Bypass Southern Terminus Relocation

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

FIGURE 1

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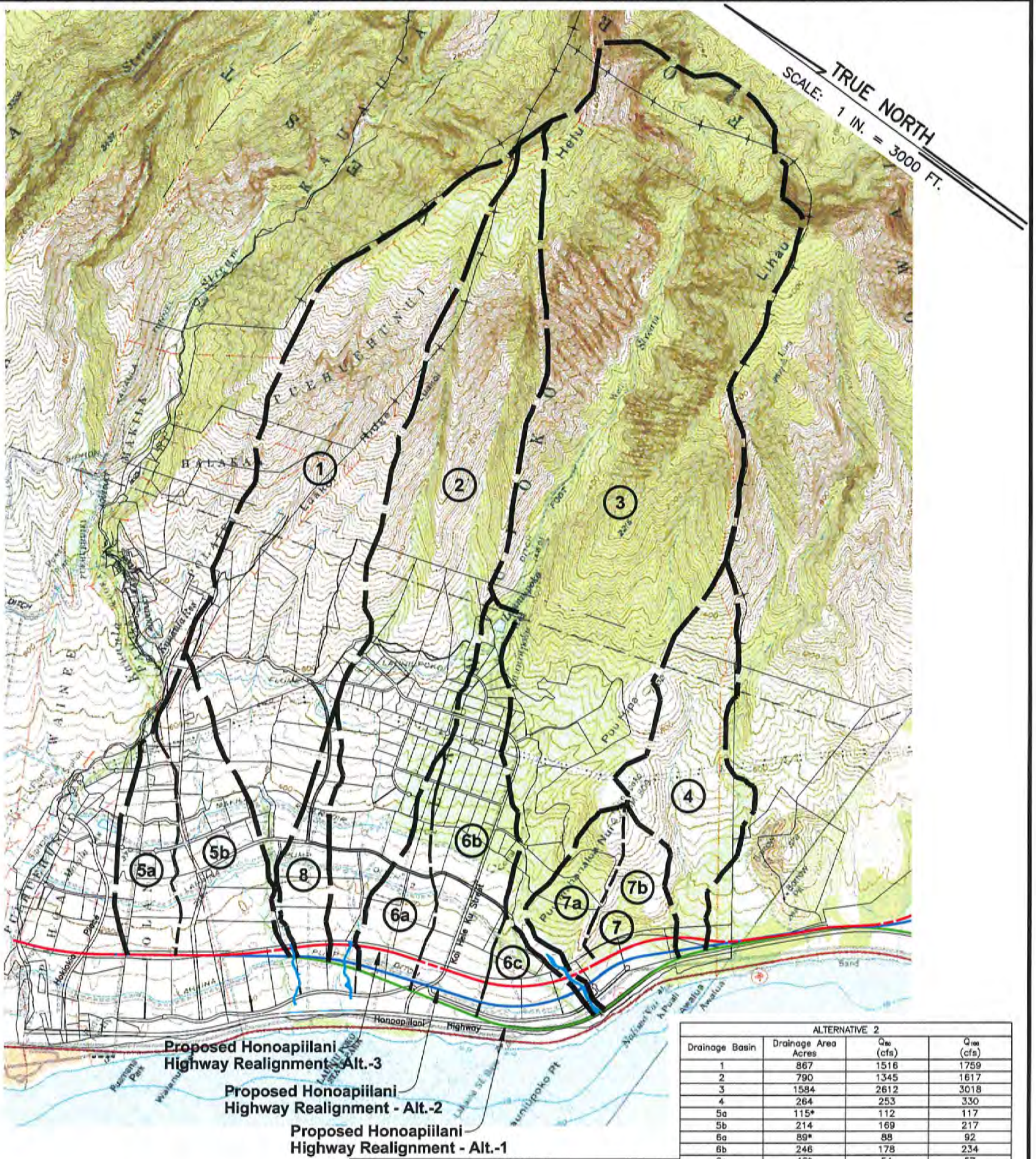

ALTERNATIVE 1			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	169	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

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

ALTERNATIVE 2			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	246	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

ALTERNATIVE 3			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	866	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	168	216
6a	76*	76	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	81*	75	79

DRAIN AREA MAP

FIGURE 2

April 10, 2008

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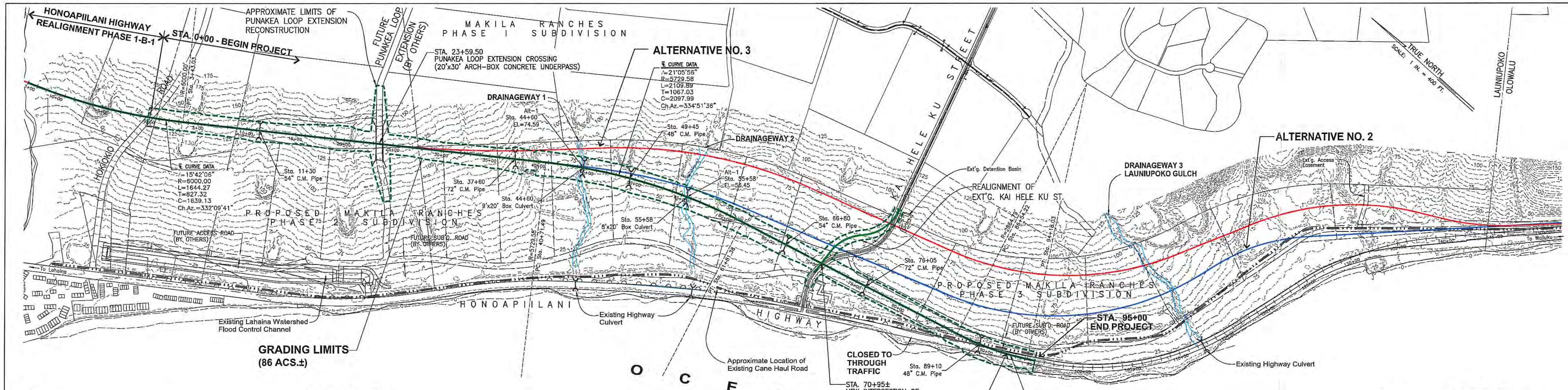
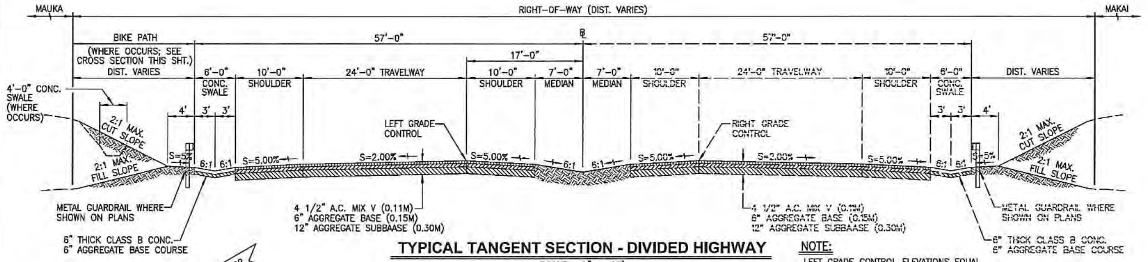
EXHIBIT

A	Plan and Profile - Alternative 1
B	Plan and Profile - Alternative 2
C	Plan and Profile - Alternative 3



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1

SCALE: HORIZ. 1"=400'



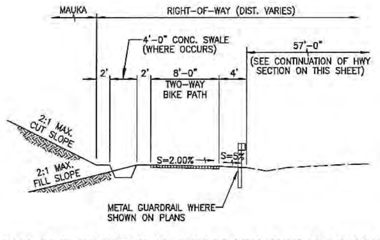
TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL RIGHT GRADE CONTROL ELEVATIONS

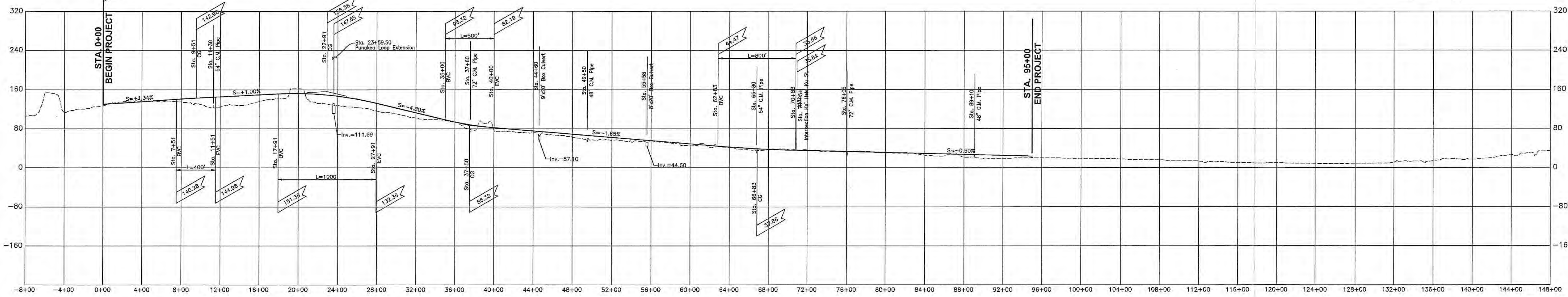
APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 1)

EXCAVATION = 33,239 CU.YD.
EMBANKMENT = 323,541 CU. YD.
HIGHWAY AREA = 52 ACS.±
ROAD RECONSTRUCTION AREA = 7 ACS.±



TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1

SCALE: HORIZ. 1"=400'
VERT. 1"=80'

EXHIBIT A

WARREN S. UNEMORI ENGINEERING, INC.

October 16, 2014

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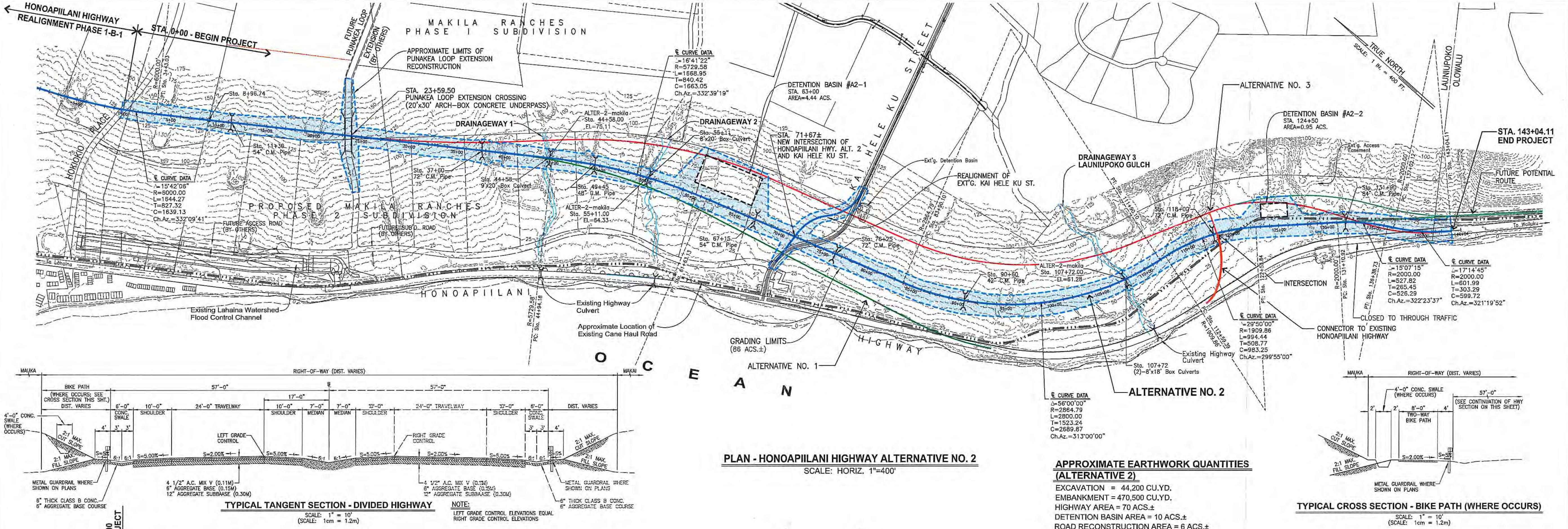


PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2

SCALE: HORIZ. 1"=400'

TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

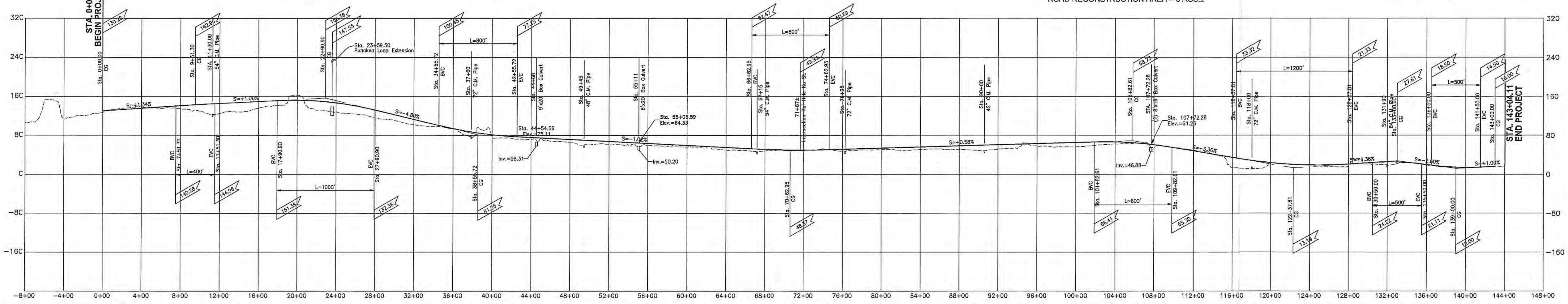
NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL RIGHT GRADE CONTROL ELEVATIONS

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 2)

EXCAVATION = 44,200 CU.YD.
EMBANKMENT = 470,500 CU.YD.
HIGHWAY AREA = 70 ACS.±
DETENTION BASIN AREA = 10 ACS.±
ROAD RECONSTRUCTION AREA = 6 ACS.±

TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2

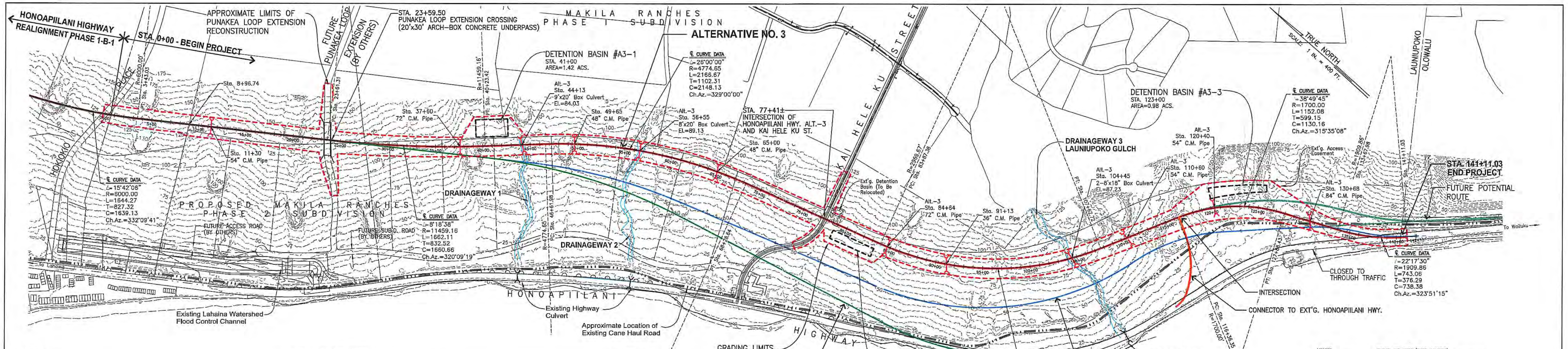
SCALE: HORIZ. 1"=400'
VERT. 1"=80'

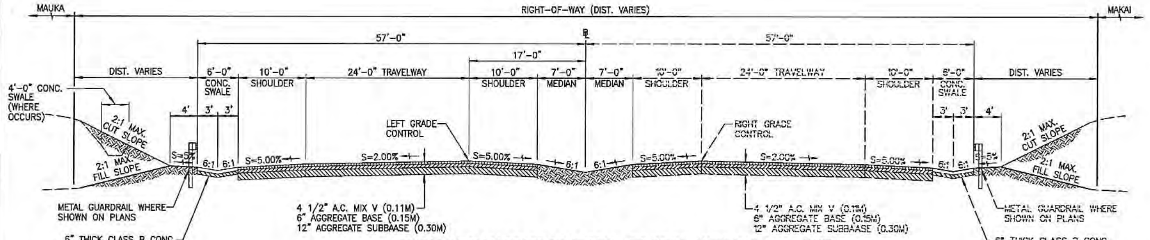
REDUCED COPY
NOT TO SCALE

EXHIBIT B

WARREN S. UNEMORI ENGINEERING, INC.

May 20, 2014





TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

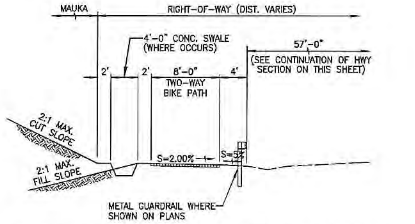
NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL
RIGHT GRADE CONTROL ELEVATIONS

PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'

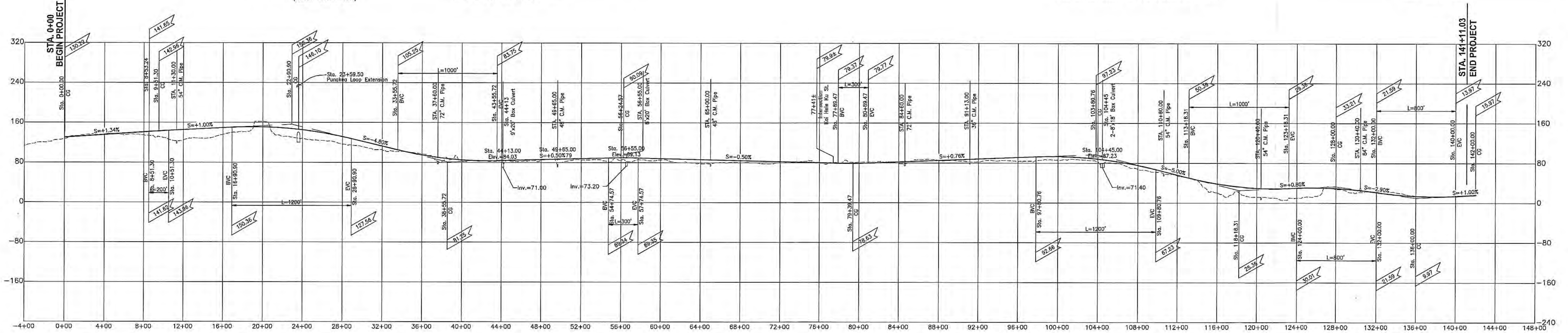
APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 3)

EXCAVATION = 60,900 CU.YD.
EMBANKMENT = 480,200 CU.YD.
HIGHWAY AREA = 67 ACS.±
DETENTION BASIN AREA = 9 ACS.±
ROAD RECONSTRUCTION AREA = 6 ACS.±



TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'
VERT. 1"=80'

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NOT TO SCALE

EXHIBIT C

WARREN S. UNEMORI ENGINEERING, INC.

May 20, 2014

TABLE

TABLE 1

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	100-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100-yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.7	196.3	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20461.0	4335.0	21.19%	**1758**	**1514**	n/a	1.04	**9'x20' Box Culvert**	2060
2	791.1	258.8	106.9	425.5	69.2	n/a	12.6	11.1	n/a	18382.0	4345.0	23.64%	**1613**	**1342**	n/a	1.12	**8'x20' Box Culvert**	1720
3	1586.9	385.9	0.0	1201.1	71.9	n/a	13.0	11.7	n/a	24538.0	4380.0	17.85%	**2960**	**2539**	n/a	1.15	**(2)-8'x18' Box Culverts**	3095
4	265.2	238.2	0.0	27.0	58.1	n/a	10.3	9.0	n/a	8714.0	1680.0	19.28%	**327**	**251**	n/a	1.10	**84" C.M. Pipe**	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	**117**	1.20	**54" C.M. Pipe**	120
5b	214.0	214.0	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6835.0	630.0	9.22%	**217**	**169**	n/a	1.07	**72" C.M. Pipe**	255
6a	92.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5043.0	460.0	9.12%	n/a	n/a	**95**	0.97	**54" C.M. Pipe**	120
6b	255.2	255.2	0.0	0.0	56.0	n/a	10.4	9.2	n/a	8310.0	860.0	10.35%	**243**	**169**	n/a	1.08	**72" C.M. Pipe**	255
6c	72.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	2290.0	180.0	7.86%	n/a	n/a	**85**	1.11	**48" C.M. Pipe**	91
7	196.8	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5448.0	800.0	14.68%	**192**	**188**	n/a	1.15	**66" C.M. Pipe**	200
8*	85.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5651.0	553.0	9.79%	n/a	n/a	**81**	1.09	**48" C.M. Pipe**	91

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TABLE 1
LAHAINA BYPASS ALTERNATIVE 1
DRAINAGE AREA CALCULATIONS

TABLE 2

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	50-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100-yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.7	196.2	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20433.0	4330.0	21.19%	**1759**	**1516**	n/a	1.04	**9'x20' Box Culvert**	2060
2	789.7	257.4	106.9	425.5	69.2	n/a	12.6	11.1	n/a	18278.0	4338.0	23.73%	**1617**	**1345**	n/a	1.12	**8'x20' Box Culvert**	1720
3	1583.7	382.6	0.0	1201.1	71.9	n/a	13.0	11.7	n/a	23895.0	4340.0	18.16%	**3018**	**2612**	n/a	1.17	**(2)-8'x18' Box Culverts**	3095
4	263.6	236.7	0.0	27.0	58.1	n/a	10.3	9.0	n/a	8550.0	1680.0	19.65%	**330**	**253**	n/a	1.10	**84" C.M. Pipe**	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	**117**	1.20	**54" C.M. Pipe**	120
5b	214.0	214.0	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6835.0	630.0	9.22%	**217.0**	**169.0**	n/a	1.07	**72" C.M. Pipe**	255
6a	88.7	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4857.0	452.0	9.31%	n/a	n/a	**92**	0.96	**54" C.M. Pipe**	120
6b	246.1	246.1	0.0	0.0	56.0	n/a	10.5	9.2	n/a	8488.0	845.0	9.96%	**234.0**	**178.0**	n/a	1.13	**72" C.M. Pipe**	255
6c	45.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	1859.0	150.0	8.07%	n/a	n/a	**57**	1.08	**42" C.M. Pipe**	65
7	174.8	174.8	0.0	0.0	56.0	n/a	9.6	8.8	n/a	5109.0	790.0	15.46%	**210**	**175**	n/a	1.08	**72" C.M. Pipe**	255
8*	85.3	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5594.0	545.0	9.74%	n/a	n/a	**82**	1.11	**48" C.M. Pipe**	91

V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revised)\drainage-areas-00.xls

TABLE 2
LAHAINA BYPASS ALTERNATIVE 2
DRAINAGE AREA CALCULATIONS

TABLE 3

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	50-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100-yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.0	195.6	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20253.0	4315.0	21.31%	**1768**	**1524**	n/a	1.05	**9'x20' Box Culvert**	2060
2	784.7	252.3	106.9	425.5	69.3	n/a	12.6	11.1	n/a	17916.0	4310.0	24.06%	**1646**	**1369**	n/a	1.13	**8'x20' Box Culvert**	1720
3	1581.0	380.0	0.0	1201.1	72.0	n/a	13.0	11.7	n/a	23352.0	4310.0	18.46%	**3067**	**2655**	n/a	1.20	**(2)-8'x18' Box Culverts**	3095
4	261.0	234.0	0.0	27.0	58.2	n/a	10.3	9.0	n/a	8342.0	1673.0	20.06%	**333**	**255**	n/a	1.10	**84" C.M. Pipe**	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	**117**	1.20	**54" C.M. Pipe**	120
5b	211.5	211.5	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6740.0	625.0	9.27%	**216.0**	**168.0**	n/a	1.07	**72" C.M. Pipe**	255
6a	76.1	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4383.0	422.0	9.63%	n/a	n/a	**80**	1.07	**48" C.M. Pipe**	91
6b	231.0	231.0	0.0	0.0	56.0	n/a	10.5	9.3	n/a	8029.0	813.0	10.13%	**227.0**	**177.0**	n/a	1.11	**72" C.M. Pipe**	255
6c	25.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	1343.0	112.0	8.34%	n/a	n/a	**34**	0.97	**36" C.M. Pipe**	44
7a	81.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	3916.0	722.0	18.44%	n/a	n/a	**94**	0.99	**54" C.M. Pipe**	120
7b	77.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	3669.0	795.0	21.67%	n/a	n/a	**91**	0.95	**54" C.M. Pipe**	120
8*	81.2	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5327.0	530.0	9.95%	n/a	n/a	**79**	1.06	**48" C.M. Pipe**	91

V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revised)\drainage-areas-00.xls

TABLE 3
LAHAINA BYPASS ALTERNATIVE 3
DRAINAGE AREA CALCULATIONS

TABLE 4 - LAHAINA BYPASS CULVERT SIZING SUMMARY TABULATION

Alternative 1

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	867	SCS	1514	SCS	1758	1.04	Single 9'x20'
2	791	SCS	1342	SCS	1613	1.12	Single 8'x20'
3	1587	SCS	2539	SCS	2960	1.15	Twin 8'x18'
4	265	SCS	251	SCS	327	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	214	SCS	184	SCS	217	1.07	72" Sect. PL CAP
6a	93	Rational	91	Rational	95	0.97	54" CAP
6b	255	SCS	169	SCS	243	1.08	72" Sect. PL CAP
6c	73	Rational	80	Rational	85	1.11	48" CAP
7	197	Rational	188	Rational	192	1.08	66" Sect. PL CAP
8	86	Rational	78	Rational	81	1.09	48" CAP

Alternative 2

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	867	SCS	1516	SCS	1759	1.04	Single 9'x20'
2	790	SCS	1345	SCS	1617	1.12	Single 8'x20'
3	1584	SCS	2612	SCS	3018	1.17	Twin 8'x18'
4	264	SCS	253	SCS	330	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	214	SCS	169	SCS	217	1.07	72" Sect. PL CAP
6a	89	Rational	88	Rational	92	0.96	54" CAP
6b	246	SCS	178	SCS	234	1.13	72" Sect. PL CAP
6c	46	Rational	54	Rational	57	1.08	42" CAP
7	175	Rational	175	Rational	192	1.08	72" Sect. PL CAP
8	85	Rational	78	Rational	82	1.11	48" CAP

Alternative 3

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	866	SCS	1524	SCS	1768	1.05	Single 9'x20'
2	785	SCS	1369	SCS	1646	1.13	Single 8'x20'
3	1581	SCS	2655	SCS	3067	1.20	Twin 8'x18'
4	261	SCS	255	SCS	333	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	212	SCS	168	SCS	216	1.07	72" Sect. PL CAP
6a	76	Rational	76	Rational	80	1.07	48" CAP
6b	231	SCS	177	SCS	227	1.11	72" Sect. PL CAP
6c	26	Rational	32	Rational	34	0.97	36" CAP
7a	82	Rational	90	Rational	94	0.99	54" CAP
7b	78	Rational	86	Rational	91	0.95	54" CAP
8	81	Rational	75	Rational	79	1.06	48" CAP

Note: Rational Method Calculation Based on a 1-hour Storm Duration
SCS Method Calculation Based on a 24-hour Storm Duration

V:\Projdata\06proj\06058\Calcs\Culvert Sizing Tabulation.xls

TABLE 5

Drainage Culvert Invert & Headwater Calculation Summary

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Drainage Basin No.	**Q_{100} (cfs)**	**Station along Highway**	**Water Surface Elevation (ft.)**	**Wetted Width of Channel Flow (ft.)**	**Bottom of Channel Elevation (ft.)**	**Centerline Hwy. Elevation (ft.)**	**Culvert Inv. = WS - 1.2 x D (ft.)**	**Cut Channel Inv. to Culvert Inv. (ft.)**	**Hw from Hwy. Centerline to Culvert Invert (ft.)**	**Size of Culvert (DxW)**	**Available Hw/D**	**Q to overtop Hwy. Assuming Inlet Control (cfs)**	**Factor Safety for Inlet Control Conditions**	**Q Open Channel D-1', assume 1' FB S = 1.0% (cfs)**	**Factor Safety for Open Channel Flow Conditions**
Alternative Alignment 1															
1	1758	44+60	68.7	33	63.1	71.8	57.9	5.2	13.9	9' x 20'	1.5	2450	1.4	4944	2.8
2	1613	55+58	54.0	60	50.7	56.4	44.4	6.3	12.0	8' x 20'	1.5	2150	1.3	4111	2.5
3	2960	112+43	17.9	63	13.4	19.0	8.3	5.1	10.7	Twin 8' x 18'	1.3	3420	1.2	8467	2.9
Alternative Alignment 2															
1	1759	44+58	69.1	34	64.1	75.1	58.3	5.8	16.8	9' x 20'	1.9	3000	1.7	4944	2.8
2	1617	55+11	57.9	64	54.5	64.3	48.3	6.2	16.1	8' x 20'	2.0	2600	1.6	4111	2.5
3	3018	107+72	55.4	42	50.0	61.3	45.8	4.2	15.5	Twin 8' x 18'	1.9	4500	1.5	8467	2.8
Alternative Alignment 3															
1	1768	44+13	83.3	41	77.3	84.0	72.5	4.8	11.5	9' x 20'	1.3	2200	1.2	4944	2.8
2	1646	56+55	85.4	36	80.0	89.7	75.8	4.2	13.9	8' x 20'	1.7	2350	1.4	4111	2.5
3	3067	104+45	83.0	57	77.3	87.2	73.4	3.9	13.8	Twin 8' x 18'	1.7	4200	1.4	8467	2.8

Note:

Column 8 = Column 5 - 1.2*D
Column 9 = Column 6 - Column 8
Column 10 = Column 7 - Column 8
Column 12 = Column 10 - D
Column 14 = Column 13 / Column 2
Column 16 = Column 15 / Column 2

APPENDIX

A Worksheets for Drainage Areas 1, 2 and 3

Worksheet for Drainage Culvert No. 1 (9'x20' Box w/ 1' freeboard)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	8.00	ft
Bottom Width	20.00	ft

Results

Discharge	4943.68	ft^3/s
Flow Area	160.00	ft^2
Wetted Perimeter	36.00	ft
Hydraulic Radius	4.44	ft
Top Width	20.00	ft
Critical Depth	12.38	ft
Critical Slope	0.00312	ft/ft
Velocity	30.90	ft/s
Velocity Head	14.84	ft
Specific Energy	22.84	ft
Froude Number	1.93	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.00	ft
Critical Depth	12.38	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00312	ft/ft

Worksheet for Drainage Culvert No. 2 (8'x20' Box w/ 1' freeboard)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	7.00	ft
Bottom Width	20.00	ft

Results

Discharge	4110.99	ft^3/s
Flow Area	140.00	ft^2
Wetted Perimeter	34.00	ft
Hydraulic Radius	4.12	ft
Top Width	20.00	ft
Critical Depth	10.95	ft
Critical Slope	0.00297	ft/ft
Velocity	29.36	ft/s
Velocity Head	13.40	ft
Specific Energy	20.40	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.00	ft
Critical Depth	10.95	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00297	ft/ft

Worksheet for Drainage Culvert No. 3 (Twin 8"x18' Box w/ 1'

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	7.00	ft
Bottom Width	36.00	ft

Results

Discharge	8467.19	ft^3/s
Flow Area	252.00	ft^2
Wetted Perimeter	50.00	ft
Hydraulic Radius	5.04	ft
Top Width	36.00	ft
Critical Depth	11.98	ft
Critical Slope	0.00212	ft/ft
Velocity	33.60	ft/s
Velocity Head	17.54	ft
Specific Energy	24.54	ft
Froude Number	2.24	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.00	ft
Critical Depth	11.98	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00212	ft/ft

APPENDIX C.

Biological Resources Survey
(December 2006)

BIOLOGICAL RESOURCES SURVEY

for the

LAHAINA BYPASS CORRIDOR PROJECT

LAHAINA , MAUI, HAWAII

by

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ENVIRONMENTAL CONSULTANT
Kokomo, Maui
December 2006

Prepared for:
Makila Land Company, LLC

BIOLOGICAL RESOURCES SURVEY
Lahaina Bypass Corridor Project

INTRODUCTION

The Lahaina Bypass Corridor project lies within the lands of Launiupoko and Polanui in leeward West Maui. The proposed highway corridor route is a 180 foot wide strip of land somewhat more than 2 miles in length stretching from the southern Launiupoko boundary near the recycling transfer station to the center of Polanui on the outskirts of Lahaina town TMK (2) 4-7-01:2 (por.).

SITE DESCRIPTION

The subject corridor crosses the entire length of the property along a gentle grade between the elevations of 30 feet and 100 feet above sea level. The northern and central portions of the corridor lie within former agricultural lands, much of it along the old Lahaina Pump Ditch. This area is presently an open grassland. The southern portion of the corridor passes through the lower Launiupoko Stream valley which has a dense growth of trees, brush and tall grass. Soils are mostly Waine'e Extremely Stony Silty Clay in the former agricultural lands and are Stony Alluvial land in the lower Launiupoko Valley (Foote et al, 1972). Rainfall averages about 15 inches per year with the bulk falling between November and April (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this area would have been a dry native shrubland with a few scattered trees. A good diversity of species would have been present, but with a preponderance of grasses such as Heteropogon, Eragrostis and Panicum, shrubs such as Dodonaea, Gouania and Hibiscus, and trees such as Erythrina and Reynoldsia.

The Launiupoko area came into sugar cane production during the 1860's and this use continued for over 100 years. All vestiges of the original flora have long since disappeared. Since the demise of sugar in West Maui in 1999 the subject parcel has largely stood fallow with only some grazing activities currently being pursued. The highly modified vegetation consists mainly of grasses and weedy species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Lahaina Bypass Corridor which was conducted in December 2006.
The objectives of the survey were to:

1. Document what plant, bird and mammal species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.
5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following both sides of the proposed corridor to ensure maximum coverage of the area. Areas most likely to harbor native or rare plants were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

About 80% of this corridor consists primarily of grass species with a mixture of agricultural and pasture weeds. The remaining 20% is made up of mixed dryland forest and shrubland. One species, buffelgrass (*Cenchrus ciliaris*), is dominant throughout most of this corridor. Also common are swollen fingergrass (*Chloris barbata*), Carolina lovegrass (*Eragrostis pectinacea*), Guinea grass (*Panicum maximum*), desert horsepurslane (*Trianthema portulacastrum*), spiny amaranth (*Amaranthus spinosus*), hairy merremia (*Merremia aegyptia*), kiawe (*Prosopis pallida*), lion's ear (*Leonotis nepetifolia*) and 'uhaloa (*Waltheria indica*). A total of 65 plant species were recorded during the survey. Of these 3 species: 'ilima (*Sida fallax*), 'a'ali'i (*Dodonaea viscosa*) and ‘uhaloa, were indigenous to Hawaii as well as other Pacific islands. Each of these is extremely widespread and common throughout Hawaii. The remaining 62 species are all common non-native agricultural or pasture plants.

DISCUSSION AND RECOMMENDATIONS

The vegetation along the entire length of the proposed corridor is dominated by non-native plant species. The three native species indigenous to Hawaii are all widespread and common and of no particular environmental concern.

No Federally listed Endangered or Threatened plant species (USFWS, 1999) were found in the project area, nor were any species found that are candidate for such status. Populations of two Endangered species, (*Gouania hillebrandii*) no common name and (*Spermolepis hawaiiensis*) no common name, are known to occur about 1.5 miles up slope of the project area in the foothills of the West Maui Mountains, but these populations lie far beyond the influence of any disturbances that might be associated with this project.

No special habitats were identified within the project area. Nothing resembling a wetland occurs within this corridor either.

Because of the above existing conditions it has been determined that there is little of botanical concern within the project area and that the anticipated disturbances associated with the development of a highway within this corridor are not expected to have a significant impact on the botanical resources in this part of Maui. No recommendations are considered appropriate or necessary with regard to the botanical resources in this area.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation
2. Common English or Hawaiian name.
3. Bio-geographical status. The following symbols are used:
   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.
4. Abundance of each species within the project area:
   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
MONOCOTS			
ARECACEAE (Palm Family)			
Washingtonia robusta Wendl.	desert palm	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	uncommon
POACEAE (Grass Family)			
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	common
Chloris virgata Sw.	feather fingergrass	non-native	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Echinochloa colona (L.) Link	jungle-rice	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	rare
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	non-native	common
Leptochloa fusca (L.) Kunth	Malabar sprangletop	non-native	rare
Melinis repens (Willd.) Zizka	Natal redtop	non-native	uncommon
Panicum maximum Jacq.	Guinea grass	non-native	common
Setaria verticillata P. Beauv.	bristly foxtail	non-native	rare
Tragus berteronianus Schult.	bur grass	non-native	rare
DICOTS			
AIZOACEAE (Fig-marigold Family)			
Trianthema portulacastrum L.	desert horsepurslane	non-native	common
AMARANTHACEAE (Amaranth Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Amaranthus spinosus L.	spiny amaranth	non-native	common
ASTERACEAE (Sunflower Family)			
Eclipta prostrata (L.) L.	false daisy	non-native	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Pluchea indica (L.) Less	Indian fleabane	non-native	rare
Synedrella nodiflora (L.) Gaertn.	nodeweed	non-native	rare
Tridax procumbens L.	coat buttons	non-native	rare
Xanthium strumarium L.	*kikania*	non-native	uncommon
Zinnia peruviana (L.) L.	zinnia	non-native	rare
BUDDLEIACEAE (Butterfly Bush Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
CAPPARACEAE (Caper Family)			
Cleome gynandra L.	wild spider flower	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea triloba L.	little bell	non-native	uncommon
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	common
CUCURBITACEAE (Gourd Family)			
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	uncommon
Momordica charantia L.	balsam pear	non-native	rare
EUPHORBIACEAE (Spurge Family)			
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	uncommon
Albizia lebbek (L.) Benth.	white monkeypod	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANC
Crotalaria incana L.	fuzzy rattlepod	non-native	uncommon
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	uncommon
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	*iniko*	non-native	rare
Leucaena leucocephala (Lam.) deWit	*koa haole*	non-native	uncommon
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*	non-native	uncommon
Prosopis pallida (Humb.&Bonpl.ex.Willd.) Kunth	*kiawe*	non-native	common
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	common
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.)Sweet	hairy abutilon	non-native	uncommon
Malva parviflora L.	cheese weed	non-native	uncommon
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	rare
Sida fallax Walp.	*'ilima*	indigenous	uncommon
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Sida spinosa L.	prickly sida	non-native	rare
MYRTACEAE (Myrtle Family)			
Syzygium cumini (L.) Skeels	Java plum	non-native	rare
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon
ONAGRACEAE (Evening Primrose Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Ludwigia octovalvis (Jacq.) Raven	primrose willow	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora foetida L.	love-in-a-mist	non-native	rare
PORTULACACEAE (Purslane Family)			
Portulaca oleracea L.	pigweed	non-native	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	*'a'ali'i*	indigenous	rare
SOLANACEAE (Nightshade Family)			
Datura stramonium L.	jimson weed	non-native	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare
STERCULIACEAE (Cacao Family)			
Waltheria indica L.	*'uhaloa*	indigenous	common
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	rare
ZYGOPHYLLACEAE (Creosote Bush Family)			
Tribulus terrestris L.	puncture vine	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Four species of mammals were observed within the project area during three site visits to the property. Taxonomy and nomenclature follow Tomich (1986).

Mongoose (*Herpestes auropunctatus)* – Several mongoose were seen in field margins. These carnivores hunt for rodents, birds and insects on these types of land.

Cattle (*Bos Taurus*) – Several domestic cattle were pastured in fields along this corridor.

Horse (*Equus caballus*) – Several domestic horses were also being pastured in a field adjacent to the cattle.

Dog (*Canis familiaris*) – Sign (scat) of domestic dogs was seen along roadways along the corridor. These are most likely pets that are either accompanied by their owners or wandering on their own.

Deep, dense grass cover over much of the project area prevented good visibility of other ground dwelling animals, but a significant population of cats (*Felis catus*), mice (*Mus domesticus*) and rats (*Rattus rattus*) would also be expected. Cats and mongoose feed on rats and mice. No cats, rats or mice were seen but their presence is virtually guaranteed by the abundant food supply in the form of grass seed and herbaceous vegetation. No sign of axis deer or other large herbivores was observed.

A special effort was made to look for the native Hawaiian hoary bat by making an evening survey of the area. When present in an area these bats can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the glow of twilight.

No evidence of such activity was observed though visibility was excellent and many flying insects were seen. Bats have not been seen in this part of Maui.

BIRDS

There was moderate birdlife diversity in this normally dry area. An ample supply of grass and herbaceous plant seeds were available. Thirteen species of non-native birds were seen, most taking advantage of this seasonal food supply. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Barred dove (*Geopelia striata*) – Many barred doves were seen and heard throughout the project. Their smaller size and striated body distinguish this species from the spotted dove.

Common myna (*Acridotheres tristis*) - Many of these easily recognizable and assertive birds were seen feeding in the open areas during the late afternoon and heading toward roosting trees in the evening.

Gray francolin (*Francolinus pondicerianus*) – Many families of gray francolins were seen in ground openings and in kiawe trees, but their loud and distinctive calls were heard frequently throughout the area indicating a larger population than seen.

House finch (*Carpodacus mexicanus*) – Several flocks of these finches were seen within the grasslands.

Northern cardinal (*Cardinalis cardinalis*) – Several of these distinctive red birds were seen in kiawe trees and heard calling.

Japanese white-eye (*Zosterops japonica*) – a few white-eyes were seen feeding in the trees and their high pitched calls were occasionally heard.

Northern mockingbird (*Mimus polyglottos*) – A few mockingbirds with their variety of calls were heard scattered across the property.

Spotted dove (*Streptopelia chinensis*) – This large dove was seen frequently in the trees and transiting overhead. Their smooth flight and evenly modulated cooing are distinctive.

Cattle egret (*Bubulcus ibis*) – A few of these large white birds were seen feeding among the cattle and flying overhead.

Black francolin (*Francolinus francolinus*) – A few of these dark francolins were seen in the grasslands and their distinctive buzzing calls were heard.

African silverbill (*Lonchura cantans*) – A few small groups of these pale tan birds were seen in trees within the grasslands.

Red-crested cardinal (*Paroaria coronata)* A few individuals and pairs were seen in the trees.

Skylark (*Alauda arvensis*) – A single skylark was seen on the ground and taking flight from the grasslands.

This area is not habitat for Hawaii's native forest birds because it lacks the flowers and fruits they prefer and because of the presence in the lowland of mosquito-born diseases that severely affect them.

INSECTS

While insects in general were not tallied, they were abundant throughout the area and fueled the bird activity observed. Only one native insect Blackburn's sphinx moth (*Manduca blackburni*) has been put on the Federal Endangered Species List (USFWS 2000) and this designation requires special focus to ascertain if it is present. None were found.

Blackburn's sphinx moth occurs on Maui although it has not been found in this area. Its native host plants are species of 'aiea (*Nothocestrum).* A non-native alternative host plant is tree tobacco (*Nicotiana glauca*). There are no 'aiea on or near the project area nor were any tree tobacco plants found anywhere on the property. No Blackburn's sphinx moths or their larvae were observed.

DISCUSSION

Fauna surveys are seldom comprehensive due to the short windows of observation, the seasonal nature of animal activities and the usually unpredictable nature of their daily movements. This survey should be considered fairly representative, although a few other common non-native species such as house sparrow and nutmeg mannikin would be expected here.

Only common, non-native mammals, birds and insects were observed on the property during the course of the survey. No Federally listed Endangered or Threatened fauna (USFWS, 1999) were found. No special fauna habitats were identified either.

As a result of the above conditions it has been determined that the proposed project is not expected to have a significant negative impact on the fauna resources in this part of Maui.

No recommendations with respect to the fauna resources in this project area are deemed appropriate or necessary.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within two groups: Mammals and Birds. For each species the following information is provided:

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.
   common = a few flocks or well scattered individuals throughout the area.
   uncommon = only one flock or several individuals seen within the project area.
   rare = only one or two seen within the project area.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Mongoose	*Herpestes auropunctatus*	non-native	uncommon
Cattle	*Bos taurus*	non-native	uncommon
Horse	*Equus caballus*	non-native	uncommon
Dog	*Canis familiaris*	non-native	rare
BIRDS			
Zebra dove	*Geopelia striata*	non-native	common
Common myna	*Acridotheres tristis*	non-native	common
Gray francolin	*Francolinus pondicerianus*	non-native	common
House finch	*Carpodacus mexicanus*	non-native	common
Northern cardinal	*Cardinalis cardinalis*	non-native	uncommon
Japanese white-eye	*Zosterops japonica*	non-native	uncommon
Northern mockingbird	*Mimus polyglottos*	non-native	uncommon
Spotted dove	*Streptopelia chinensis*	non-native	uncommon
Cattle egret	*Bubulcus ibis*	non-native	uncommon
Black francolin	*Francolinus francolinus*	non-native	uncommon
African silverbill	*Lonchura cantans*	non-native	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Sky lark	*Alauda arvensis*	non-native	rare

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APPENDIX C-1.

Biological Resources Survey (Resurvey - November 2012)

BIOLOGICAL RESOURCES SURVEY

for the

LAHAINA BYPASS CORRIDOR PROJECT

Resurvey November 2012

LAHAINA , MAUI, HAWAII

by

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
November 2012

Prepared for:
Makila Land Company, LLC

BIOLOGICAL RESOURCES SURVEY
LAHAINA BYPASS CORRIDOR PROJECT

INTRODUCTION

The Lahaina Bypass Corridor project traverses the lands of Polanui and Launiupoko in leeward West Maui, beginning at Hokiokio Street on the southern edge of Lahaina Town and extending approximately 2 miles to the southern Launiupoko boundary near the Olowalu Recycling Transfer Station (see Figure 1). This biological resources survey brings current an outdated survey of this route performed in 2006 to satisfy environmental requirements of the planning process.

SITE DESCRIPTION

The subject corridor crosses the entire length of the property along a gentle grade between the elevations of 30 feet and 100 feet above sea level. The corridor varies in width but includes the blue line (alternative 2) and the red line (alternative 3) and the area between these lines. The northern and central portions of the corridor lie within former agricultural lands, much of it along and below the old Lahaina Pump Ditch. This area is presently an open grassland. The southern portion of the corridor passes through the lower Launiupoko Stream channel and a former plantation wastewater sump which has a dense growth of trees, brush and tall grass. Soils are mostly Waine'e Extremely Stony Silty Clay in the former agricultural lands and are Stony Alluvial land in the lower Launiupoko Valley (Foote et al, 1972). Rainfall averages about 15 inches per year with the bulk falling between November and April (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this area would have been a dry native shrubland with a few scattered trees. A good diversity of species would have been present, but with a preponderance of grasses such as Heteropogon, Eragrostis and Panicum, shrubs such as Dodonaea, Gouania and Hibiscus, and trees such as Erythrina and Reynoldsia.

The Launiupoko area came into sugar cane production during the 1860's and this use continued for over 100 years. All vestiges of the original flora have long since disappeared. Since the demise of sugar in West Maui in 1999 the subject parcel has largely stood fallow with only some grazing activities currently being pursued. The highly modified vegetation consists mainly of grasses and weedy species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Lahaina Bypass Corridor which was conducted in November 2012.
The objectives of the survey were to:

1. Document what plant and animal species occur on the property or may likely occur in the existing habitat.
2. Document the status and abundance of each species.
3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following the entire length of the corridor. Areas most likely to harbor native or rare plants such as gullies or rock outcrops were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

About 80% of this corridor consists primarily of grass species with a mixture of agricultural and pasture weeds. The remaining 20% is made up of mixed dryland forest and shrubland. One species, buffelgrass *(Cenchrus ciliaris),* is dominant throughout most of this corridor. Also common are kiawe *(Prosopis pallida)*, and 'uhaloa (*Waltheria indica).* A total of 26 plant species were recorded during the survey. Of these 2 species: 'ilima (*Sida fallax*), and 'uhaloa, are indigenous to Hawaii as well as other Pacific islands. Each of these is extremely widespread and common throughout Hawaii. The remaining 24 species are all common non-native agricultural or pasture plants.

DISCUSSION AND RECOMMENDATIONS

The vegetation along the entire length of the proposed corridor is dominated by non-native plant species. The two native species indigenous to Hawaii are both widespread and common and of no particular environmental concern.

No Federally listed Endangered or Threatened plant species (USFWS, 2012) were found in the project area, nor were any species found that are candidate for such status. Populations of two Endangered species, (*Gouania hillebrandii*) no common name and (*Spermolepis hawaiiensis*) no common name, are known to occur about 1.5 miles up slope of the project area in the foothills of the West Maui Mountains, but these populations lie far beyond the influence of any disturbances that might be associated with this project. No special habitats were identified within the project area.

Because of the above existing conditions it has been determined that there is little of botanical concern within the project area and that the anticipated disturbances associated with the development of a highway within this corridor are not expected to have a significant impact on the botanical resources in this part of Maui. No recommendations are considered appropriate or necessary with regard to the botanical resources in this area.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

1. Scientific name with author citation
2. Common English or Hawaiian name.
3. Bio-geographical status. The following symbols are used:
   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.
4. Abundance of each species within the project area:
   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MONOCOTS			
ARECACEAE (Palm Family)			
Washingtonia robusta Wendl.	Mexican featherduster palm	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	rare
POACEAE (Grass Family)			
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	rare
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Megathyrsus maximus (Jacq.) Simon & Jacobs	Guinea grass	non-native	uncommon
DICOTS			
AMARANTHACEAE (Amaranth Family)			
Amaranthus spinosus L.	spiny amaranth	non-native	uncommon
ASTERACEAE (Sunflower Family)			
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Pluchea indica (L.) Less.	Indian fleabane	non-native	rare
Xanthium strumarium L.	kikania	non-native	uncommon
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawl.	---------------------------	non-native	rare
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	uncommon
EUPHORBIACEAE (Spurge Family)			
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Family)			
Albizia lebbek (L.) Benth.	white monkey pod	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koahaole	non-native	uncommon
Pithecellobium dulce (Roxb.) Benth.	'opiuma	non-native	uncommon
Prosopis pallida (Humb.&Bonpl. ex Willd.) Kunth	kiawe	non-native	common
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R.Br.	lion's ear	non-native	uncommon
MALVACEAE (Mallow Family)			
Sida fallax Walp.	'ilima	indigenous	rare
Sida rhombifolia L.	Cuban jute	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	common
MYRTACEAE (Myrtle Family)			
Syzygium cumini (L.) Skeels	Java plum	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora foetida L.	Love-in-a-mist	non-native	uncommon

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Four species of mammals were observed within the project area during three site visits to the property. Taxonomy and nomenclature follow Tomich (1986). Cattle (*Bos Taurus*) and mongoose (*Herpestes auropunctatus*) were uncommon while cats (*Felis catus*) and the Hawaiian bat were rare (see the Animal inventory). Other non-native mammals that one might expect to see in this habitat include rats (*Rattus* spp.) and mice (*Mus domesticus*). Rats and mice feed on seeds, fruits, eggs and herbaceous vegetation, and are in turn preyed upon by the mongoose and cats.

The evening survey was conducted at the site of the former sump with the use of a bat detector (Batbox IIID), set to the frequency of 27,000 Hertz, which the Hawaiian bat is known to use for echolocation in its pursuit of nocturnal flying insects (mostly species of moths). At least two bats were heard making their modulated sound bursts as they trolled back and forth, near at hand and farther afield. This activity was followed closely for 20 minutes.

BIRDS

Birdlife was sparse to moderate along this corridor with an increasing diversity of species toward the forested southern end. Thirteen species of non-native birds were recorded during the survey. Most common were zebra dove (*Geopelia striata*), common myna (*Acridotheres tristis*) and gray francolin (*Francolinus pondicerianus*). The remaining ten species were or of uncommon or rare occurrence. Taxonomy and nomenclature follow American Ornithologists' Union (2011).

This habitat is not suitable for Hawaii's native forest birds, water birds or sea birds and none were seen.

INSECTS

Insect life was rather sparse of much of the property due to the close grazing of the dry grasslands on the northern half of the corridor. Just ten insect species were recorded during three site visits. Taxonomy and nomenclature follow Nishida et al (1992). Just one species was found to be common, the passion flower butterfly (*Agraulis vanilla*). The remaining nine species were of uncommon or rare occurrence.

One dragonfly, the globe skimmer (*Pantala flavescens*), is an indigenous native species. This dragonfly is common throughout Hawaii and is also native throughout the tropics and subtropics worldwide.

And Endangered moth, the Blackburn's sphinx moth (*Manduca blackburni*), was looked for during the survey. This moth breeds only on plants in the nightshade family (*Solanaceae*), and most notably on the tree tobacco (*Nicotiana glauca*) which grows in dry forest habitats. No tree tobacco plants were found during the survey, nor any other plants in the nightshade family. No Blackburn's sphinx moths, their larvae or eggs were found.

REPTILES

One non-native reptile, the mourning gecko (*Lepidodactylus lugubris*), was found during the evening survey in forests in the former sump area.

DISCUSSION AND RECOMMENDATIONS

The fauna along this approximately two mile long road corridor is dominated by non-native species that are not of any heightened conservation concern. One notable exception is the finding of the 'ōpe'ape'a or Hawaiian hoary bat which is listed as an Endangered species. These bats fall under the jurisdiction of the U.S. Fish and Wildlife Service which have oversight over listed species under provisions of the Endangered Species Act (1973). The Service needs to be consulted regarding these bats to ensure that they are not harmed or destroyed as the road project moves forward.

A second native species, the globe skimmer dragonfly, is widespread and common and needs no special management focus.

No other recommendations regarding fauna species are deemed necessary with regard to the Lahaina Bypass Project.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within four groups: Mammals, Birds, Reptiles and Insects. For each species the following information is provided:

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:

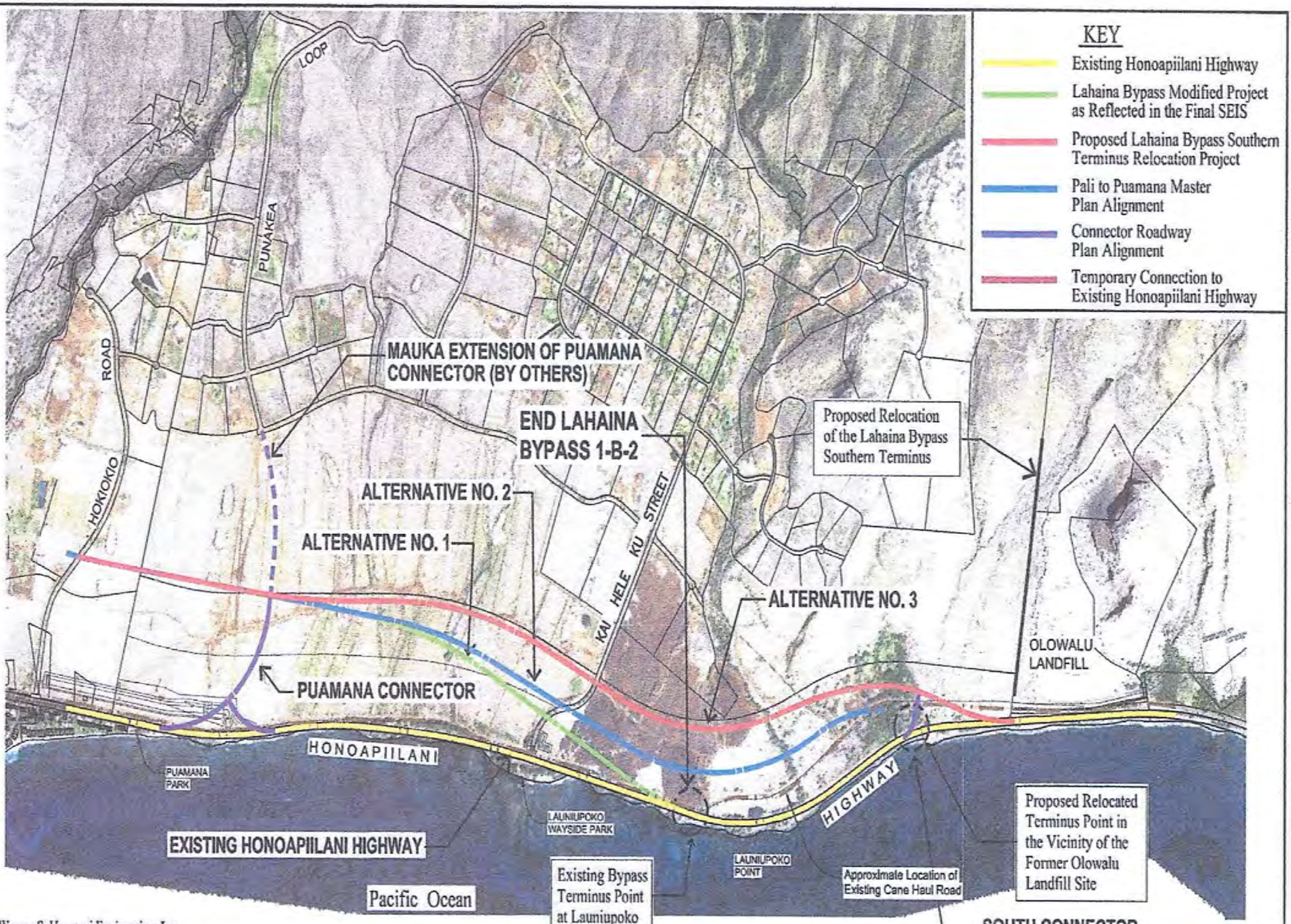
    endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
    indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
    non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
    migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

    abundant = many flocks or individuals seen throughout the area at all times of day.
    common = a few flocks or well scattered individuals throughout the area.
    uncommon = only one flock or several individuals seen within the project area.
    rare = only one or two seen within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MAMMALS			
Bos taurus L.	cattle	non-native	uncommon
Herpestes auropunctatus Hodgson	mongoose	non-native	uncommon
Felis catus L.	feral cat	non-native	rare
Lasiurus cinereus semotus Allen	'ōpe'ape'a, Hawaiian bat	endemic	rare
BIRDS			
Geopelia striata L.	zebra dove	non-native	common
Acridotheres tristis L.	common myna	non-native	common
Francolinus pondicerianus Gmelin	gray francolin	non-native	common
Lonchura malacca	chestnut mannikin	non-native	uncommon
Streptopelia chinensis Scopoli	spotted dove	non-native	uncommon
Francolinus francolinus L.	black francolin	non-native	uncommon
Carpodacus mexicanus Muller	house finch	non-native	uncommon
Cardinalis cardinalis L.	northern cardinal	non-native	uncommon
Zosterops japonicus Temminck & Schlegel	Japanese white-eye	non-native	uncommon
Lonchura cantans Gmelin	African silverbill	non-native	rare
Paroaria coronata Miller	red-crested cardinal	non-native	rare
Mimus polyglottos L.	northern mockingbird	non-native	rare
Tyto alba Scopoli	barn owl	non-native	rare
REPTILES			
Lepidodactylus lugubris Dumeril & Bibron	mourning gecko	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
INSECTS			
Order DIPTERA - flies			
CALLIPHORIDAE (Blow Fly Family)			
Calliphora vomitoria L.	blow fly	non-native	uncommon
CULICIDAE (Mosquito Family)			
Culex quinquefasciatus Say	house mosquito	non-native	uncommon
DROSOPHILIDAE (Fruite Fly Family)			
Chymomyza procnemis Williston	drosophilid fly	non-native	rare
Order HYMENOPTERA - bees, wasps & ants			
APIDAE (Honey Bee Family)			
Apis mellifera L.	honey bee	non-native	uncommon
Xylocopa sonorina Smith	Sonoran carpenter bee	non-native	rare
Order LEPIDOPTERA - butterflies & moths			
LYCAENIDAE (Gossamer-winged Butterfly Family)			
Lampides boeticus L.	long-tailed blue butterfly	non-native	uncommon
NOCTUIDAE (Owlet Moth Family)			
Condica illecta Walker	----------------------	non-native	rare
NYMPHALIDAE (Brush-footed Butterfly Family)			
Agraulis vanillae L.	passion flower butterfly	non-native	common
Danaus plexippus L.	monarch butterfly	non-native	rare
Order ODONATA - dragonflies & damselflies			
Pantala flavescens Fabricius	globe skimmer	indigenous	uncommon
Order ORTHOPTERA - grasshoppers & crickets			
ACRIDIDAE (Grasshopper Family)			
Oedaleus abruptus Thunberg	short-horned grasshopper	non-native	rare



Source: Warren S. Unemori Engineering, Inc.

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APPENDIX D.

Section 7, 1973 Endangered Species Act Consultation Documentation

U.S. Department
of Transportation
Federal Highway Administration

Hawaii Federal-Aid Division

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
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July 18, 2013

In Reply Refer To:
HDA-HI

Loyal Mehrhoff
Field Supervisor
U.S. Fish and Wildlife Service
300 Ala Moana Boulevard, Room 3-122
Honolulu, HI 96850

Subject: Proposed Relocation of the Lahaina Bypass Southern Terminus
Launiupoko, Island of Maui
Informal Section 7 Consultation

Dear Dr. Mehrhoff:

This letter is in response to the U.S. Fish and Wildlife Service (Service) Technical Assistance (TA) letter dated June 8, 2012, (log # 2012-TA-0302) which provided comments on the proposed action's Draft Environmental Assessment (EA) in accordance with Section 7 of the Endangered Species Act (ESA). We are seeking concurrence from your office that the proposed action will not likely to adversely affect any listed species that may be found in the project area, including the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), Hawaiian goose (*Branta sandvicensis*), Blackburn's sphinx moth (*Manduca Blackburni*), Hawaiian petrel (*Pterodroma sandwichensis*), and Newell's shearwater (*Puffinus auricularis newlii*).

Section 7 Consultation History

After receipt of the Service's TA letter in June 2012, there were various discussions and emails with Ian Bordenave, Fish and Wildlife Biologist, and the project's consultant team, including Mr. Robert Hobdy, project Biologist. Following the initial discussions, it was agreed via email on November 6, 2012, that an updated biological survey would be conducted in November 2012. The purpose of the new survey was to update information in the previous survey, which had been conducted in December 2006, and to specifically assess if the Blackburn's sphinx moth or its larvae are present in the project area or if potential host species of the moth are present. Following completion of the updated survey, additional discussion and email exchanges took place, including a teleconference with our staff and consultants on February 5, 2013, regarding potential impacts to the Hawaiian goose.

Project Description

The proposed project involves the relocation of the southern extension of the Lahaina Bypass Highway, which is to be constructed mauka and roughly parallel to the existing Honoapiilani Highway between Puamana and the former Olowalu Landfill. Total length of new roadway corridor will be approximately 2 miles. The total width of the right-of-way or construction corridor will be approximately 150 ft. The construction phase is expected to last approximately 18-24 months. Traffic will not be traveling on the new roadway corridor until the construction phase is complete. Major grading and earthwork activities will occur in the early phases of the project. After completion of grading and earthwork activities, the bare soils will be re-vegetated as part of erosion control Best Management Practices (BMPs). Temporary irrigation will be used as part to support the re-vegetation of the grading and earthwork areas. The temporary irrigation will be in place until the landscape cover takes hold, which is usually between 30 to 45 days. No significant relocation of overhead transmission lines will be taking place. Limited permanent lighting at proposed intersections will be installed.

Discussion of Species that May be Found in the Project Area and Proposed Minimization Measures

Hawaiian Hoary Bat

The TA letter noted that the Hawaiian hoary bat roosts in both exotic and native woody vegetation. During the field survey conducted as part of the updated Biological Resources Survey (2012), an evening survey using a bat detector did note the presence of at least two bats in the area. Since the bat is known to leave young unattended in "nursery" trees and shrubs, the TA letter recommended that as part of the project's minimization and avoidance measures, woody plants greater than 15 feet tall should not be removed or trimmed from June 1 to September 15. The Federal Highway Administration (FHWA) and Hawaii Department of Transportation (HDOT) concur with this recommendation and will incorporate this minimization measure into the project requirements to ensure that activities have minimal impact on the Hawaiian hoary bat.

Hawaiian Goose

The TA letter noted that due to its range and foraging behavior, the Hawaiian goose, or Nene, may be present in the vicinity of the proposed action at any time of the year. The letter also noted that there have been previous fatalities in the West Maui region due to the species' attraction to young grass growing on the embankments of new roadways during and after the construction phase.

Consultation with project biologist, Mr. Robert Hobdy, confirms that Nene are strong flyers and have a wide range of habitat areas on Maui, including West Maui. The Nene is known to be attracted to water features or small ponding areas as well as young succulent grasses. Temporary irrigation and young emergent grasses, which are associated with the initial stages of construction project landscaping, could be an attraction for the Nene. Consultation with Maui Department of Forestry and Wildlife (DOFAW) personnel indicate that based on their experiences, the presence of overhead irrigation provides a significant attraction for the Nene, especially if there is overwatering and ponding occurs. Thus, the primary goal of the proposed avoidance and minimization measures is to coordinate project phasing and timing in order to reduce or eliminate the presence of attractions to the Nene prior to opening up the highway corridor to the public.

After the establishment of initial groundcover, the temporary irrigation will be removed and the vegetated groundcover will harden and adapt to the hot and dry West Maui climate. The temporary irrigation will be removed at least 90 days prior to opening up the new highway corridor to public traffic. Removal of the overhead irrigation system will remove the primary attraction for the Nene. Allowing time for the grasses to mature past the young succulent shoot phase will remove the other attraction for the Nene. Based on discussions with DOFAW staff on Maui, mowing could prolong or encourage the presence of young succulent grasses. Thus, it has been recommend that the grasses be allowed to establish without mowing, allowing for the taller grasses to dry and harden up.

Consultations with landscape installation contractors in the area have led to a further recommendation that common Bermuda grass be used for the groundcover for the following reasons:

1. It is a drought resistant grass that will survive with no irrigation after establishment;
2. It matures quickly with a relatively low height and mass (lowering fuel potential for fires); and
3. The grass spreads on its own, creating a dense matt like ground cover.

Therefore, specific avoidance and minimization measures to ensure minimal impact on the Nene would include:

1. As part of the BMPs for erosion controls, establish vegetated groundcover as early as possible in project construction phasing.
2. Remove all temporary irrigation at least 90 days prior to opening up the new highway corridor to public traffic.
3. Utilize common Bermuda grass as part of BMP erosion control.
4. Avoid the use of geotextile matting for BMPs erosion control since bird species may get tangled in the netting.
5. Grade all shoulder areas so that there is adequate slope in order to prevent ponding.
6. A biologist familiar with the nesting behavior of the Hawaiian goose should survey the area around proposed construction areas prior to the initiation of any work during the Hawaiian goose breeding season (December through April), or after any subsequent delay of work of three or more days (during which the birds may attempt to nest). If a nest is discovered within a radius of 150 feet of proposed construction activity, or a previously undiscovered nest is found within said radius after work begins, all work should cease immediately and the Service contacted for further guidance.
7. If a Hawaiian goose appears within 100 feet of ongoing work at any time during the construction phase of the proposed project, all activity in the affected area should be temporarily suspended until the bird moves off to a safe distance of its own volition.
8. Construction personnel shall be provided with standard operating procedures regarding avoiding interaction with the Hawaiian goose.

Blackburn's Sphinx Moth

Pursuant to the recommendation in the TA letter, a re-survey of the area by a qualified biologist was undertaken and the report concluded that there are no occurrences of Blackburn's sphinx moth or potential host species, including *Nicotiana glauca* in the action area.

Listed Seabirds

The TA letter noted that the endangered Hawaiian petrel and threatened Newell's shearwater, collectively known as seabirds, may transit the proposed action area while flying between the ocean and nesting sites in the mountains during their breeding season (March through December). Seabird fatalities resulting from collisions with high-tension power lines, utility poles and other artificial appurtenances have been documented throughout the State of Hawaii where high densities of transiting seabirds occur. There are no plans to re-locate (or co-locate) electrical transmission lines as part of the project. Limited overhead lighting will be installed at the planned intersections. Based on consultation with the Service, the following minimization and avoidance measures for listed seabirds will be implemented:

1. All permanent overhead lighting will comply with standard down shielding requirements.
2. If nighttime work will be required, all lights will be shielded and directed towards the ground to reduce potential for interactions of nocturnally flying Hawaiian petrels and Newell's shearwaters with external lights and man-made structures.
3. No nighttime construction will occur during the peak fall out period, September 15 through December 15.

In summation, we are seeking concurrence from your office that the proposed action is not likely to adversely affect the species listed as discussed above. If you have any questions, or would like additional information please contact me at (808) 541-2326 or the HDOT project manager, Mr. Darell Young, at (808) 587-1835.

Sincerely yours,

Wayne Kaneshiro
Transportation Engineer

Enclosures

cc: Mr. Darell Young, HWY-P

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

RECEIVED
AUG [illegible]
HAWAII DIVISION

In Reply Refer To:
2012-I-0380

AUG 15 2013

Mr. Wayne Kaneshiro
Transportation Engineer
U.S. Department of Transportation
Federal Highway Administration
300 Ala Moana Boulevard, Room 3-036
Honolulu, Hawaii 96850

Subject: Informal Consultation for the Proposed Relocation of the Lahaina Bypass Southern Terminus, Maui

Dear Mr. Kaneshiro:

The U.S. Fish and Wildlife Service (Service) received your letter on July 18, 2013, requesting concurrence with your determination that the proposed relocation of the Honoapiilani Highway Lahaina Bypass Southern Terminus on Maui is not likely to adversely affect the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), Hawaiian goose (*Branta sandvicensis*), Blackburn's sphinx moth (*Manduca blackburni*), Hawaiian petrel (*Pterodroma sandwichensis*), or threatened Newell's shearwater (*Puffinus auricularis newelii*). This response is in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Project Description

The State of Hawaii, Department of Transportation (HDOT), in coordination with the Federal Highways Administration (FHWA), is proposing the relocation of the southern extension of the Lahaina Bypass Highway. This alignment is to be constructed mauka and roughly parallel to the existing Honoapiilani Highway, between Puamana and the former Olowalu Landfill. Total length of the new highway corridor will be approximately two miles, and total width of the construction corridor will be approximately 150 feet. The construction phase is expected to last 18 to 24 months, and traffic will not be travelling on the new highway segment until the construction phase is complete. Major grading, earthworks, and construction activities will comprise the majority of the early part of the construction phase. After these activities are completed, bare soils will be re-vegetated as part of erosion control Best Management Practices (BMPs). Temporary irrigation will be in place until landscape cover has been established, which should take approximately 30 to 45 days. No relocation of overhead transmission lines will be taking place, and permanent street lighting will only be installed at proposed intersections.

Conservation measures, as outlined below, have been crafted cooperatively between the FHWA and the Service to avoid and minimize impacts to listed species which may occur within the action area of the proposed project. These conservation measures are considered part of the project description. Any changes to, modifications of, or failure to implement these conservation measures may result in the need to reinitiate this consultation.

Species Affected

Hawaiian hoary bat

The Hawaiian hoary bat roosts in both exotic and native woody vegetation and, while foraging, will leave young unattended in "nursery" trees and shrubs. If trees or shrubs suitable for bat roosting are cleared during the breeding season, there is a risk that young bats could inadvertently be harmed or killed. As a result, the Service recommends that woody plants greater than 15 feet tall should not be removed or trimmed from June 1 to September 15. According to your letter, the action agency will incorporate this avoidance measure into the project requirements to ensure that potential impacts to the Hawaiian hoary bat from construction activities are discountable.

Hawaiian goose

Due to its range and foraging behavior, the Hawaiian goose may be present in the vicinity of the proposed action at any time of the year. There have been numerous fatalities of Hawaiian geese associated with road construction in the West Maui region in the past due to the species' attraction to grasses growing on the embankments of new roadways during and after the construction phase. Foraging behavior along those corridors can result in interaction with speeding vehicles, which may result in Hawaiian goose mortality. Accordingly, the action agency will ensure that, after the initial establishment of groundcover grasses to address erosion control, temporary irrigation will be removed 90 days prior to the opening of the new Highway. The established vegetation will then be allowed to harden and adapt to the arid West Maui climate. Removal of the temporary overhead irrigation system, and allowing time for established grasses to mature past the young succulent phase, will abrogate the attractive nuisance for the Hawaiian goose on the highway shoulder. Additionally, grasses will be allowed to establish without mowing. The presence of a taller, year-round, vegetative stature will further deter Hawaiian geese from foraging on road shoulders, berms, and earthworks within the proposed project area. No erosion control matting will be used to avoid Hawaiian goose entanglement. Lastly, if a Hawaiian goose appears within 100 feet of ongoing work, all activity will be temporarily suspended until the bird moves off to a safe distance of its own volition. Moreover, a biologist familiar with the nesting behavior of the Hawaiian goose will survey the area around the proposed construction area prior to the initiation of work during the Hawaiian goose breeding season (December through April), or after any subsequent delay of work during that time period of three or more days (as the birds may attempt to nest). If a nest is discovered within a radius of 150 feet of proposed construction activity, or a previously undiscovered nest is found within said radius after work begins, all work will cease immediately and the Service will be contacted for further guidance.

Blackburn's sphinx moth

The Blackburn's sphinx moth has been historically documented as breeding and feeding within the proposed action area. Adult moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*); larvae feed upon non-native tree tobacco (*Nicotiana glauca*) and native aiea (*Nothocestrum latifolium*). According to surveys undertaken in November of 2012 by consulting biologist, Robert Hobdy, no host plants for the species (including the larval host plant *Nicotiana glauca*) where found to occur within the proposed project area.

Listed seabirds

The endangered Hawaiian petrel and threatened Newell's shearwater, collectively known as seabirds, have been documented transiting through the proposed action area while flying between the ocean and nesting sites in the mountains during their breeding season (March through December). Seabird fatalities resulting from collisions with high-tension power lines, utility poles, and other artificial appurtenances have been documented throughout the State of Hawaii where high densities of transiting seabirds occur. Additionally, artificial lighting, such as flood lighting for construction work and site security, can adversely impact seabirds by causing disorientation which may result in collision with utility lines, buildings, fences, and vehicles. Fledging seabirds are especially affected by artificial lighting and have a tendency to exhaust themselves while circling the light sources and become grounded. Too weak to fly, these birds become vulnerable to depredation by feral predators such as dogs, cats, and mongoose. According to your letter, the action agency will ensure that artificial lighting, such as flood lighting for construction work, storage site security, and street lighting will be down-shielded to minimize glare. Outdoor lighting will be constructed in a manner that fully shields lighting sources and directs light downward. No significant changes in location of transmission line will occur. Lastly, no night-time construction work will be undertaken during the peak seabird fall-out period, from September 15 through December 15.

Conclusion

Due to the aforementioned conservation measures to avoid and minimize impacts to ESA-listed species, the Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect, listed species. Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

If you have any questions or concerns regarding this informal consultation, please contact Ian Bordenave, Fish and Wildlife Biologist (phone: 808-792-9400, email: ian_bordenave@fws.gov).

Sincerely,

Loyal Mehrhoff
Field Supervisor

U.S. Department
of Transportation
**Federal Highway
Administration**

Hawaii Federal-Aid Division

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
Fax: (808) 541-2704

September 20, 2013

In Reply Refer To:
HDA-HI

Michael Tosatto
Regional Administrator, Pacific Islands Regional Office (PIRO)
National Oceanic and Atmospheric Administration/NMFS
1601 Kapiolani Boulevard, Suite 1110
Honolulu, HI 96814

Subject: Proposed Relocation of Lahaina Bypass Southern Terminus
Launiupoko, Island of Maui
Federal-aid Project No. NH-030-1(051)
Informal Section 7 Consultation

Dear Mr. Tosatto:

The Federal Highway Administration (FHWA) intends to fund the State of Hawaii Department of Transportation's (HDOT) relocation of the southern terminus of the Lahaina Bypass Highway in West Maui. We are seeking concurrence from your office that the proposed action may affect, but is not likely to adversely affect the Hawaiian monk seal (*Monachusschauinslandi)*, as well as sea turtles: green (*Cheloniamydas)*, hawksbill (*Eretmochelys imbricate)*, loggerhead (*Carettacaretta)*, olive ridley (*Lepidochelysolivacea)*, and the leatherback (*Dermochelyscoriacea)*.

Section 7 Consultation History

The FHWA designated the HDOT and its consultant, Munekiyo and Hiraga Inc., as non-federal representatives to consult with National Oceanic and Atmospheric Administration (NOAA) regarding the potential impact of the project to species of concern covered under the Endangered Species Act (ESA) via letter dated June 7, 2013. As part of early coordination and pre-consultation, a preliminary teleconference was held with the NOAA PIRO on July 2, 2013, and a follow up telephone conference was held with Mr. David Nichols and Mr. Don Hubner of the Protected Resources Division on July 14, 2013. The Draft Environmental Assessment (DEA) for the project was transmitted to the Protected Resources Division subsequent to the July 2, 2013, teleconference and prior to the July 14, 2013, teleconference. The DEA contains a detailed description of the project and its environmental setting. The information below is presented in response to discussions and issues raised during the July 14, 2013, teleconference.

Project Description

The project involves the southern extension of the Lahaina Bypass Highway, which is to be constructed mauka (inland) and roughly parallel to the existing Honoapi`ilani Highway between Puamana and the former Olowalu Landfill in West Maui. Total length of new roadway corridor will be approximately 2 miles. On average, the corridor route is roughly 1,000 feet inland from the existing Honoapi'ilani Highway. At the southern end of the project, a connection will be made to the existing Honoapi'ilani Highway. All construction activities will be land based, no work will occur seaward of the exiting highway.

The project corridor traverses the moderately sloping alluvial fans of the Kaua`ula and Launiupoko streams and passes beneath Mahanaluanui Cinder Cone. The corridor is situated on elevated, sloping terrain where water runs off readily and does not accumulate. The project site is not located within a Federal Emergency Management Agency designated floodplain, mass wastage areas, or braided stream bottom lands. The corridor crosses three unnamed gulches and Launiupoko Stream, which directly discharge to the ocean. The gulch and stream crossings are unavoidable given the route of this regional transportation corridor, which runs inland and parallel to the coast. The 3 unnamed gulches are classified as ephemeral (intermittent) with annual flow rates ranging from 3-10 days per year. These gulches are dry for most of the year but convey flow into the ocean only during large storm events.

Launiupoko Stream originates deep in the West Maui mountains and is fed by both rainfall and artesian groundwaters. It has perennial flow in the upper valley, but only flows for about a mile before it is intercepted by a diversion that channels the stream down to an old plantation reservoir that dates from the early 1900's. According to the Hawaii Stream Assessment, Launiupoko Stream in its lower reaches (i.e. the locale of the project site) is not considered to be perennial as it runs dry for most of the year and flows only following large storm events.

While bridges were considered, given the flow characteristics within the 3 unnamed gulches and Launiupoko Stream, culverts are being proposed as the best practicable alternative for the highway crossings in these areas. Overall, the length of the proposed culverts (approximately 150-200 ft) represents a small percentage of the overall length of these drainageways, which extend approximately 2 miles inland. The remainder of the drainageways will not be altered. Thus, only a small percentage of the drainage ways will be hardened. The culverts will be designed to accommodate 100-year flood flows and will include side tapered and slope tapered transitional inlets, as well as energy dissipaters necessary to maintain the existing velocities in the drainageways. The construction schedule for this highway project will likely span several years; however, opportunities will be evaluated for the installation of the proposed drainage culverts to be scheduled, where feasible, during the summer months. In addition, site specific best management practices (BMP) will be installed during construction in these areas to mitigate the potential for sedimentation impacts during rainfall events.

The construction phase is expected to last approximately 18-24 months. Major grading and earthwork activities will occur in the early phases of the project. A comprehensive BMP program will be implemented during the construction of the project to mitigate the potential for sedimentation impacts to near shore waters and marine species.

Listed Marine Species within the Action Area, potential effects and mitigation measures

Based on consultation with the Protected Resources Division staff, ESA species in the area may include the Hawaiian monk seal *(Monachusschauinslandi)*, as well as sea turtles: green (*Cheloniamydas*), hawksbill (*Eretmochelys imbricate)*, loggerhead (*Carettacaretta)*, olive ridley (*Lepidochelysolivacea)*, and the leatherback (*Dermochelyscoriacea).* There is no designated critical habitat in the project area or vicinity. These species may reside in the near shore waters in proximity to the project site. In addition, the Hawaiian monk seal is known to frequent sand and cobble beaches in the area.

Since all construction activities will occur on land, inland of coastal shoreline features, no direct impacts to marine species or habitats are anticipated. Indirect impacts may occur from increased sedimentation in coastal waters associated with upland construction activities. As noted above, a comprehensive BMP program will be implemented during the construction of the project to mitigate the potential for sedimentation impacts to near shore waters and marine species. Long term measures include establishment of desilting and retention basins to capture the additional runoff generated by the impermeable paved highway to maintain the current peak runoff during a 100-year storm.

Specific measures to be implemented to prevent contamination of the marine environment from project related activities include:

1. The project manager and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.

2. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.

3. A plan shall be developed to prevent debris and other wastes from entering or remaining in the marine environment during the project.

Protected Resources Division staff also raised concerns regarding acoustic impacts to the monk seal and sea turtles during the construction phase for portions of the project near the coastline in the vicinity of the southern connection point to the existing highway. Species may be impacted from noise generated by heavy machinery work if the species are in the nearby vicinity. As such, the following condition will apply during the construction phase of the project.

4. All heavy machinery work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s).

In conclusion, we have determined that the proposed action may affect, but is not likely to adversely affect the Hawaiian monk seal (Monachusschauinslandi), as well as sea turtles: green (Cheloniamydas), hawksbill (Eretmochelys imbricate), loggerhead (Carettacaretta), olive ridley (Lepidochelysolivacea), and the leatherback (Dermochelyscoriacea). We seek concurrence from your office that the proposed action is not likely to adversely affect the species listed and discussed above. We would appreciate your response within 30 days of receipt of the letter.

If you have any questions or would like additional information, please contact me at (808) 541-2326 or by email at wayne.kaneshiro@dot.gov. You may also contact the HDOT project manager Mr. Darell Young, at (808) 587-1835 or by email at darell.young@hawaii.gov . Thank you for your assistance.

Sincerely yours,

Wayne Kaneshiro

Wayne Kaneshiro
Highway Engineer

cc: Darell Young, HDOT, HWY-P
Mr. Mark Roy, Munekiyo and Hiraga, Inc.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1601 Kapiolani Blvd., Suite 1110
Honolulu, Hawaii 96814-4700
(808) 944-2200 • Fax (808) 973-2941

DEC 10 2013

Wayne Kaneshiro, Highway Engineer
Department of Transportation
Federal Highway Administration
Hawaii Federal Aid Division
300 Ala Moana Blvd., Rm 3-306, Box 50206
Honolulu, Hawaii 96850

Dear Mr. Kaneshiro:

This letter responds to your September 20, 2013 letter regarding the proposal from the U.S. Federal Highway Administration (FHWA) and the State of Hawaii Department of Transportation's (HDOT) relocation of the southern terminus of the Lahaina Bypass Highway in West Maui (Federal-aid Project No. NH-030-1(051)). The letter requested our concurrence under section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. §1531 et seq.), with the FHWA determination that the proposed action is not likely to adversely affect endangered or threatened species under National Marine Fisheries Service (NMFS) jurisdiction.

Proposed Action/Action Area: The proposed action would consist of FHWA funding the HDOT project described in your letter (FHWA 2013). In summary, the project involves the relocation of the southern terminus of the Lahaina Bypass Highway inland and roughly parallel to the existing Honoapi'ilani Highway between Puamana and the former Olowalu Landfill in West Maui. All construction activities will be land based and no work is to occur seaward of the existing highway. The construction phase is expected to last approximately 18-24 months. Major grading and earthwork activities will occur in the early phases of the project. Comprehensive best management practices (BMPs) will be implemented during the project to prevent contamination of the environment from project related activities as well as addressing concerns regarding acoustic impacts. These BMPs will help mitigate the potential impacts from sedimentation to marine species in nearshore waters as well as address potential acoustic impacts to species that may be in or near the project area. The action area for this project is estimated to be the in-water area within 50-yards around project-related activities, and the in-water extent of any plumes that may result from mobilized sediments or discharges of wastes or toxic chemicals such as fuels and/or lubricants associated with the machinery used for this activity.

Species That May Be Affected: Based on the project's location, scope, and timing, FHWA determined that the proposed action may affect but is not likely to adversely affect green sea turtles (*Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), loggerhead sea turtles (*Caretta caretta*), olive ridley sea turtles (*Lepidochelys olivacea*), leatherback sea turtles (*Dermochelys coriacea*) and Hawaiian monk seals (*Monachus schauinslandi*). No other ESA-listed marine species are expected to be affected by the proposed action. Detailed information about the biology, habitat, and conservation status of sea turtles and monk seals can be found in their recovery plans and other sources at http://www.nmfs.noaa.gov/pr/species.

Critical Habitat: There is no designated critical habitat for any listed marine species within or adjacent to the action area. Therefore, this project will have no effect on designated critical habitat. However, please be aware that NMFS has proposed designating additional Hawaiian monk seal critical habitat in areas around the main Hawaiian Islands (76 FR 32026).

Analysis of Effects: In order to determine that a proposed action is not likely to adversely affect listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or beneficial as defined in the Endangered Species Consultation Handbook (USFWS & NMFS 1998): (1) insignificant effects relate to the size of the impact and should never reach the scale where take occurs; (2) discountable effects are those that are extremely unlikely to occur; and (3) beneficial effects are positive effects without any adverse effects. This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions between ESA-listed marine species and the proposed action, were applied during the analysis of effects of the proposed action, as is described in detail in the FHWA letter.

The most likely potential stressors and impacts on marine listed species are: (1) disturbance from human activity and equipment operations; (2) exposure to elevated noise levels; (3) exposure to elevated turbidity; and (4) exposure to wastes and discharges. FHWA specifically addressed these stressors in their letter, providing impact analyses to justify their determination. Based on the effects analyses provided by FHWA and the Draft Environmental Assessment for the Proposed Relocation of Lahaina Bypass Southern Terminus (2012), NMFS agrees that with the appropriate BMPs incorporated into the project the potential stressors posed by the proposed action would result in insignificant impacts, or the likelihood of impacts would be discountable, for ESA-listed sea turtles and monk seals.

Conclusion: NMFS concurs with your determination that funding the proposed relocation of the Lahaina Bypass Southern Terminus is not likely to adversely affect ESA-listed marine species or designated critical habitat. Our concurrence is based on the finding that the effects of the proposed action are expected to be insignificant, discountable, or beneficial as defined in the joint USFWS-NMFS Endangered Species Consultation Handbook (USFWS-NMFS 1998) and summarized above. This concludes your consultation responsibilities under the ESA for species under NMFS jurisdiction. However, this consultation focused solely on compliance with the ESA. Any additional compliance review that may be required of NMFS for this action (such as assessing impacts on Essential Fish Habitat) would be completed by NMFS Habitat Conservation Division in separate communication, if applicable.

ESA Consultation must be reinitiated if: (1) a take occurs; (2) new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner causing effects to listed species or designated critical habitat not previously considered; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

If you have further questions please contact David Nichols on my staff at (808) 944-2243 or David.Nichols@NOAA.gov. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

Michael D. Tosatto
Regional Administrator

cc: Tony Montgomery, Coastal Conservation, USFWS, Honolulu

NMFS File No. (PCTS): PIR-2013-9362
PIRO Reference No.: I-PI-13-1133-LVA

Literature Cited

Federal Highway Administration (FHWA). 2013. ESA consultation request letter, re. Proposed Relocation of Lahaina Bypass Southern Terminus (FHWA Project No. NH-030-1(051)). U.S. Department of Transportation, FHWA, Honolulu, HI. September 20, 2013.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook. Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.
http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf

From: David Nichols - NOAA Federal [mailto:david.nichols@noaa.gov]
Sent: Wednesday, October 14, 2015 3:56 PM
To: Takara, Richelle (FHWA)
Subject: Re: Fwd: Relocation of the Souther Terminus of the Lahaina Bypass Highway in West Maui- question on culvert design

Richelle:

Thanks for the clarification on the the culvert design which indicates that they are to accommodate a 50-year flood flow and not the 100-year flow as indicated. We agree that this "change" would have no additional impacts to listed species or critical habitat that were not previously analyzed and therefore the existing letter of concurrence is still valid.

I would also recommend, if you haven't already, contacting NOAA's Habitat Conservation Division (specifically Danielle.Jayewardene@noaa.gov) to ensure Essential Fish Habitat concerns have been addressed.

Please let me know if you have any questions.

Aloha,
David

On 10/13/2015 3:19 PM, Patrick Opay wrote:
Hello Richelle-
David will review your email and get back to you.
Thanks.

-------- Forwarded Message --------

Subject: Relocation of the Souther Terminus of the Lahaina Bypass Highway in West Maui- question on culvert design
Date: Tue, 13 Oct 2015 23:30:29 +0000
From: Richelle.TAKARA@dot.gov
To: patrick.opay@noaa.gov

Patrick:

Back in Sept/Dec 2013, FHWA and NOAA exchanged letters regarding the subject project. Attached are the letters.

In our letter, we stated on page 2 3rd full paragraph "The culverts will be designed to accommodate 100-year flood flows and ..."

The Hawaii DOT standard design criteria for culverts is actually to accommodate a 50-year flood flow. The "100-year" was a typo.

We believe that this change in the project does not change our determination that the proposed action "may affect, but is not likely to adversely affect" the Hawaiian monk seal, as well as sea turtles: green, hawksbill, loggerhead, olive ridley, and the leatherback.

We want to make sure you concur with our determination and to understand the process that needs to be followed to make this change.

Thank You!!!

Richelle M. Takara, P.E.
Transportation Engineer
FHWA Hawaii Division
300 Ala Moana Blvd. Rm 3-306 | BOX 50206 | Honolulu, HI 96850
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APPENDIX E.

Aquatic Resource Survey

AQUATIC RESOURCE SURVEY

For the

LAHAINA BYPASS CORRIDOR PROJECT

PHASE 1 B - 2 SEGMENT

LAHAINA, WEST MAUI, HAWAII

By:

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
September 2012
Revised October 2013

Prepared for:
Makila Land Company, LLC

Aquatic Resource Survey for the Lahaina Bypass Corridor Project Phase 1 B–2 Segment

A September 2012 Report, Revised in November, 2013

Lahaina, West Maui, Hawaii (Reference Corps File No. POH-2007-00099)

INTRODUCTION

In September, 2012 a report was completed, assessing the aquatic resources along an approximately 2.6 mile proposed alignment for the Lahaina Bypass Corridor Project – Phase 1B-2 Segment that stretches from Hokiokio Road at the north end to the southern terminus at the Launiupoko boundary with Olowalu. It traverses former sugar cane fields, a stream channel, drainage basins and one old settling basin. This report was submitted to the Corps of Engineers for their review and an Approved Jurisdictional Determination (see Figure 1).

The Corps' review of this report raised questions that led to a September 5, 2013 request for further information and analysis on additional potential aquatic features. This revised report provides the additional information and analysis requested regarding the existing Wetland Determination analysis of the old settling basin, and the Waters of the U.S. analyses of the four drainageways that had a direct connection with the Pacific Ocean that were presented in the original report.

SITE DESCRIPTION

The selected alternative for the highway alignment (see Figures 2, 3, 4) traverses the lower slopes of the alluvial fans of the Kauaula and Launiupoko Streams in the northern and central portions and passes beneath the rocky Pu'u Mahanaluanui at the southern end. Elevations range between 120 feet in the north and decrease to 25 feet at the southern end. Slopes are mostly gentle to moderate. Vegetation consists mostly of dry open grassland with some forested land at the southern end.

The highway corridor crosses several natural drainages. The watersheds that feed each of these drainages have been outlined to show their relative sizes and relationships in the landscape (see Figures 5 & 6). Each of these drainages needs to be evaluated to see if it meets criteria to qualify it as a jurisdictional Waters of the U.S.

An important historical overlay of the mapping of these aquatic resources that will aid our understanding of the ways that waters move across this landscape, or are restricted from such movement, involves alterations created in the past by the sugar plantation to irrigate their crops on the one hand, and to protect their fields from erosion during large rainfall events on the other.

The first alteration was the diversion of the perennial water of Launiupoko Stream into a large reservoir where it was stored for later distribution to the fields for irrigation. From the reservoir the water flowed down into a three-tiered lateral ditch system including, the Lahaina Pump Ditch, the Lahaina Pump Ditch 2 and the

Makila Ditch. These ditches distributed water laterally to the fields between Kauaula Stream and the Launiupoko Stream at the elevations of 83 feet, 258 feet and 370 feet respectively. To protect these lateral ditches from erosion damage and from siltation, each had a continuous 3 to 4 foot high soil berm constructed above it to prevent surface storm waters from reaching them. This three-tiered system of berms truncated the natural flow of rainfall waters in the watersheds draining this area. Any water accumulating above the berms would percolate into the landscape without lateral movement. The three lateral ditches no longer carry water in them but their berms still restrict the downward flow of storm waters in drainageways in the fields where they occur.

Another larger soil berm was constructed at the lower edge of the fields along the upper edge of the old plantation cane haul road and the coastal Honoapi'ilani Highway. This berm is about 8 feet in height and was created to prevent storm waters from reaching these roads or the ocean.

Another standard plantation practice in Hawaii was to line stream channels with berms consisting of large field boulders and soil. These berms created deeper drainage channels that prevented storm flows from breaching the banks and damaging fields and crops. These berms are prominent along the banks of three of the four larger channels that run to the ocean.

A final plantation feature that needs explanation involves the old settling basin located near the southern end of the road alignment beneath Pu'u Mahanaluanui cinder cone. This site was originally excavated for cinders creating a depression. This depression was later developed into a settling basin. Large volumes of muddy Pioneer Mill waters resulting from the cane washing process were channeled to the south from Lahaina in the Lahaina Pump Ditch, through a large iron pipe spanning Launiupoko Stream and into this settling basin. Here most of the soil would settle out of the water. The overflow from this basin then travelled laterally in a ditch to the southernmost unnamed drainage where it was channeled through culverts to the ocean (see Figures 7,8).

When Pioneer Mill shut down in 1999 the flow of mill water ceased and the Lahaina Pump Ditch was blocked off on the north side of the Launiupoko Stream pipe crossing. The settling basin dried up within a few weeks as the water percolated into the ground. This old settling pond now only receives meager local runoff from the slopes of Pu'u Mahanaluanui and is dry almost all of the time with the water table 5 to 6 feet below the surface.

SURVEY METHODS

The project area, focusing on the Alternative 3 selected alignment, consists of 11 drainage basin units with 12 proposed culvert locations. At the request of Corps reviewers these watersheds have been renumbered on the Drain Area Map to reflect a sequential north to south order starting with 5 for ease of conceptualization and to be consistent with the numbering system used for the Lahaina Bypass Phase 1B-1 project (see Figure 5). Each drainage basin is evaluated individually for criteria relative to whether it is a jurisdictional Waters of the U.S. aquatic feature.

Figure 1. Aerial Photo – Project area Lahaina Bypass Phase 1B-2

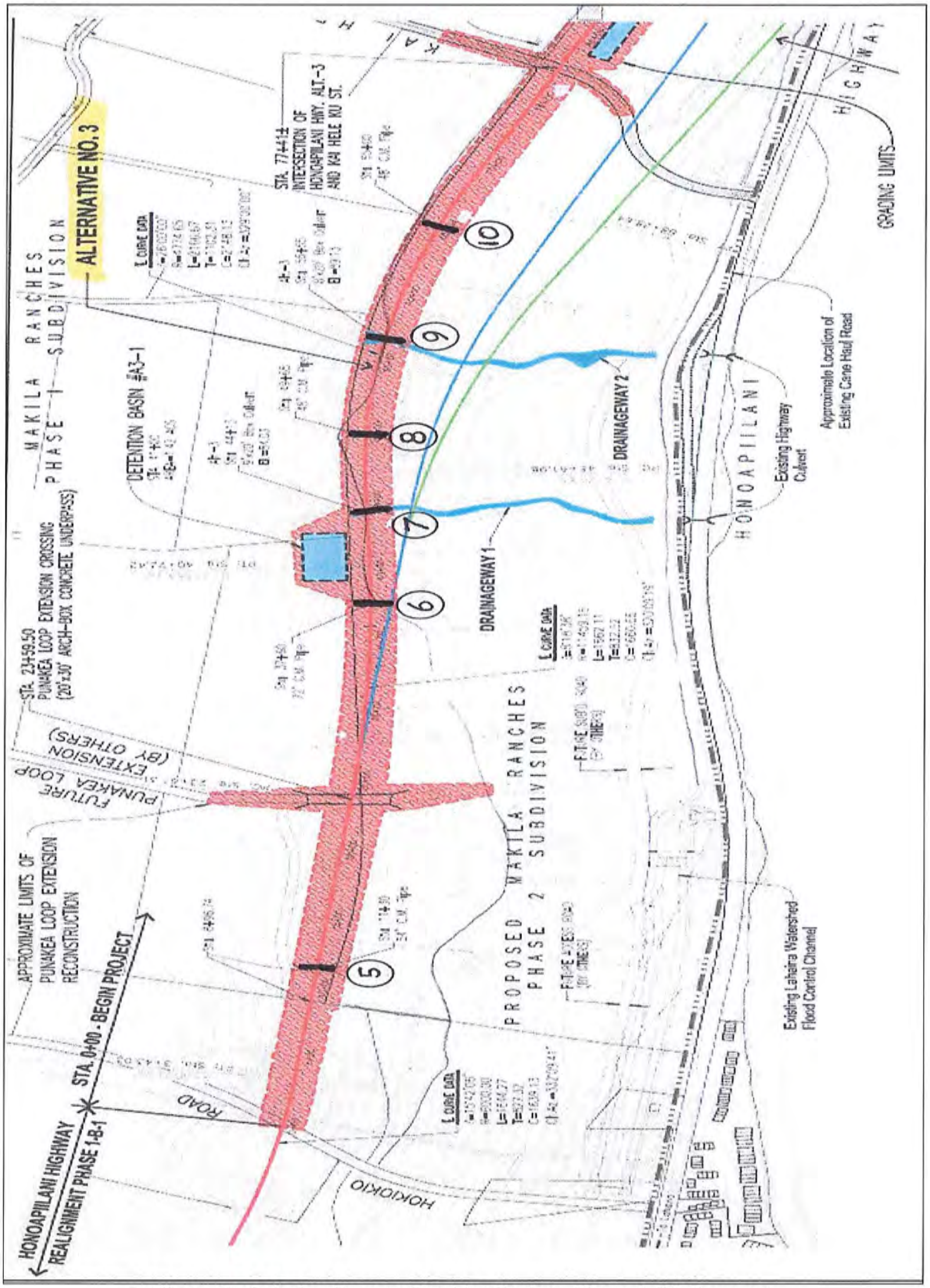


Figure 2. Lahaina Bypass Corridor Project, Phase 1-B2 Segment
Drainage Engineering Plan – Northern Half

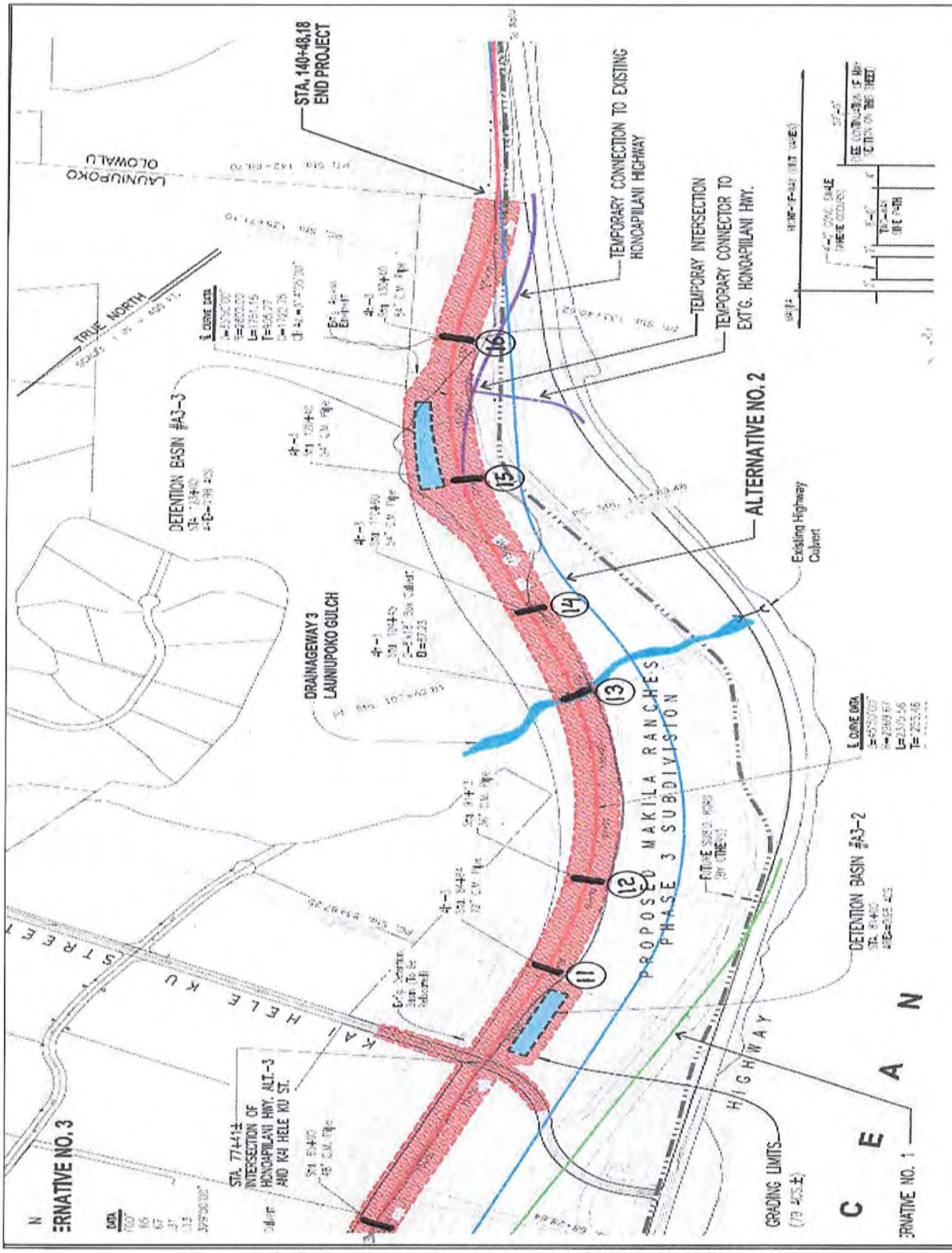


Figure 3. Lahaina Bypass Corridor Project, Phase 1B-2 Segment
Drainage Engineering Plan – Southern Half

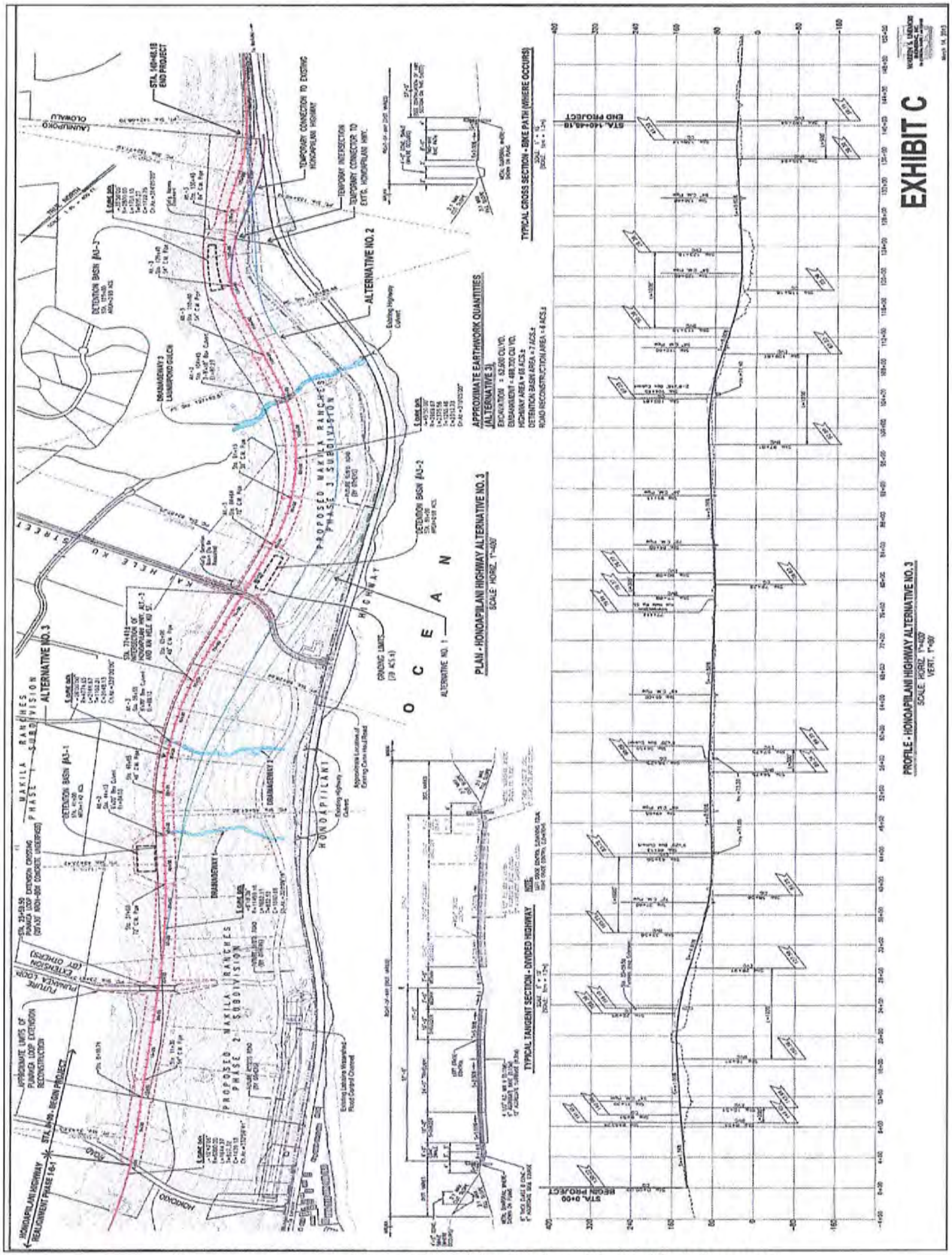
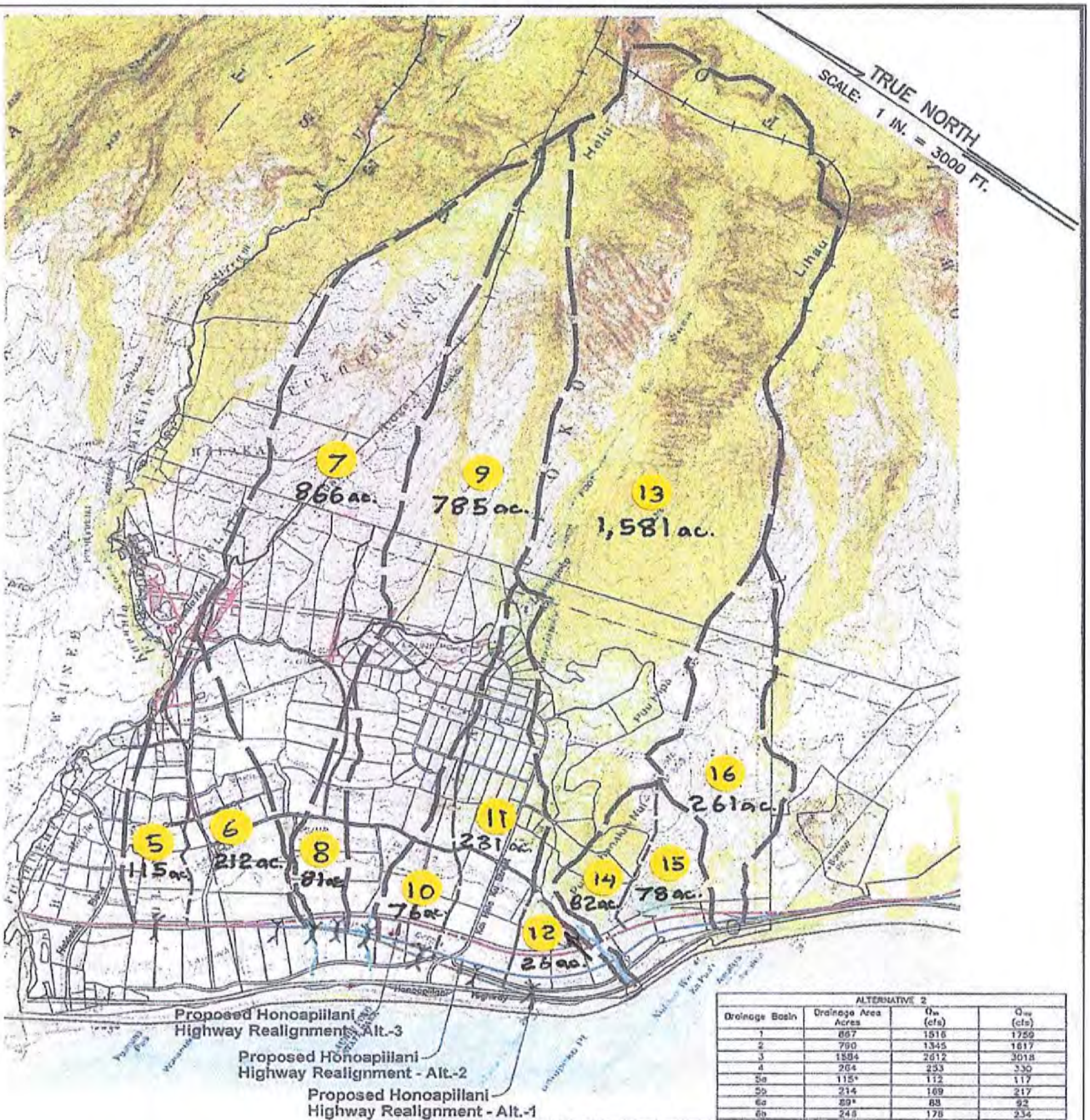


Figure 4. Lahaina Bypass Corridor Project, Phase 1B-2 Segment
Exhibit C – Alternative #3 Road Alignment (selected)



ALTERNATIVE 1

Drainage Basin	Drainage Area Acres	Q_{10} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	169	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

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

ALTERNATIVE 2

Drainage Basin	Drainage Area Acres	Q_{10} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	248	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

ALTERNATIVE 3

Drainage Basin	Drainage Area Acres	Q_{10} (cfs)	Q_{100} (cfs)
1	865	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	168	216
6a	76*	76	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	81*	75	79

DRAIN AREA MAP

FIGURE 5

April 10, 2008

Figure 5. Drainage Area Map – Warren S. Unemori Engineering, Inc. with renumbering and acreages added.

Figure 6. Project Area, Lahaina Bypass, Phase 1B-2
with numbered drainage basins, flow paths and culvert locations.

Figure 7. Lahaina Bypass Project, Phase 1B-2

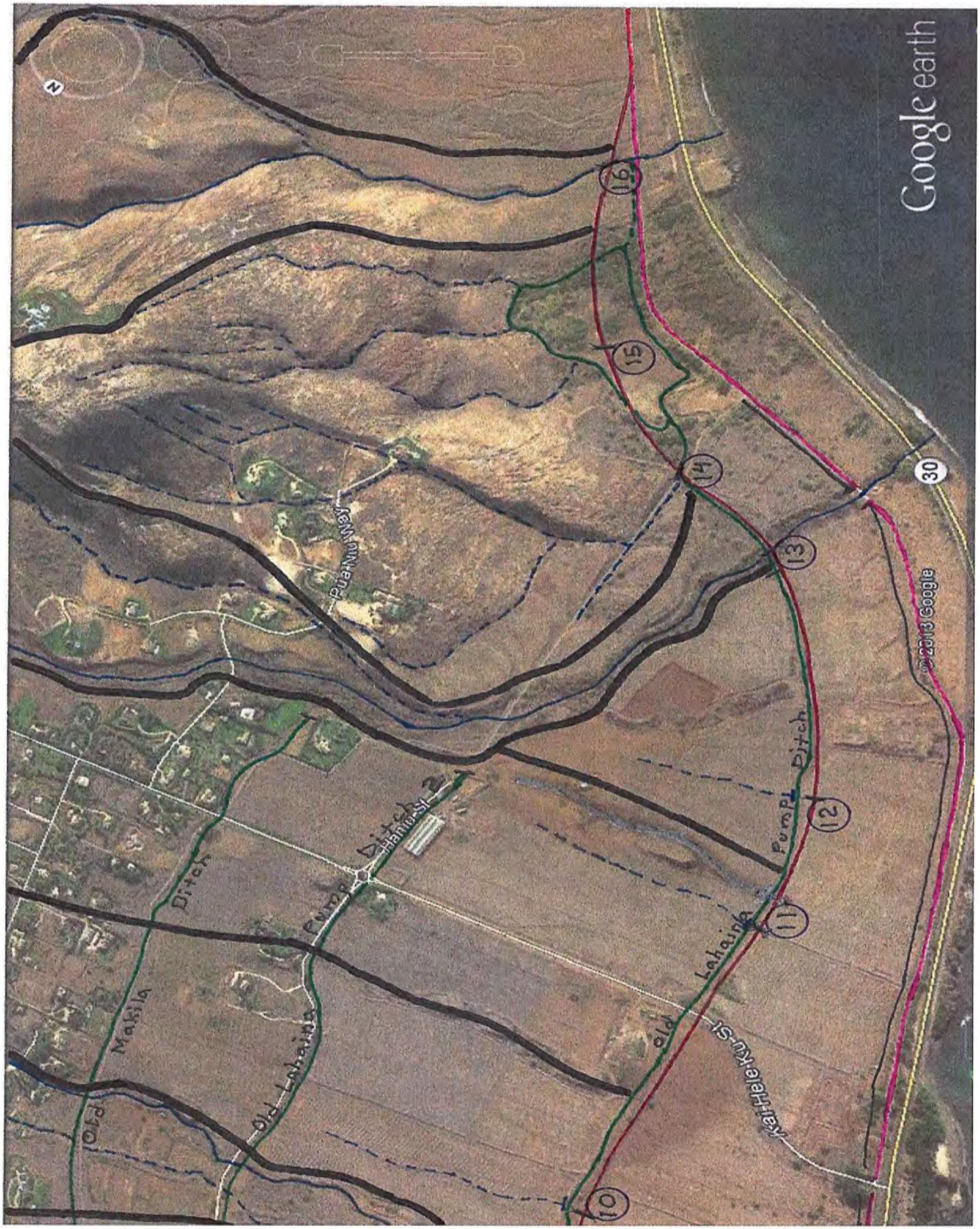


Figure 8. Lahaina Bypass Project, Phase 1B-2

🟥	Alternative No. 3 Alignment (Selected)
I	Proposed culvert Locations with numbers
🟩	Abandoned Lahaina Pump Ditch alignment, Lahaina Pump Ditch 2 alignment & Makila Ditch alignment
▬	Drainage basin boundaries
┆ |	Drainage flow paths- interrupted and uninterrupted
○	Abandoned Settling Pond
▬	6-8' high soil berm above cane haul road
🟥	Cane haul road alignment

Map Legend for Figures 7 & 8.

RESULTS

Drainage Basin 5 (= Drainage Basin 5a in Sept., 2012 report) (see Figures 5, 6 & 7).

Location at proposed culvert: latitude 20.8581 N., Longitude 156.6556 W.

Size of drainage basin: 115 acres

Tributary gradient: 5 ½ to 7%

Annual rainfall: 12 to 15 inches per year

Drainage surface flow Q50 = 112 cfs, Q100 = 117 cfs

This drainage has no discernible stream channel. All surface flow appears to occur as sheet flow. Any moving water from the proposed culvert location would not be able to flow beyond the berm at the Lahaina Pump Ditch downslope of this location. It does not feed into any other tributary or to the ocean. This watershed would be an ephemeral feature and an Isolated Water that percolates into the landscape and would not be a candidate for a jurisdictional Waters of the U.S.

Drainage Basin 5. View upslope at proposed culvert location. Terrain is a gently sloping swale with dense grass. There is no visible channel. Culvert site is located above the abandoned Lahaina Pump Ditch

Drainage Basin 5. View downslope at proposed culvert location. Terrain is a gently sloping swale with no visible channel. Culvert site lies above the abandoned Lahaina Pump Ditch which has a three foot high berm above it to restrict any sheet flow from local rainfall from entering the ditch.

Drainage Basin 6. (= Drainage Basin 5b in Sept., 2012 report) (see Figures 5,6 & 7)

Location at proposed culvert: Latitude 20.8522 W., Longitude 156.6546 W.

Size of drainage basin: 212 acres

Tributary gradient: 5.5% to 7%

Annual rainfall: 12 to 15 inches per year

Drainage surface flow: Q50 = 168 cfs Q100 = 216 cfs

This proposed culvert location on the road alignment lies just below the Lahaina Pump ditch. The berm above the ditch prevents any water falling above it from reaching this culvert. No discernible stream channel was visible. Any water falling in this area will not flow into any other tributary and would not be able to pass the 6 foot high berm above the cane haul road, Honoapi'ilani Highway and the ocean. This watershed would be an ephemeral feature and an Isolated Water that percolates into the landscape. This would not be a candidate for a jurisdictional Waters of the U.S.

Drainage Basin 6. View upslope from proposed culvert location. No channel is visible.

Drainage Basin 6. View downslope from proposed road alignment below ditch. Terrain is a highly altered landscape with an old plantation road, piled field stones and cattle trails. No channel was seen. Rainfall in the form of sheet flow runs downslope to where it encounters a continuous six foot high berm above the old cane haul road above the highway.

Drainage Basin 6. Proposed road alignment passes just below (to the right) the abandoned Lahaina Pump Ditch. Note: the three foot high berm that restricts any sheet flow from local rainfall from entering the ditch from above.

Drainage Basin 7. (= Drainage Basin 1 in the Sept. 2012 report) (see Figures 5, 6, 7).

Location at proposed culvert: Latitude 20.8511 N., Longitude 156.6532 W.

Size of drainage basin: 866 acres

Tributary gradient: 5.5% to 7%

Annual Rainfall: 12 inches to 15 inches per year.

Drainage surface flow: Q50 = 1,824 cfs, Q100 = 1,768 cfs

This drainage was evaluated in the Sept., 2012 report using the Approved Jurisdictional Determination Form (Drainageway 1) and found to qualify as an Ephemeral Jurisidictional Non-RPW that flows directly into a TNW (see Appendix).

Drainage Basin 7. View downslope in channel (drainageway 1 in Sept.2012 report) that was found to be a Jurisdictional Ephemeral Stream with direct connections to the Pacific Ocean TNW through culverts under the cane haul road and the coastal highway. The plantation created large lateral berms along this drainage to channelize water flow. No bed, banks or Ordinary High Water Marks were visible.

Drainage Basin 7. View upslope in the hardened drainage channel that protected the plantation road crossing which lies on the proposed road alignment. Small culvert on left brings in additional flow from within the same drainage basin.

Drainage Basin 8 (= Drainage Basin 8 in the Sept. 2012 report) (see Figures 5, 6 & 7)

Location at proposed culvert: Latitude 20.8499 N., Longitude 156.6522 W.

Size of drainage basin: 81 acres

Tributary gradient: 5.5 % to 7%.

Annual rainfall: 12 inches to 15 inches per year.

Drainage surface flow: Q50 = 75 cfs Q100 = 79 cfs

This drainage feature lies about 100 feet below the old Lahaina Pump Ditch which has a 4 foot high berm above it. No water from above this berm reaches the area below it. There is no visible drainage channel at this location and any water movement here would travel downslope as sheet flow. It would not be able to pass an 8 foot high berm above the cane haul road and would percolate into the landscape. This drainage basin does not have any connections to any other tributaries or to the ocean. It is an Isolated Water feature and not a candidate for a jurisdictional Waters of the U.S..

Drainage Basin 8. View upslope from proposed culvert location showing a large lateral berm along the ditch that prevents sheet flow from local rainfall from reaching this area.

Drainage Basin 8. View downslope at the proposed culvert location showing an old plantation road alongside a pile of field stones. There is a slight swale but no identifiable channel is visible. Sheet flow from local rainfall encounters a six foot high berm above the cane haul road that prevents water from reaching the highway or the ocean.

Drainage Basin 9. (= Drainage Basin 2 in the Sept., 2012 report) (see Figures 5,6 & 7).
Location at proposed culvert: Latitude 20.8348 N., Longitude 156.6510 W.
Size of drainage basin: 785 acres
Tributary gradient: 5.5% to 7%
Annual rainfall: 12 inches to 15 inches per year
Drainage surface flow: Q50 – 1,369 cfs, Q100 = 1,646 cfs
This stream was evaluated in the Sept., 2012 report using the Approved Jurisdictional Form and found to be a Jurisdictional Non-RPW that flows directly into a TNW (see Appendix).

Drainage Basin 9. View upslope in a partially hardened channel above the proposed road alignment. This stream channel, which equates to Drainage Way 2 in the Sept., 2012 report, was found to be a Jurisdictional Ephemeral Stream with direct connections to the Pacific Ocean TNW through culverts under the cane haul road and the coastal highway.

Drainage Basin 9. View downslope in the stream channel. The plantation constructed large lateral berms along this ephemeral stream to channelize water flow. No bed, banks or OHWM were visible.

Drainage Basin 10 (= Drainage Basin 6a in the Sept., 2012 report) (see Figures 5, 6 & 7)
Location at proposed culvert: Latitude 20.8346 N., Longitude 156.6502 W.
Size of drainage basin: 76 acres
Tributary gradient: 5.5% to 7%
Annual rainfall: 12 inches to 15 inches per year
Drainage surface flow: Q50 = 76 cfs O100 = 80 cfs

This proposed culvert lies about 50 feet below the old Lahaina Pump Ditch and has a 4 feet high berm above it. There is no visible drainage channel above or below this site and any water movement here would travel downslope as sheet flow. It would not be able to pass an 8 foot high berm above the cane haul road and would percolate into the landscape. This Drainage Basin does not have any connections to any tributaries or to the ocean. It is an Isolated Water feature and not a candidate for a Jurisdictional Waters of the U.S.

Drainage Basin 10. View upslope from proposed culvert location. Four foot berm is visible where the ditch passes above the site. Sheet flow from local rainfall does not pass this barrier and there are no discernible bed, banks or OHWMs.

Drainage Basin 10. View downslope from the proposed culvert location. Terrain is gently sloping with no channel visible. Sheet flow from local rainfall flows down to a continuous eight foot tall berm above the cane haul road.

Drainage Basin 11. (= Drainage Basin 6B in the Sept., 2012 report) (see Figures 5, 6 & 8)
Location at proposed culvert: Latitude 20.8407 N., 156.6455 W.
Size of drainage basin: 231 acres
Tributary gradient: 5.5% to 7%
Annual rainfall: 12 inches to 15 inches per year.
Drainage surface flow: Q50 177 cfs Q100 227 cfs

This proposed road alignment lies about 50 feet below the old Lahaina Pump Ditch which has a 3 foot high continuous berm above it that captures all the surface water flowing from the drainage above it. The area above the ditch has no visible stream channel and all runoff occurs as sheet flow. Below the road alignment the proposed culvert would drain into a straight, manmade channel that was designed to carry excess water from the old ditch downslope to the large berm above the cane haul road where it would percolate into the landscape. The ditch no longer carries water and this channel below it looks like it has not had water flowing in it for many years. This channel has no bed or banks, no silting and debris and no Ordinary High Water Mark. This drainage basin does not have any connections to any tributaries or to the ocean. It qualifies as an Isolated Water feature and is not a candidate for a Jurisdictional Waters of the U.S.

Drainage Basin 11. View upslope showing a gently sloping basin with a dense growth of grass. No stream channel is visible.

Drainage Basin 11. View along old ditch. Proposed road alignment lies below the ditch on the right. A three foot high berm on the left prevents any sheet flow from above from reaching the slopes below the ditch.

Drainage Basin 11. View downslope from the road alignment showing a straight man-made drainage that used to carry ditch overflow. This channel no longer receives water from the ditch and appears not to have carried water for years. There are no flow marks, debris or Ordinary High Water Marks.

Drainage Basin 11. View down old ditch overflow channel showing straight-line construction and prominent lateral berms. This channel no longer receives water from the ditch or above it and cannot receive water from the sides because of the berms. It has not carried water in it since the plantation shut down fourteen years ago. There is no sign of silt deposition, debris accumulation or Ordinary High Water Mark.

Drainage Basin 11. View along the continuous lateral eight foot high berm above the cane haul road and Honoapi'ilani highway that prevents any sheet flow rain water from getting down to these roads or to the coast.

Drainage Basin 12. (= Drainage Basin 6C in the Sept., 2012 report) (see Figures 5, 6 & 8)
Location at proposed culvert: Latitude 20.8390 N., Longitude 156.6347 W.
Size of Drainage Basin: 26 acres
Tributary gradient: 5%
Annual rainfall: 12 inches to 15 inches per year
Drainage surface flow: Q50 = 32 cfs, Q100 = 34 cfs

The proposed road alignment lies about 50 feet below the old Lahaina Pump Ditch which has a 3 foot high continuous berm above it that captures all of the surface water from the drainage above it. The drainage area above the berm appears to be smooth and no sign of a swale is apparent. All of the storm water from this small drainage would travel as sheet flow. No channel is visible. Below the road and the proposed culvert location the terrain is similarly smooth and lacking any channel. All of the storm water here would also travel as sheet flow. The 8 foot high berm above the cane haul road would prevent any of these waters from reaching the roads or the ocean. It would all percolate into the landscape as it has no connections to other tributaries or the ocean. This drainage qualifies as an Isolated Water feature and is not a candidate for a Jurisdictional Waters of the U.S.

Drainage Basin 12. View upslope of proposed culvert location showing the former irrigation ditch and a three foot high berm that prevents downslope sheet flow of waters from above. No channels were visible in the grassy plain.

Drainage Basin 12. View downslope of the proposed culvert location showing the nearly flat coastal plain. Rain water moves gently down slope as sheet flow and cannot by pass the continuous eight foot high berm that is visible in the distance.

Drainage Basin 12. View along the continuous eight foot high berm above the cane haul road and Honoapi'ilani Highway that prevents any sheet flow rain water from getting down to these roads or to the coast.

Drainage Basin 13. Launiupoko Stream(= Drainage Basin 3 in the Sept., 2012 report) (See Figures 5, 6, 8 & 9)

Location at proposed box culvert: Latitude 20.8336 N., Longitude 156.3446 W.
Size of drainage basin: 1,581 acres
Tributary stream order: Second order
Relevant Reach: 6,000 feet or 1.15 miles
Tributary gradient: 5.5% to 7%
Annual rainfall: 12 inches to 15 inches per year at culvert, 100 inches per year at headwaters
Drainage surface flow: Q50 – 2,655 cfs, Q100 = 3,067 cfs

Launiupoko Stream was evaluated in the Sept., 2012 report using the Approved Jurisdictional Determination Form (Drainageway 3), and was proposed as being a perennial RPW stream above the ditch intake and an Ephemeral Non-RPW stream in its Relevant Reach. Some more detailed information on the stream character and flow is provided to clarify the proposed Jurisdictional Determination.

Launiupoko Stream originates deep in the West Maui Mountains and is fed by both rainfall (100 inches per year at the headwaters) and by artesian springs. The total stream length is a little over 4 miles to where it enters the Pacific Ocean. It has perennial flow for 1.5 miles down to 1,250 feet elevation to where its water is diverted into an old plantation ditch and into which a new 8 in. diam. HDPE pipe has been installed that carries the water to the Launiupoko Reservoir which is still in use.

Below the diversion the stream rarely runs. Although, the intake and the reservoir both have spillways to protect the system from excess water from storm flow events, these are rarely employed because all of the water is used for non-potable irrigation use. Launiupoko Stream channel continues for another 2.65 miles down from the intake to the ocean, passing through dry, hot lowlands. Lower Launiupoko Stream currently only runs 1 to 3 times a year for periods of one to three days during larger storm events.

The Relevant Reach along Launiupoko Stream associated with the Lahaina Bypass Project road alignment extends 6,000 feet inland from the ocean up to the first stream branch at 470 feet elevation. The proposed box culvert location on Launiupoko Stream is situated 750 feet from the ocean at an elevation of 60 feet. The entire stretch of the lower reach of Launiupoko Stream within the Relevant Reach for this project qualifies as an Ephemeral Non-RPW Jurisdictional Waters of the U.S. aquatic feature (see Appendix).

Two photographs show the location of the culvert crossings on the proposed road alignment just below the iron pipe. The stream bed is about 25 feet wide and 10 feet deep with steep rocky sides.

Drainage Basin 13. The view upstream in Launiupoko Stream channel under the pipe. Launiupoko Stream channel is about 25 feet wide and 10 feet deep with steep sides. This is the site where the proposed Highway will cross Launiupoko Stream channel.

Drainage Basin 13. View downstream in Launiupoko Stream channel in the location where the proposed road alignment will be located.

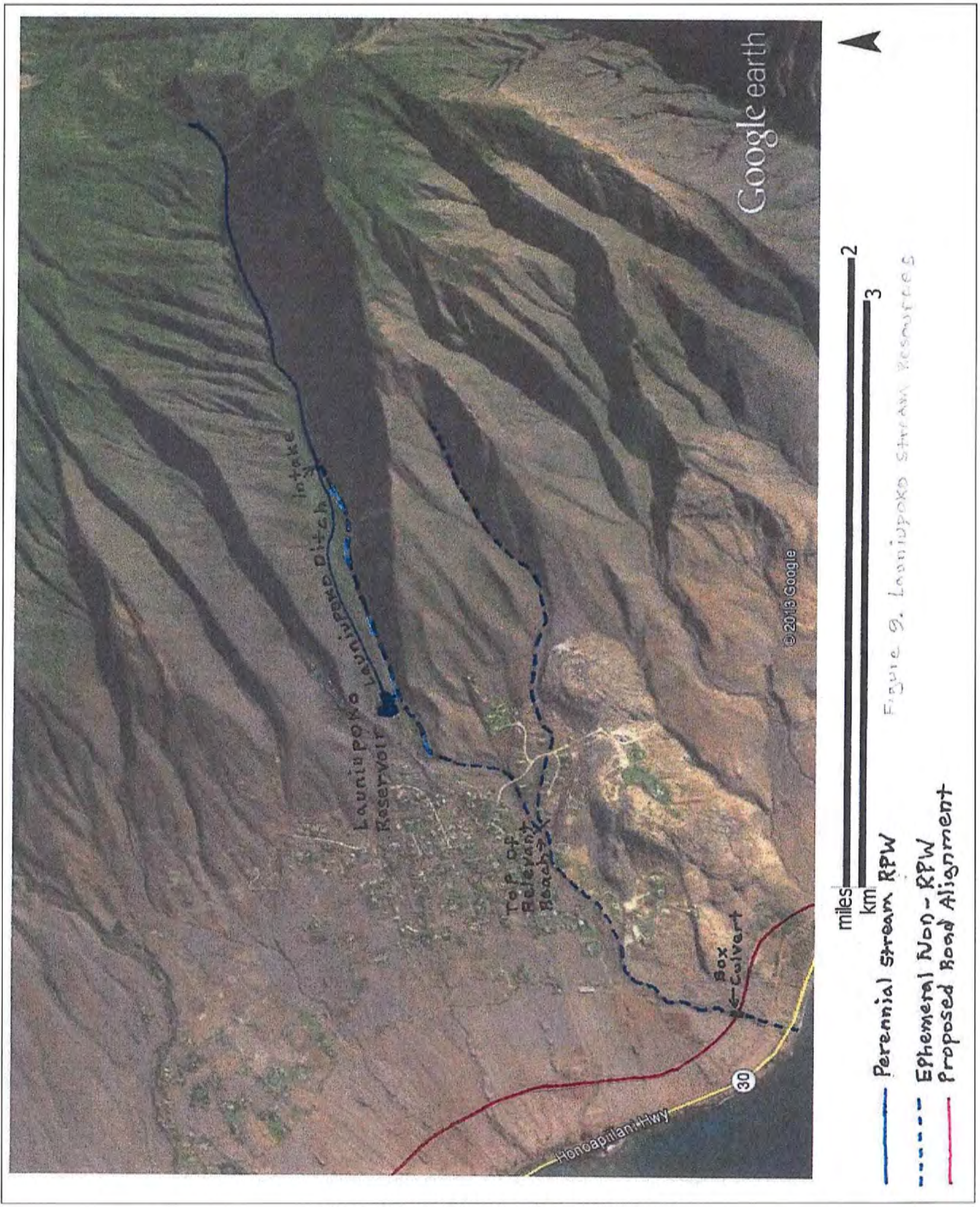


Figure 9. Launiupoko Stream Resources

Launiupoko Reservoir (see Figures 5,6,8 & 9)

Launiupoko Reservoir is over 90 years old and was used to irrigate sugar crops until 1999 when Pioneer Mill Company shut down operations. An intake on Launiupoko Stream is located at 1,250 feet in the upper valley. This intake feeds the Launiupoko Ditch into which has been installed an 8 in. diam. HDPE pipe that transports the water down 0.75miles along the north side of the valley to the reservoir.

The diversion of Launiupoko Stream water has continued since the plantation shutdown under the management of the Launiupoko Irrigation Company, Inc. that utilizes the non-potable water supply to irrigate pasture lands and rural landscaping using large rotary sprinklers.

Launiupoko Intake/Ditch/Reservoir has two protective measures to minimize serious flood damage. A spillway at the intake regulates the amount of water entering the pipeline and a spillway at the reservoir prevents overfilling of this structure. These protective features are rarely employed, however, because virtually all of the water is used for irrigation. There is almost no water overflowing the spillway at the intake except during larger rainfall events when the stream may run to the ocean. This occurs no more than ten days a year. None of the diverted waters from Launiupoko Stream flow into any other tributary.

Figure 10. Launiupoko Reservoirs showing Launiupoko Ditch that brings water down from the stream intake to the smaller sediment collection pond. Excess waters can overflow back into the stream, although this rarely if ever occurs. Reservoir water is then distributed downslope for irrigation.

Drainage Basins 14. (= Drainage Basin 7A in the Sept., 2012 report) (see Figures 5, 6 & 8)
Location at proposed culvert: Latitude 20.8350 N, 156.6430 W
Size of drainage basin: 82 acres
Tributary gradient: 15%
Annual rainfall: 12 inches to 15 inches per year.
Drainage surface flow: Q50 = 90 cfs, Q100 = 94 cfs

This small channel flows off the steep rocky northwest slope of Pu'u Mahanaluanui and flows into the old plantation settling basin at its foot. Water flows for only a few days a year for short periods following local rainstorms. The small amounts of rainfall that flow to the settling basin gravitate to the lowest part of this basin. Any accumulated water ponds there for a short time but soon percolates into the landscape. This tributary and settling pond currently has no connections to other channels or to the ocean. It is an Isolated Water that qualifies as an Ephemeral Non-RPW but not as a Jurisdictional Waters of the U.S.

Drainage Basin 14. Ephemeral waters from the northwest slope of Pu'u Mahanaluanui flows down through this gap to the left of this bike path. They join the old Lahaina Pump Ditch, flow through a culvert under the path, and into a gully that feeds into the large settling basin further to the south. This is the proposed culvert location site.

Drainage Basin 14. This is the gully leading to the settling pond from the proposed culvert location.

Drainage Basin 15. (= Drainage Basin 7B in the Sept., 2012 report) (see Figures 5, 6 & 8)
Location at proposed culvert: Latitude 20.3267 N., Longitude 1566386 W.
Size of drainage basin: 78 acres
Tributary gradient: 3 %
Annual rainfall: 12 inches to 15 inches per year.
Drainage surface flow: Q50 = 86 cfs, Q100 = 91 cfs

This road alignment and culvert lies within the dry, abandoned plantation settling basin on a higher bench to the west of the lowest point in the basin. The culvert will transmit storm waters under the road from west to east where it will accumulate in the lowest portion of the basin where a detention basin is to be constructed.

Three short, steep, rocky gullies also drain the west face of Puu Mahanaluanui into this low point. The waters collected in this low point currently have no connections with other tributaries or to the ocean. It is an Isolated Water feature that qualifies as an Ephemeral Non-RPW but not as a Jurisdictional Waters of the U.S.

Drainage Basin 15. View southeast from the proposed culvert site toward the lowest part of the settling old basin where the new detention basin is to be located.

Drainage Basin 15. View northwest from the proposed culvert site toward the higher portion of the settling basin.

Abandoned Plantation Settling Basin. (see Figures 5, 6 & 8).

This potential aquatic resource near the southern end of the project corridor was examined in the Sept., 2012 report to see if it qualified as a jurisdictional resource following the Wetland Determination Data Form. In that analysis it was found to be a non-wetland by Corps of Engineers Standards (see Appendix).

The settling pond is a large basin encompassing 20 acres with a potential depth of 20 feet at its deepest part. This basin used to receive hundreds of thousands of gallons of muddy mill water on a daily basis during the 9-month cane harvesting season. This water used to be carried south in the Lahaina Pump Ditch, passed over Launiupoko Stream through a 30 inch diameter iron pipe and on to the settling basin. When the basin overflowed it traveled 250 feet further south in a man-made ditch above the cane haul road where it spilled into a final drainage channel. It then traveled down this stream bed, through culverts under the cane haul road and Honoapi'ilani Highway to the ocean.

When the Pioneer Mill shut down in 1999, the flow of water to the settling basin stopped and the Lahaina Pump Ditch was blocked off so that water could no longer pass through the iron pipe over Launiupoko Stream. Within a couple weeks the settling basin dried up as the existing water percolated into the ground.

Today the settling basin receives waters only from local rainfall that falls in a 160 acre watershed comprising the northwest and west slopes of the rocky Pu'u Mahanaluanui above it. This rainfall is but a tiny fraction of the amount of water this basin used to receive and the heaviest rains produce just a tiny pond in the lowest area that percolates into the ground in a few days. Under present circumstances the settling basin will never overflow and this settling pond no longer has a connection with another tributary or the ocean. The settling basin is at best merely an Isolated Water and is not a Jurisdictional aquatic feature.

View of the truncated end of the former Lahaina Pump Ditch where it was blocked off after it was abandoned. Launiupoko Stream channel lies about 100 feet distance in the kiawe trees. This blockage prevents water from the north side of Launiupoko Stream from reaching the former settling basin.

View of a 40 foot length of steel pipe spanning Launiupoko Stream channel to a ditch continuation on the far side that used to carry excess waters to the settling basin.

View of the 40 foot long x 30 inch diameter iron pipe spanning Launiupoko Stream channel.

Abandoned Plantation Settling basin. View south into the former 20 acre settling basin. The proposed road alignment passes across a higher portion of this depression in the center of the picture.

Drainage Basin 16. (= Drainage Basin 4 in the Sept., 2012 report) (see Figures 5, 6 & 8).
Location at proposed culvert: Latitude 20.8526 N., Longitude 156.6285 W.
Size of drainage basin: 261 acres
Tributary gradient: 5.5% to 7%,
Annual rainfall: 12 inches to 15 inches per year.
Drainage surface flow: Q50 = 255 cfs, Q100 = 333 cfs

This drainage basin was evaluated in the Sept., 2012 report using the Approved Jurisdictional Determination Form (Drainageway 4) and found to qualify as an Ephemeral Jurisdictional Non-RPW that flows directly into the Pacific Ocean TNW (see Appendix).

Drainage Basin 16. View inland from the proposed culvert location showing the drainage channel (Drainageway 4 in the Sept., 2012 Report) that was found to be a Jurisdictional Ephemeral Non RPW with a direct connection to the Pacific Ocean TNW. No bed, banks or OHWM were visible.

Drainage Basin 16. View downslope toward the Pacific Ocean from the proposed culvert location. This Jurisdictional Ephemeral Non RPW Stream flows through existing culverts under the cane haul road and Honoapi'ilani Highway to the Pacific Ocean TNW.

SUMMARY

The additional aquatic resources analyzed in this revised report included eight smaller drainage basins not treated in the Sept., 2012 report as well as a review of the four larger drainages with direct connections to the ocean that were found to be jurisdictional resources in the earlier report. Also additional information was provided to clarify the hydrological relationships of the Launiupoko Reservoir and the abandoned settling basin to their adjacent drainage features.

All of the eight smaller Drainage Basins, including numbers 5, 6, 8, 10, 11, 12, 14 & 15, are here proposed as being Ephemeral, Non-RPW Isolated Waters that are not jurisdictional. None of them have connections to other tributaries or to the Pacific Ocean TNW, and none of them have identifiable channels with beds, banks or Ordinary High Water Marks.

Supplemental information on Drainage Basins 7, 9, 13 & 16 has been provided as requested to clarify their hydrological function. All four of these larger drainages are considered to be Jurisdictional Ephemeral, Non-RPW Waters of the U.S.

APPENDIX

The project corridor was examined to identify any wetlands or Waters of the U.S. following USACE guidelines and forms.

Wetlands Analysis

Most of the project corridor is situated on elevated, sloping terrain where water runs off readily and does not accumulate. Ground water levels are deeply buried, soils are well drained and the vegetation is of a typical upland type. One area, however, needed a closer look. This was the old silting basin near the southern end of the corridor below Mahanaluanui Cinder Cone.

This site was originally excavated for cinders leaving a depression. This depression was then converted to use as a silting basin to let soil settle out of muddy mill waters before flowing into the sea. During the mid to late 1900s there would have been seasonal ponding followed by drying. Every few years the plantation would clean out the soil to restore pond capacity.

When Pioneer Mill Co. shut down in 1999, the flow of water from the mill ceased and the channel to the settling basin was blocked off. The water quickly dried up, and.the area remains dry almost all of the time. Soil mining, however, has continued periodically and the area continues to be a depression. Following large rainfall events, surface runoff may accumulate in this depression and it may take a week or more to filter down into the ground, allowing it to dry out again. These ponding events are very infrequent.

Due to these circumstances it was deemed prudent to examine this site to evaluate the three parameters of vegetation, soil and hydrology following USACE Wetland Determination guidelines. A relatively undisturbed spot was selected in the lowest part of the depression to establish a sampling point.

RESULTS

An 18 inch deep soil pit was dug with a sharpshooter shovel and the hole was continued downward with a 3 inch auger to a depth of 54 inches. The soil was a uniformly loose, unstratified and well drained silty texture and had no indicators of a hydric soil. There were also no positive indicators of wetland hydrology. A nearby pit that had been dug by a backhoe revealed a water table at a depth of 6 feet. The vegetation had some facultative species that seemed to thrive on the deep, soft silty soil, but it was rated as non-hydophytic in character.

Overall this sampling point lacked any positive indicators of a wetland and was thus determined to be a non-wetland by USACE standards.

It has been noted that the U.S. Fish and Wildlife Service has classified much of this old silting basin as a Palustrine Emergent Wetland (National Wetland Inventory), but by USACE guidelines it clearly is not a wetland. The analysis for this sampling point is documented in the Wetland Determination Form that follows.

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands

Project/Site: Lahaina Bypass Corridor City: Lahaina Sampling Date: 2-19-12 Time: 1300

Applicant/Owner: ______ State/Terr.: HI Island: Maui Sampling Point: 1

Investigator(s): Robert W. Hobdy TMK/Parcel: (2)4-7-01:26&30

Landform (hillslope, coastal plain, etc.): Coastal Plain Local relief (concave, convex, none): Concave

Lat: 20.8343° N Long: 156.6399° W Datum: 8 ft. Slope (%): 0 - 1 %

Soil Map Unit Name: Stony Alluvial Land (rSM) NWI classification: none

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

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

Are Vegetation NO Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach 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: This is a highly altered site that was successively a cinder pit, a settling basin for effluent waters from Pioneer sugar mill, and more recently as a borrow pit for accumulated soils. It is presently a depression reaching down to 8 to 10 ft. above sea level that is partly overgrown with trees and grass.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 ft. radius)			
1. Pithecellobium dulce	90	Yes	FAC
2.			
3.			
4.			
5.			
	90	= Total Cover	
Sapling/Shrub Stratum (Plot size: 30 ft. radius)			
1. Pluchea carolinensis	5	Yes	FAC
2. Leucaena leucocephala	3	Yes	UPL
3. Pluchea indica	1	NO	FAC
4.			
5.			
	9	= Total Cover	
Herb Stratum (Plot size: 30 ft. radius)			
1. Megathyrsus maximus	20	Yes	FAC
2. Cenchrus ciliaris	2	NO	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	22	= Total Cover	
Woody Vine Stratum (Plot size: 30 ft. radius)			
1. Ipomoea indica	1	Yes	FACU
2.			
	1	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	116	x 3 = 348
FACU species	3	x 4 = 12
UPL species	3	x 5 = 15
Column Totals:	122 (A)	375 (B)

Prevalence Index = B/A = 3.07

Hydrophytic Vegetation Indicators:

NO 1 - Rapid Test for Hydrophytic Vegetation

Yes 2 - Dominance Test is >50%

NO 3 - Prevalence Index is ≤3.0[1]

NO 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:
When the FAC Neutral test is applied, the vegetation is clearly non-hydrophytic in character.

SOIL

Sampling Point: 1

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

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-38	2.5YR 6/2	100	—	—	—	—	silt	unstratified, pale red
38-54	2.5YR 3/1	100	—	—	—	—	Loamy silt	unstratified, dark reddish gray

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

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

Hydric Soil Indicators:

___ Histosol (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: none
Depth (inches): ______

Hydric Soil Present? Yes ______ No X

Remarks: This silty, unstratified soil is the result of years of the settling out of effluent from Pioneer Mill. Soil mining has removed some of this accumulation leaving a depression. Excavation of one small spot with a back hoe revealed a permanent water table at a depth of 6 feet beneath the Lowest surface level. This is not a hydric soil.

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 Tilled 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)
___ 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:
No primary or secondary wetland hydrology indicators were found.

Wetland Plot 1a – Portion of old silting basin overgrown with ‘opiuma (Pithecellobium dulce). Shovel marks the Location of Sampling Point 1.

Wetland Plot 1b – Soils developed from silting pond sediment. Unstratified soils included dry silt from 0 – 38 inches and Loamy Silt from 38 to 54 inches.

Waters of the U.S. Analysis

The term Waters of the U.S. covers a broad range of aquatic features that include both marine and freshwater resources. These could be ocean waters, near shore waters, estuaries, freshwater streams, lakes, reservoirs and wetlands. Wetlands are technically a subset of Waters of the U.S. but have their own defining parameters and analysis process. A survey of this project area revealed two types of potential aquatic features that needed examination. These included the above potential wetland which has been analyzed in this report, and a number of drainage channels which must be traversed by the proposed highway. Twelve drainage channels and their watersheds were identified that span the length of the project area (see Figure 5). Four of these drainages were large enough to have enough storm flow to have a connection to the sea through culverts under the old cane haul road and the Honoapi'ilani Highway . The other eight were insignificant in flow size and most of their sheetflow runoff is captured by three tiers of old plantation ditch berms that arrests downslope flow. All these waters percolate into the landscape.

The four larger drainage channels were analyzed using the Approved Jurisdictional Determination Form guidelines. These analyses follow this discussion.

RESULTS

Drainageways 7, 9 and 16 have been identified as ephemeral drainage channels with annual flow rates estimated at 10 days/year, 10 days/year and 3 days/year respectively, these periods only following large rainfall events. Each of these channels runs through culverts under the cane haul road and Honoapi'ilani Highway and flows directly into the ocean. Each of these ephemeral streams demonstrates a clear nexus with a Traditional Navigable Water (the Pacific Ocean) and each was found to be a Jurisdictional Waters of the U.S.

Drainageway 13 – Launiupoko Stream is the largest of the streams in the project corridor. It originates deep in the West Maui Mountains and is fed by both rainfall and artesian groundwaters. The stream has perennial flow in the upper valley, but only flows for about 1.5 miles before it is intercepted by a diversion that channels the stream down to an old plantation reservoir that dates from the early 1900s. Below the diversion there is almost no stream flow and none of it reaches the ocean except following large rainfall events. This stream in reality is a perennial stream that is reduced to a defacto ephemeral stream in its lower reach.

Launiupoko Stream is proposed to be a Jurisdictional Ephemeral Non-RPW Waters of the U.S. over the entire 6,000 foot length of its Relevant Reach in lower Launiupoko Valley (see Figure 9).

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: HAWAII County/parish/borough: MAUI City: LAHAINA

Center coordinates of site (lat/long in degree decimal format): Lat. 20.8486° N, Long. 156.6563° W.

Universal Transverse Mercator:

Name of nearest waterbody: PACIFIC OCEAN

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: PACIFIC OCEAN

Name of watershed or Hydrologic Unit Code (HUC): Drainage Way 1 - Unnamed Tributary (= DRAINAGE 7 in revised report Nov.2013)

☐ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc...) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.

☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

- ☐ TNWs, including territorial seas
- ☐ Wetlands adjacent to TNWs
- ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
- ☒ Non-RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
- ☐ Impoundments of jurisdictional waters
- ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: 2,600linear feet: 5 width (ft) and/or 867 acres.

Wetlands: NONE acres.

c. Limits (boundaries) of jurisdiction based on: **Not Applicable.**

Elevation of established OHWM (if known): NO VISIBLE OHWM.

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.

[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

---

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is:
☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts
☐ Cobbles
☐ Bedrock
☐ Other. Explain: .
☐ Sands
☐ Gravel
☐ Vegetation. Type/% cover:
☐ Concrete
☐ Muck

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:

Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
  ☐ clear, natural line impressed on the bank
  ☐ changes in the character of soil
  ☐ shelving
  ☐ vegetation matted down, bent, or absent
  ☐ leaf litter disturbed or washed away
  ☐ sediment deposition
  ☐ water staining
  ☐ other (list):
  ☐ the presence of litter and debris
  ☐ destruction of terrestrial vegetation
  ☐ the presence of wrack line
  ☐ sediment sorting
  ☐ scour
  ☐ multiple observed or predicted flow events
  ☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
  ☐ oil or scum line along shore objects
  ☐ fine shell or debris deposits (foreshore)
  ☐ physical markings/characteristics
  ☐ tidal gauges
  ☐ other (list):
☐ Mean High Water Mark indicated by:
  ☐ survey to available datum;
  ☐ physical markings;
  ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.). Explain: .
Identify specific pollutants, if known: .

---

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: This ephemeral Stream flows from a dry rocky gulch with a watershed of 867 acres, and an annual rainfall of 15 inches near the coast and increasing to 75 inches at the top. The relevant reach extends from the Pacific Ocean upstream 2,600 feet to the first stream branch. Winter storms bring sufficient rainfall to make the stream flow for two or three days, three to five times a year. The water passes under the old cane haul road and Honoapiilani Highway through culverts and enters the ocean along a rocky coastline. This stream is ephemeral in flow characteristics but has the capacity to carry floodwaters and pollutants directly into a TNW. This small stream demonstrates a clear nexus with the Pacific Ocean and is thus determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☒ Tributary waters: **2,600** linear feet **6** width (ft).
☐ Other non-wetland waters: **NO** acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

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[8] See Footnote # 3.

[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

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

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

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

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: U.S.G.S. Olowalu Quad Map.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☐ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name: HAWAII.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .
  or ☒ Other (Name & Date): SEE ATTACHED.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .

Drainageway 7 – Dry stream bed traversing a parched pasture from an 867 acre watershed. Channel passes through 2 culverts before entering the ocean.

Drainageway 7 – Culvert passing under the cane haul road

Drainageway 7 – Channel passing through parched pastures above Honoapiilani Highway.
Note manmade berms on either side.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: HAWAII County/parish/borough: MAUI City: LAHAINA

Center coordinates of site (lat/long in degree decimal format): Lat. 20.8461 ° **N**, Long. 156.6541° **W**.

Universal Transverse Mercator:

Name of nearest waterbody: PACIFIC OCEAN

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: PACIFIC OCEAN

Name of watershed or Hydrologic Unit Code (HUC): Drainageway 2 - Unnamed Tributary (= Drainage 9 in revised report Nov.2013)

☐ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. *[Required]*

☐ Waters subject to the ebb and flow of the tide.

☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. *[Required]*

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☒ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: 2,450 linear feet: 5 width (ft) and/or 791 acres.

Wetlands: none acres.

c. Limits (boundaries) of jurisdiction based on: **Not Applicable.**

Elevation of established OHWM (if known): NO VISIBLE OHWM .

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.

[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
Identify TNW: **N/A.**

Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

(i) **General Area Conditions:**
Watershed size: **Pick List**
Drainage area: **Pick List**
Average annual rainfall: inches
Average annual snowfall: inches

(ii) **Physical Characteristics:**
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☐ Tributary flows through **Pick List** tributaries before entering TNW.

Project waters are **Pick List** river miles from TNW.
Project waters are **Pick List** river miles from RPW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Project waters are **Pick List** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: .
Tributary stream order, if known: .

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is:
☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts
☐ Cobbles
☐ Bedrock
☐ Other. Explain: .
☐ Sands
☐ Gravel
☐ Vegetation. Type/% cover:
☐ Concrete
☐ Muck

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
  ☐ clear, natural line impressed on the bank
  ☐ changes in the character of soil
  ☐ shelving
  ☐ vegetation matted down, bent, or absent
  ☐ leaf litter disturbed or washed away
  ☐ sediment deposition
  ☐ water staining
  ☐ other (list):
  ☐ the presence of litter and debris
  ☐ destruction of terrestrial vegetation
  ☐ the presence of wrack line
  ☐ sediment sorting
  ☐ scour
  ☐ multiple observed or predicted flow events
  ☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
  ☐ oil or scum line along shore objects
  ☐ fine shell or debris deposits (foreshore)
  ☐ physical markings/characteristics
  ☐ tidal gauges
  ☐ other (list):
☐ Mean High Water Mark indicated by:
  ☐ survey to available datum;
  ☐ physical markings;
  ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

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[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.

[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: This ephemeral stream flows from a dry rocky gulch with a watershed of 791 acres, and an annual rainfall of 15 inches near the coast and increasing to 75 inches at the top. The relevant reach extends from the Pacific Ocean upstream 2,450 feet to the first stream branch. Winter storms bring sufficient rainfall to make the stream flow for two to three days, three to five times a year. The water passes under the old cane haul road and Honoapi'ilani Highway through culverts and enters the ocean along a rocky coastline. This stream is ephemeral in flow characteristics but has the capacity to carry floodwaters and pollutants directly into a TNW. This small stream demonstrates a clear nexus with the Pacific Ocean and is thus determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):

☐ Tributary waters: linear feet width (ft).

☐ Other non-wetland waters: acres.

Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**

☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):

☐ Tributary waters: **2,450** linear feet **5** width (ft).

☐ Other non-wetland waters: **NO** acres.

Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**

☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.

☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**

☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**

☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**

As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.

☐ Demonstrate that impoundment was created from "waters of the U.S.," or

☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or

☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

---

[8] See Footnote # 3.

[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

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

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
  Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

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

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: U.S.G.S. OLOWALU QUAD MAP.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☐ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name: HAWAII.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): SEE ATTACHED.
  or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

Drainageway 9 – Looking mauka at the channel from the cane haul road.

Drainageway 9 – Passing through dry pastures above the cane haul road. Note manmade berms on either side.

Drainageway 2 – Looking makai at culvert under cane haul road which is just above Honoapi'ilani Highway and the ocean.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State:HAWAII County/parish/borough: MAUI City: LAHAINA

Center coordinates of site (lat/long in degree decimal format): Lat. 20.8342° N, Long. 156.6452° W.

Universal Transverse Mercator:

Name of nearest waterbody: PACIFIC OCEAN

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: PACIFIC OCEAN

Name of watershed or Hydrologic Unit Code (HUC): Drainage Way 3 - Launiupoko Stream (= DRAINAGE 13 in revised report Nov2013)

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.

☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☒ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: 6,000 linear feet: 10 width (ft) and/or 1,587 acres.

Wetlands: NONE acres.

c. Limits (boundaries) of jurisdiction based on: **Established by OHWM.**

Elevation of established OHWM (if known): 10 inches.

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.

[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW
Identify TNW: .

Summarize rationale supporting determination: .

2. Wetland adjacent to TNW
Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:
Watershed size: **Pick List**
Drainage area: **Pick List**
Average annual rainfall: inches
Average annual snowfall: inches

(ii) Physical Characteristics:
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☐ Tributary flows through **Pick List** tributaries before entering TNW.

Project waters are **Pick List** river miles from TNW.
Project waters are **Pick List** river miles from RPW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Project waters are **Pick List** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: .
Tributary stream order, if known: .

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is:
☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts
☐ Cobbles
☐ Bedrock
☐ Other. Explain: .
☐ Sands
☐ Gravel
☐ Vegetation. Type/% cover:
☐ Concrete
☐ Muck

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
  ☐ clear, natural line impressed on the bank
  ☐ changes in the character of soil
  ☐ shelving
  ☐ vegetation matted down, bent, or absent
  ☐ leaf litter disturbed or washed away
  ☐ sediment deposition
  ☐ water staining
  ☐ other (list):
  ☐ the presence of litter and debris
  ☐ destruction of terrestrial vegetation
  ☐ the presence of wrack line
  ☐ sediment sorting
  ☐ scour
  ☐ multiple observed or predicted flow events
  ☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
  ☐ oil or scum line along shore objects
  ☐ fine shell or debris deposits (foreshore)
  ☐ physical markings/characteristics
  ☐ tidal gauges
  ☐ other (list):
☐ Mean High Water Mark indicated by:
  ☐ survey to available datum;
  ☐ physical markings;
  ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

---

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
  ☐ Discrete wetland hydrologic connection. Explain: .
  ☐ Ecological connection. Explain: .
  ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed:

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: LAUNIUPOKO STREAM IS 4.5 MILES LONG. AT ITS HEADWATERS DEEP IN THE WEST MAUI MOUNTAINS IT IS A PERENNIAL STREAM. A STREAM INTAKE DATED FROM THE EARLY 1900'S DIVERTED ALL OF THE NORMAL FLOW OF THIS STREAM INTO A DITCH FOR SUGARCANE IRRIGATION. DOWNSTREAM FROM THE INTAKE THE STREAM ONLY FLOWS FOR A FEW DAYS A YEAR FOLLOWING LARGE RAINFALL EVENTS WHEN THE WATER OVERTOPS THE INTAKE SPILLWAY. THE RELEVANT REACH FOR THIS PROJECT LIES ENTIRELY WITHIN THIS DEWATERED STREAM COURSE. LAUNIUPOKO STREAM IS PROPOSED TO BE A JURISDICTIONAL EPHEMERAL NON-RPW WATERS OF THE U.S. IN ITS ENTIRE RELEVANT REACH .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**

☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. Non-RPWs[8] that flow directly or indirectly into TNWs.

☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☒ Tributary waters: **6,000** linear feet **10** width (ft).
☐ Other non-wetland waters: **NONE** acres.
Identify type(s) of waters: .

4. Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.

☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.

☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.

☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.

☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. Impoundments of jurisdictional waters.[9]

As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

---

[8] See Footnote # 3.

[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

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

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

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

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: U.S.G.S. OLOWALU QUAD MAP .
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☐ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name: HAWAII.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .
  or ☒ Other (Name & Date): (SEE ATTTACHED).
☐ Previous determination(s). File no. and date of response letter: .

☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .


Drainageway 13 – Looking mauka up Launiupoko Stream Channel from cane haul bridge. Dry rocky stream bed.


Drainageway 13 – Launiupoko dry stream bed where it passes under the Launiupoko cane haul road bridge.

Drainageway 13 – Launiupoko stream channel passing under Honoapi'ilani Highway on to the beach.

Drainageway 13 – Launiupoko Stream channel exiting directly into the sea.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: HAWAII County/parish/borough: MAUI City: LAHAINA

Center coordinates of site (lat/long in degree decimal format): Lat. 20.8324° N, Long. 156.6388° W.

Universal Transverse Mercator:

Name of nearest waterbody: PACIFIC OCEAN

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: PACIFIC OCEAN

Name of watershed or Hydrologic Unit Code (HUC): Drainage Way 4 - Unnamed Tributary (= DRAINAGE 16 in revised report Nov.2013)

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.

☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.

☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☒ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: 2,400 linear feet: 4 width (ft) and/or 265 acres.

Wetlands: NONE acres.

c. Limits (boundaries) of jurisdiction based on: **Not Applicable.**

Elevation of established OHWM (if known): NO VISIBLE OHWM.

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.

[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **N/A.**

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) General Area Conditions:
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

---

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☐ Natural
☐ Artificial (man-made). Explain:
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts
☐ Cobbles
☐ Bedrock
☐ Other. Explain: .
☐ Sands
☐ Gravel
☐ Vegetation. Type/% cover:
☐ Concrete
☐ Muck

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank
☐ changes in the character of soil
☐ shelving
☐ vegetation matted down, bent, or absent
☐ leaf litter disturbed or washed away
☐ sediment deposition
☐ water staining
☐ other (list):
☐ the presence of litter and debris
☐ destruction of terrestrial vegetation
☐ the presence of wrack line
☐ sediment sorting
☐ scour
☐ multiple observed or predicted flow events
☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):
☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

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[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: This ephemeral Stream flows from a low elevation rocky gulch with a watershed of 265 acres, and an annual rainfall of 15 inches near the coast and increasing to 40 inches at the top. The relevant reach extends from the Pacific Ocean upstream 2,400 feet to the first stream branch. Winter storms bring sufficient rainfall to make the stream run for 1 to 2 days, one to three times a year. The water passes under the old cane haul road and Honoapi'ilani Highway through culverts and enters the ocean along a rocky coastline. This stream is ephemeral in stream flow characteristics, but has the capacity to carry floodwaters and pollutants directly into a TNW. This small stream demonstrates a clear nexus with the Pacific Ocean and is thus determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: **2,400** linear feet **4** width (ft).
☐ Other non-wetland waters: **NO** acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

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[8] See Footnote # 3.

[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

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

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based <u>solely</u> on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the <u>sole</u> potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

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

<u>SECTION IV: DATA SOURCES.</u>

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: U.S.G.S. OLOWALU QUAD MAP.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☐ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name: HAWAII.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .
  or ☒ Other (Name & Date): SEE ATTACHED.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

Drainageway 16 – This 265 acre watershed drains the south side of Pu'u Hipa.

Drainageway 16 – Channel flows through this culvert under the cane haul road, through another box culvert under Honoapi'ilani Highway and directly into the ocean to the left of the kiawe tree.

APPENDIX F.

Department of Army Jurisdictional Determination

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

October 23, 2014

SUBJECT: Approved Jurisdictional Determination for Lahaina Bypass Relocation of the Southern Terminus Project, Phase 1B-2, Corps File No. POH-2007-00099

Mr. Darell Young
State of Hawaii, Department of Transportation
Highways Division
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Young:

The Honolulu District, U.S. Army Corps of Engineers (Corps) is in receipt of your request for an approved Jurisdictional Determination (AJD), dated June 25, 2013, for Launiupoko Stream and a number of unnamed tributaries/drainage features located within the proposed Lahaina Bypass Relocation of the Southern Terminus Project, Phase 1B-2 study area near the town of Lahaina on the Island of Maui, Hawaii (TMK Nos. (2) 4-7-001:026 and 030 and (2) 4-7-013:002, 005, 008, 010, and 011). We have assigned Corps File No. POH-2007-00099 to this action. Please refer to this file number in all future correspondence with our office on this project.

As background, the Corps issued an AJD on November 19, 2009 to the State of Hawaii, Department of Transportation, Highways (HDOT) for four different unnamed tributaries (gulches) and the perennial Kaua'ula Stream as part of the planning, design, and construction of the Lahaina Bypass Relocation of the Southern Terminus Project, Phase 1B-1 segment (located between Lahainaluna Road and Hoki'oki'o Place). These unnamed tributaries (gulches) occurring within the Phase 1B-1 segment study area were generically identified in the Corps' 2009 AJD as "Lahaina Bypass Drainages 1, 2, 3, and 4". We determined these tributaries to be isolated waters pursuant to the 2001 Supreme Court decision in the *Solid Waste Agency of Northern Cook County* (SWANCC) *v. Corps* and therefore, not under the regulatory jurisdiction of the Corps. To avoid confusion with the additional unnamed drainages under consideration in this new AJD for the Lahaina Bypass Southern Terminus Relocation Project, Phase 1B-2 segment we have referred to these drainage features as Lahaina Bypass Drainages 5 through 16, including Launiupoko Stream (Drainage Feature 13).

Pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344; "Section 404") we completed our review of your June 25, 2013 JD request letter, the *Aquatic Resource Survey for the Lahaina Bypass Corridor Project* (Hobdy, 2012 and revised version dated October 2013), the draft environmental assessment entitled *Proposed Relocation of the Lahaina Bypass Southern Terminus* (HDOT, 2012), and the additional information we received from your agent in November 2013. Based on the aforementioned documents and our March 13, 2014 site visit, we have determined there are waters of the United

States within the project area, as well as non-jurisdictional aquatic features in the review area, as depicted on the enclosed maps (Enclosure 1). The basis for our determination can be found in the enclosed summary table (Enclosure 2) and is documented in the JD forms included in the project's administrative record. Therefore, in accordance with Section 404, a DA permit will be required for any activity that would result in the discharge of dredged and/or fill material below the ordinary high water mark established for each of the jurisdictional waterways, namely Drainage Features 7, 9, 13 (Launiupoko Stream), and 16.

This letter contains an approved JD that identifies the basis for asserting jurisdiction. The approved JD is valid for a period of five (5) years unless new information warrants revision of the determination before the expiration date. If you object to this determination, you may request an Administrative Appeal under 33 CFR Part 331. We have enclosed a Notification of Appeal Process and Request for Appeal (NAP/RFA) form (Enclosure 3). If you request to appeal this determination you must submit a completed RFA form, according to instructions in the RFA, to the Corps' Pacific Ocean Division office at the following address:

Cindy Barger, Appeals Review Officer
U.S. Army Corps of Engineers
Pacific Ocean Division, ATTN: CEPOD-PDC
Building 525
Fort Shafter, Hawaii 96858-5440

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact Susan A. Meyer at (808) 835-4599 or via e-mail at susan.a.meyer@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

Michelle Lynch

Michelle R. Lynch
Chief, Regulatory Office

Enclosures

Copy Furnished (via email w/o enclosures):
Mr. Rory Frampton, Makila Land Company, LLC

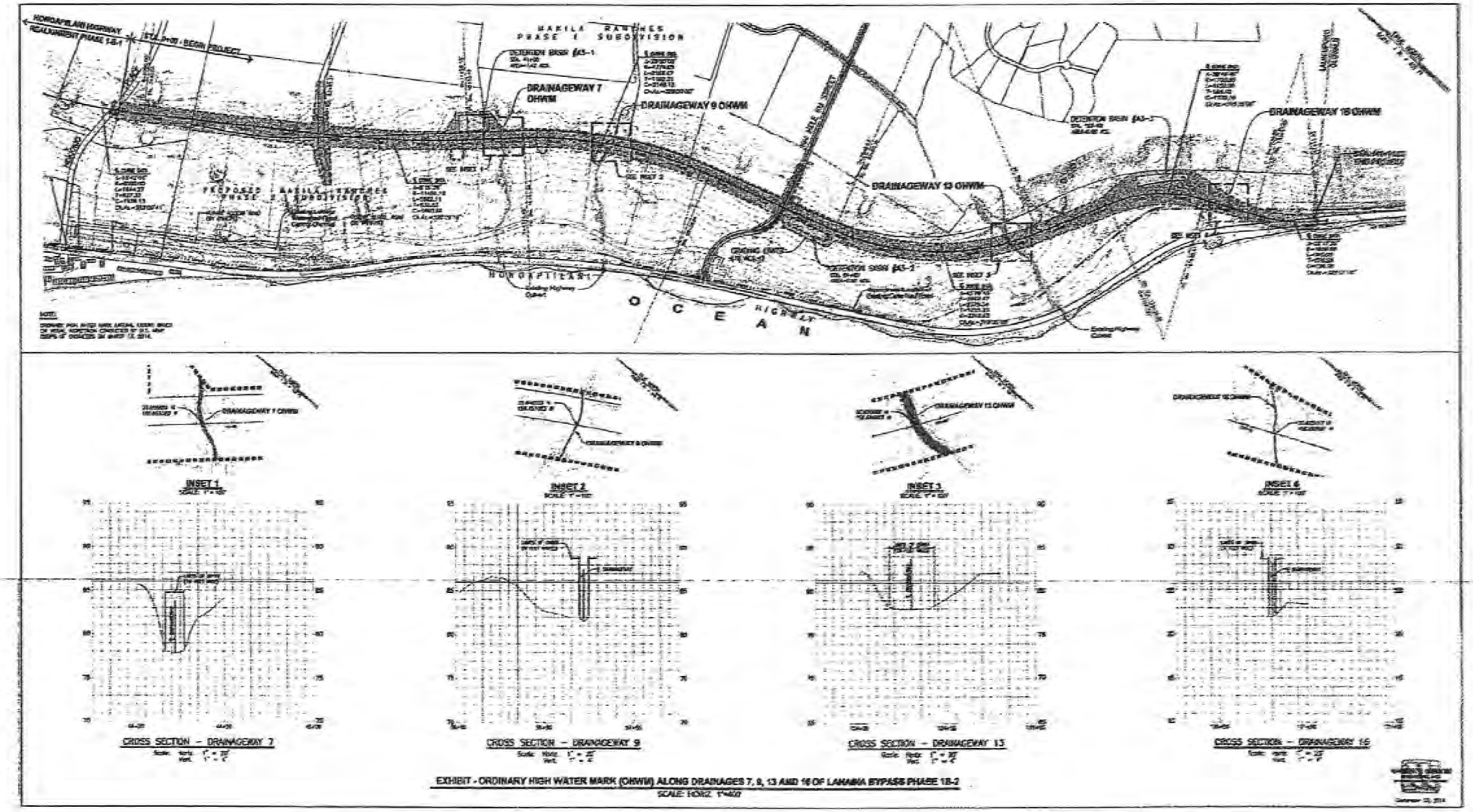
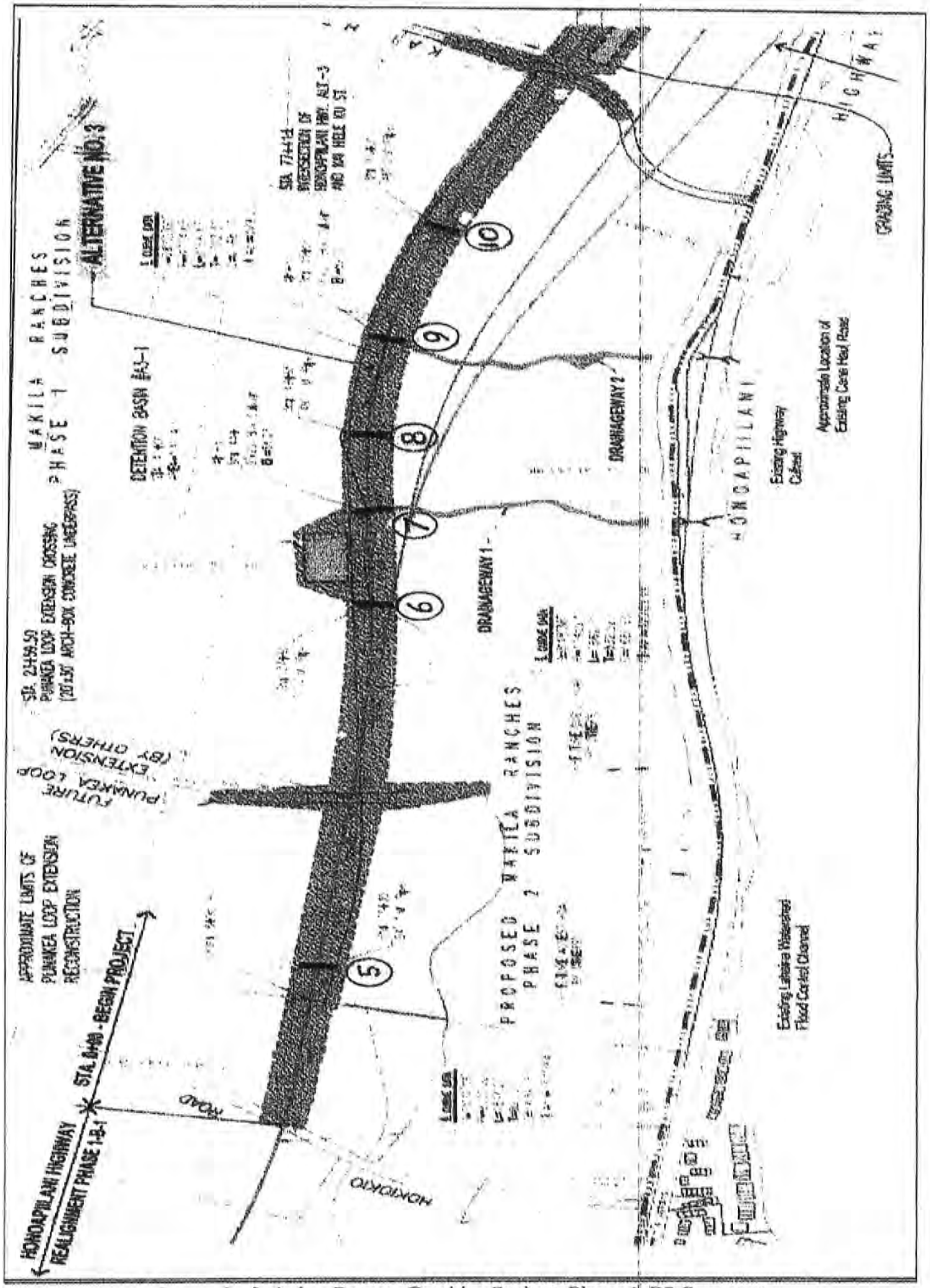


EXHIBIT - ORDINARY HIGH WATER MARK (OHWM) ALONG DRAINAGES 7, 9, 13 AND 16 OF LAHAINA BYPASS PHASE 1B-2
SCALE: HORIZ. 1"=400'

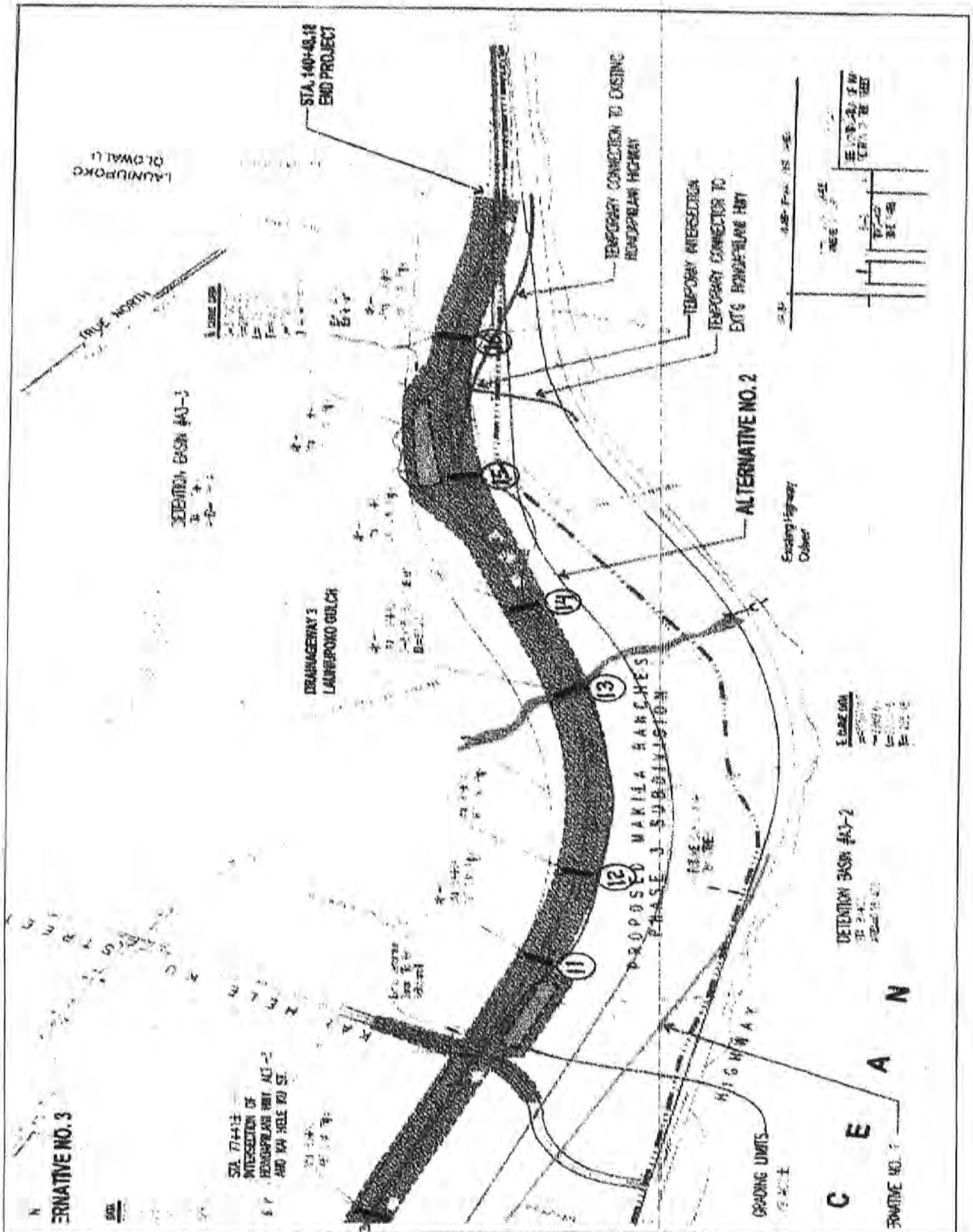
ENCLOSURE 1

Maps of Aquatic Resources within Review Area and OHWM of Jurisdictional Waters of the U.S.



Lahaina Bypass Corridor Project, Phase 1-B2 Segment
Drainage Engineering Plan – Northern Half

ENCLOSURE 1
Maps of Aquatic Resources within Review Area and OHWM of Jurisdictional Waters of the U.S.



Lahaina Bypass Corridor Project, Phase 1B-2 Segment
Drainage Engineering Plan – Southern Half

Summary of Jurisdictional Status of Waters of the United States

Lahaina Bypass Corridor Project – Phase IB-2, Lahaina, Island of Maui, HI

(Corps File No. POH-2007-00099)

October 2014

Drainage Name	Location		Aquatic Resource Type	Basis of Jurisdictional Determination[1]	Authority	
	Latitude	Longitude			Sect. 404	Sect. 10
Drainage 5	20.8581	-156.6556	Swale	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 6	20.8522	-156.6546	Erosional feature	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 7	20.8511	-156.6532	Non-wetland WoUS; non-RPW	Non-RPW with a direct surface hydrologic connection to a TNW and a significant nexus to the TNW	X	
Drainage 8	20.8499	-156.6522	Swale	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 9	20.8348	-156.6510	Non-wetland WoUS; non-RPW	Non-RPW with a direct surface hydrologic connection to a TNW and a significant nexus to the TNW	X	
Drainage 10	20.8346	-156.6502	Swale	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 11	20.8407	-156.6455	Swale	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 12	20.8390	-156.6347	Swale	No discernible bed and bank, lacks evidence of an OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 13—Launiupoko Stream	20.8336	-156.3446	Non-wetland WoUS; non-RPW	Non-RPW with a direct surface hydrologic connection to a TNW and a significant nexus to the TNW	X	
Drainage 14	20.8350	-156.6430	Erosional feature	No discernible bed and bank, lacks evidence of OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 15	20.3267	-156.6386	Erosional feature	No discernible bed and bank, lacks evidence of OHWM; not a WoUS per 33 CFR 328.3 and 2008 Rapanos guidance		
Drainage 16	20.8526	-156.6285	Non-wetland WoUS; non-RPW	Non-RPW with a direct surface hydrologic connection to a TNW and a significant nexus to the TNW	X	

[1] All approved jurisdictional determinations have been documented using the HQUSACE "Approved Jurisdictional Determination Form" and, where required by agency guidance, preliminary/draft determinations for non-RPWs that required a significant nexus evaluation were coordinated with U.S. EPA Region IX prior to the issuance of the approved JD. All final JD forms are included in the administrative record for Corps File No. POH-2007-00099.

Non-RPW = non-relatively permanent water
OHWM = ordinary high water mark
TNW = Traditional Navigable Water
WoUS = waters of the United States

ENCLOSURE 2
Summary of Basis for Jurisdictional Determination, POH-2007-00099

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **Darell Young, State of Hawaii, Department of Transportation, Highways Division**	File Number: **POH-2007-00099**	Date: **October 23, 2014**

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of Permission)	B
	PERMIT DENIAL	C
XX	**APPROVED JURISDICTIONAL DETERMINATION**	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A. INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district commander. Your objections must be received by the district commander within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district commander will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district commander will send you a proffered permit for your reconsideration, as indicated in Section B below.

B. PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

C. PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

D. APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.**
- **APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.**

E. PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:

Honolulu District, U.S. Army Corps of Engineers
Regulatory Office, CEPOH-RO
Building 230
Fort Shafter, Hawaii 96858-5440
Phone: (808) 835-4303

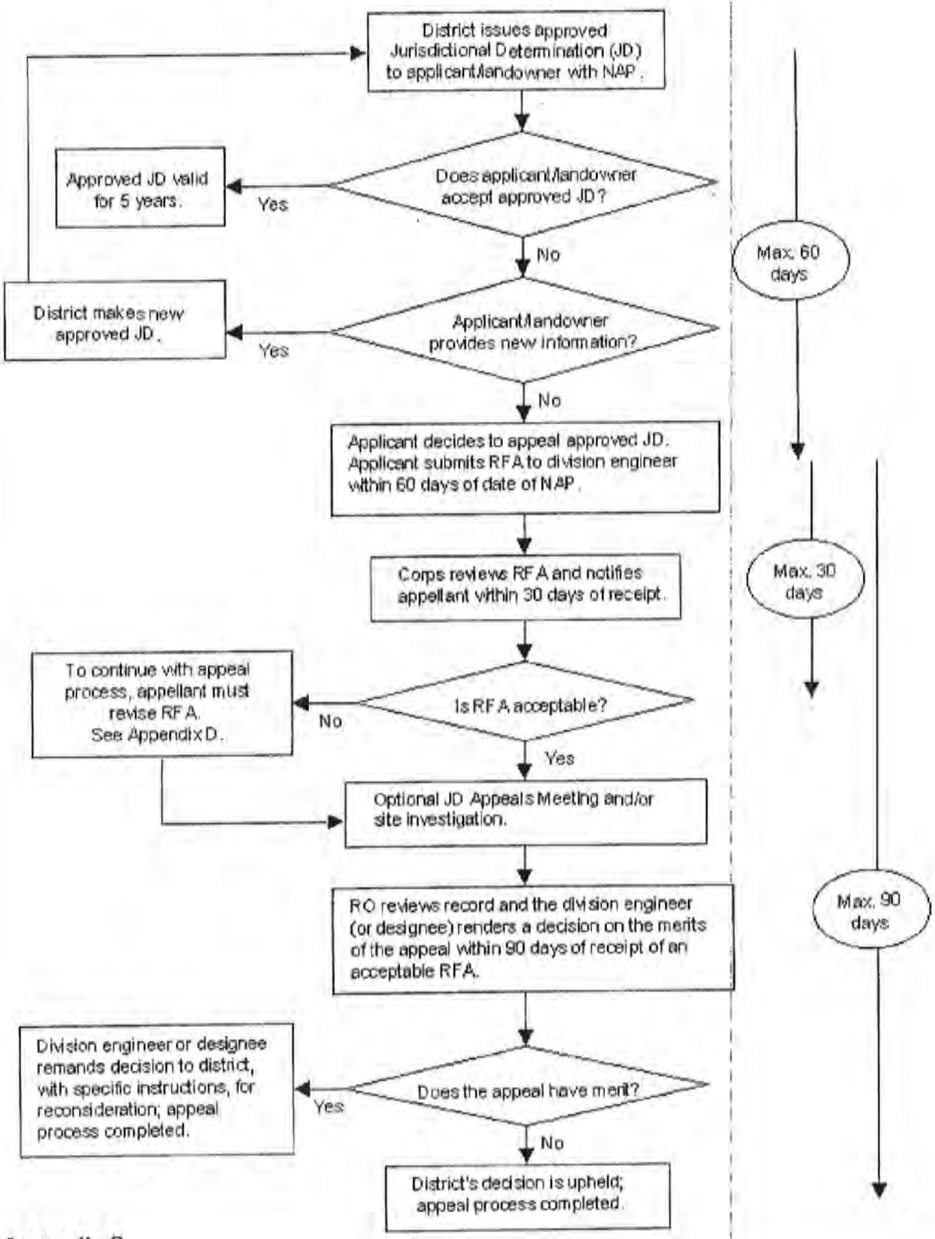
If you only have questions regarding the appeal process you may also contact:

Pacific Ocean Division, U.S. Army Corps of Engineers
Cindy Barger, Appeals Review Officer, CEPOD-PDC
Building 525
Fort Shafter, Hawaii 96858-5440
Phone: (808) 835-4626

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Commanders personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15-day notice of any site investigation, and will have the opportunity to participate in all site investigations.

____________________________ Signature of appellant or agent.	Date:	Telephone number:

Administrative Appeal Process for Approved Jurisdictional Determinations



Appendix C

APPENDIX G.

Acoustic (Noise) Study

ACOUSTIC STUDY FOR THE PROPOSED LAHAINA BYPASS - SOUTHERN TERMINUS PROJECT
LAUNIUPOKO, MAUI, HAWAII

Prepared for:

MAKILA LAND COMPANY, LLC

Prepared by:

Y. EBISU & ASSOCIATES
1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

JULY 2013

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CHAPTER I. SUMMARY

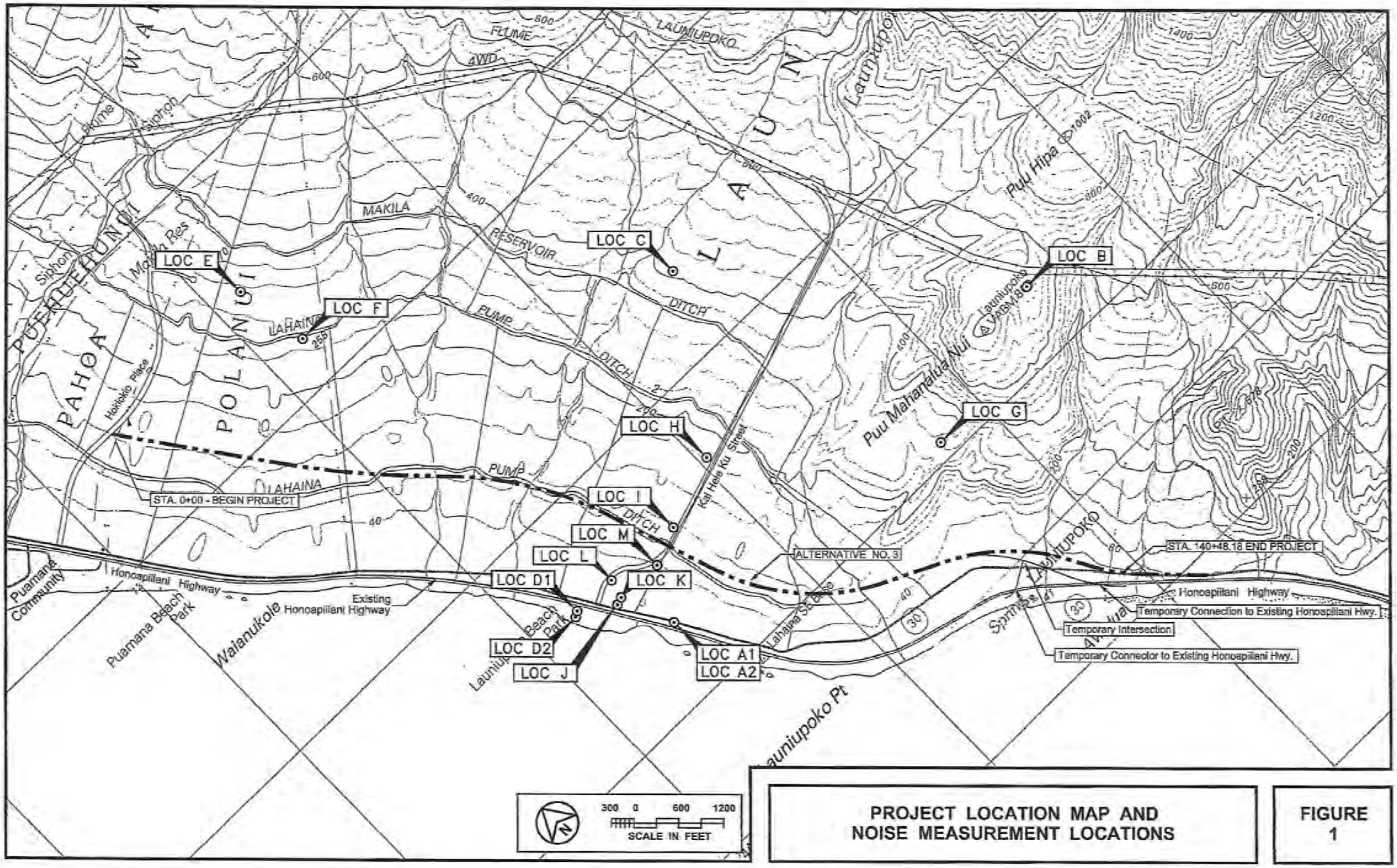
The existing and future traffic noise levels in the environs of the proposed Lahaina Bypass - Southern Terminus Project in Launiupoko on the island of Maui were studied to evaluate potential noise impacts associated with the proposed relocation of the Lahaina Bypass Southern Terminus from Launiupoko to the vicinity of the former Olowalu Landfill (see Figure 1). Noise measurements were obtained, traffic noise predictions developed, and noise abatement alternatives evaluated. Two possible realignments (Alternatives 2 and 3) of the Lahaina Bypass were evaluated as alternatives to the previously planned alignment (Alternative 1) whose southern terminus is just south of Launiupoko Park (see Figure 2).

Existing traffic noise levels in the project area currently do not exceed the U.S. Federal Highway Administration (FHWA) and Hawaii State Department of Transportation, Highways Division (HDOT) noise abatement criteria along the Lahaina Bypass - Southern Terminus alignment. Future (CY 2035) traffic noise levels are expected to exceed the "66 Leq" HDOT noise abatement criteria for noise sensitive land uses along the mauka and makai Rights-of-Way of the Lahaina Bypass - Southern Terminus under the Build Alternatives. At some locations, along the mauka and makai Rights-of-Way, the "71 Leq" HDOT noise abatement criteria for commercial and industrial land uses will also be exceeded.

All three alignment alternatives (Alternatives 1 through 3) will result in similar traffic noise levels along their Rights-of-Way because the CY 2035 traffic volumes, mixes, and speeds were assumed to be identical among the alternatives. At the north end of the project from Hokiokio Place to the Puamana extension makai from Punakea Loop, the traffic noise levels are the same for all three alternatives because the three bypass alignments coincide in that area (see Figure 2). The Alternative 1 alignment coincides with the original Lahaina Bypass alignment, while Alternatives 2 and 3 present alternate extensions of the bypass highway's southern terminus at Honoapiilani Highway. Alternatives 2 and 3 will also extend the traffic noise levels from the bypass toward the south beyond the original terminus at Launiupoko Beach Park. Because the lots which are crossed by Alternatives 2 and 3 are currently vacant and undeveloped, traffic noise impacts associated with both Alternatives 2 and 3 are avoidable. The alignment of Alternative 3 has been adjusted further toward the west which increases the buffer distance to the closest lot were a noise sensitive dwelling unit is presently under development.

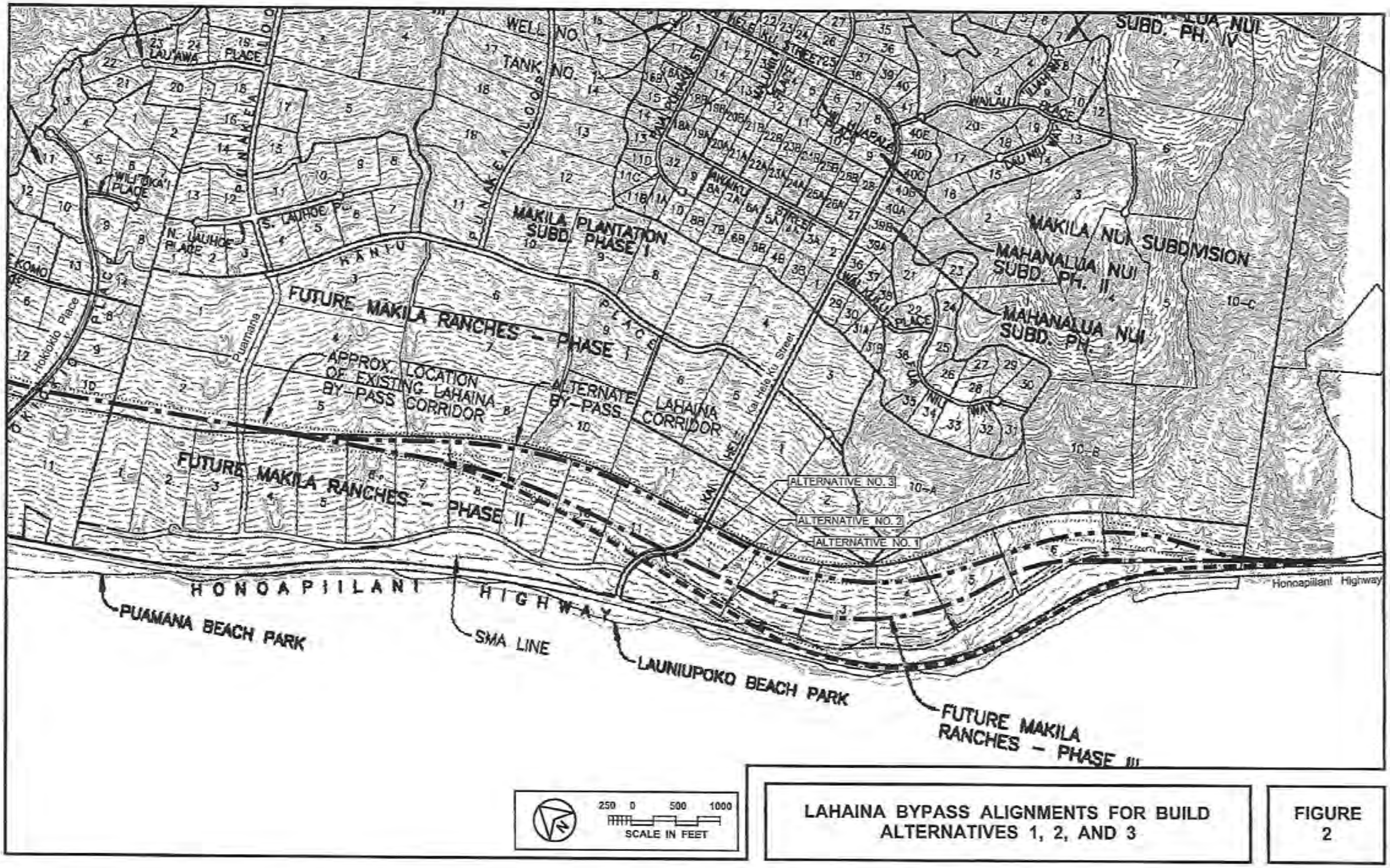
The following general conclusions can be made in respect to the number of impacted structures and lands which can be expected by CY 2035 under the Preferred Alternative 3. These conclusions are valid as long as the future vehicle volumes, mixes, and average speeds do not differ from the assumed values.

- The HDOT's ">15 dB increase" criteria for substantial change in traffic noise levels will not be exceeded at any existing or planned noise sensitive structure for which a Maui County Building Permit is pending. Increases in existing back-



PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

FIGURE 1



LAHAINA BYPASS ALIGNMENTS FOR BUILD ALTERNATIVES 1, 2, AND 3

FIGURE 2

ground noise levels by 15 dB or more will typically occur at the first row of lots which front the mauka and makai sides of the bypass alignment.

- Because the first row of lots which front the proposed Alternative 3 alignment are currently undeveloped and have no noise sensitive or other development pending for those lots, traffic noise mitigation measures along the Preferred Alternative 3 are not required by current HDOT noise policy and abatement guidelines.

- There are two lots which are closest to the proposed Alternative 3 alignment and which have dwellings on or planned for those lots. Future CY 2035 traffic noise levels at these two lots are predicted to be less than the "66 Leq" criteria level for residences. Future traffic noise levels are predicted to exceed the "15 dB increase" criteria at the western regions of these two lots. Existing or permit applications for noise sensitive structures on these two lots do not appear to warrant traffic noise abatement measures.

- The existing Launiupoko and Puamana Beach Parks and existing residences of the Puamana Community south of Hokiokio Place should experience lower future traffic noise levels under Alternatives 1, 2, or 3 than exist currently. This is because all three alternatives will displace the high volume traffic (and its associated noise levels) inland and away from Honoapiilani Highway and Launiupoko Beach Park to the Lahaina Bypass. North of Hokiokio Place, traffic noise levels along Honoapiilani Highway may be 1 dB higher than was measured in 2012, but should be identical under all three alternatives.

- Current HDOT noise abatement policy requires that a minimum number (75 percent) of noise impacted receptors within the first row of lots fronting the highway benefit from at least 7 dB of sound attenuation if sound attenuation walls are to be included in a highway project. While other requirements (cost, opinions of affected property owners and tenants, and ability to design and construct the sound walls) must also be met, the lack of noise impacted receptors within the front row lots on the mauka and makai sides of the bypass eliminated the use of sound attenuating walls as a noise abatement measure on this project.

- No parks are located within the limits of project construction; therefore, none should be affected by the proposed project or require noise mitigation measures under the Build Alternative.

Potential short term construction noise impacts are possible during the project construction period primarily in the developed areas mauka of the Lahaina Bypass - Southern Terminus alignment. However, minimizing these types of noise impacts is possible using standard curfew periods, properly muffled equipment, administrative controls, and construction barriers as required.

CHAPTER II. GENERAL STUDY METHODOLOGY

Noise Measurements. Existing traffic and background ambient noise levels at fifteen locations in the project area were measured in October 2012. The traffic noise measurements were used to calibrate the traffic noise model which was used to calculate the Base Year (CY 2012) and future (CY 2035) traffic noise levels under three Build Alternatives. The background ambient noise measurements were used to define existing noise levels at receptors which may be affected by the project. Also, the measurements were used in conjunction with forecast traffic noise levels to determine if future traffic noise levels are predicted to "substantially exceed" existing background ambient noise levels at these receptors, and therefore exceed FHWA and HDOT noise standards and noise abatement criteria (see Reference 5).

The noise measurement locations ("A1," "A2," "B," "C," "D1," "D2," "E," "F," "G," "H," "I," "J," "K," "L," and "M") are shown in Figure 1. The results of the traffic and background noise measurements are summarized in Tables 1 and 2. In the tables, Leq represents the average (or equivalent), A-Weighted, Sound Level. A list and description of the acoustical terminology used are contained in Appendix B.

Traffic Noise Predictions. The Federal Highway Administration (FHWA) Traffic Noise Model, Version 2.5 (or TNM, see Reference 1) was used as the primary method of calculating Base Year and future traffic noise levels, with model parameters adjusted to reflect terrain, ground cover, and local shielding conditions. At all traffic noise measurement locations, the measured noise levels were compared with TNM model predictions to insure that measured and calculated noise levels for the existing conditions were consistent and in general agreement. As indicated in Table 1, spot counts of traffic volumes were also obtained during the measurement periods and were used to generate the Equivalent Sound Level (Leq) predictions shown in the table. The average vehicle speeds entered into the TNM were typically higher than posted speeds so as to achieve better agreement between measured noise levels and those calculated by the TNM. In addition, the TNM predictions were 1.8 dBA lower than actual measured traffic noise levels, and were scaled upward to achieve better agreement between measured and predicted results. With these input speed and TNM output scaling adjustments, the agreement between measured and predicted traffic noise levels was considered to be good and sufficiently accurate to formulate the Base Year and future year traffic noise levels.

Base Year traffic noise levels were estimated in the project environs using the October 2012 background noise and traffic volume data for the AM and PM peak hours shown in Tables 1 and 2. Traffic mix by vehicle types and average vehicle speeds for the various sections of the existing and future roadways were derived from observations during the October 2012 noise monitoring periods. Determinations of the periods of highest hourly traffic volumes and noise levels along the project corridor were made after reviewing the AM and PM peak hour traffic volumes and traffic noise level

TABLE 1
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	------- Hourly Traffic Volume -------			Measured Leq (dB)	Predicted Leq (dB)
			AUTO	M.TRUCK	H.TRUCK		
A1 50 FT from centerline of Honoapiilani Hwy. (10/2/12)	0700 TO 0800	45-N.Bound 55-S.Bound	1,472	37	40	72.6	72.6
A2 75 FT from centerline of Honoapiilani Hwy. (10/2/12)	0700 TO 0800	45-N.Bound 55-S.Bound	1,472	37	40	69.3	69.1
A1 50 FT from centerline of Honoapiilani Hwy. (10/2/12)	1544 TO 1644	40-N.Bound 50-S.Bound	1,874	45	30	72.0	71.9
A2 75 FT from centerline of Honoapiilani Hwy. (10/2/12)	1544 TO 1644	40-N.Bound 50-S.Bound	1,874	45	30	68.9	68.5
A1 50 FT from centerline of Honoapiilani Hwy. (10/3/12)	0700 TO 0800	43-N.Bound 53-S.Bound	1,457	45	40	72.2	72.1
A1 50 FT from centerline of Honoapiilani Hwy. (10/3/12)	1132 TO 1232	39-N.Bound 49-S.Bound	1,392	30	37	70.7	70.7
A1 50 FT from centerline of Honoapiilani Hwy. (10/3/12)	1545 TO 1645	38-N.Bound 48-S.Bound	1,882	40	26	71.3	71.3

TABLE 1 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

		Time of Day	Ave. Speed	------ Hourly Traffic Volume ------			Measured	Predicted
	LOCATION	(HRS)	(MPH)	AUTO	M.TRUCK	H.TRUCK	Leq (dB)	Leq (dB)
G	Vacant lot at south end of Pua Niu Way (10/3/12)	0700 TO 0715	43-N.Bound 53-S.Bound	1,457	45	40	43.2	41.8
H	105 FT from centerline of Kai Hele Ku St. (10/3/12)	0721 TO 0736	43-N.Bound 53-S.Bound	1,457	45	40	39.0	41.6 *
I	81 FT from centerline of Kai Hele Ku St. (10/3/12)	0743 TO 0758	43-N.Bound 53-S.Bound	1,457	45	40	43.5	45.2 *
J	90 FT from centerline of Honoapiilani Hwy. (10/3/12)	1133 TO 1148	39-N.Bound 49-S.Bound	1,392	30	37	66.7	66.9
K	200 FT from centerline of Honoapiilani Hwy. (10/3/12)	1149 TO 1204	39-N.Bound 49-S.Bound	1,392	30	37	54.4	60.5
L	90 FT from centerline of Kai Hele Ku St. (10/3/12)	1207 TO 1222	39-N.Bound 49-S.Bound	1,392	30	37	47.2	54.9 *
M	30 FT from centerline of Kai Hele Ku St. (10/3/12)	1228 TO 1243	39-N.Bound 49-S.Bound	1,392	30	37	49.7	48.3 *

TABLE 1 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

		Time of Day	Ave. Speed	------ Hourly Traffic Volume ------			Measured	Predicted
	LOCATION	(HRS)	(MPH)	AUTO	M.TRUCK	H.TRUCK	Leq (dB)	Leq (dB)
G	Vacant lot at south end of Pua Niu Way (10/3/12)	1545 TO 1600	38-N.Bound 48-S.Bound	1,882	40	26	39.6	41.5
H	105 FT from centerline of Kai Hele Ku St. (10/3/12)	1607 TO 1622	38-N.Bound 48-S.Bound	1,882	40	26	36.5	41.3 *
I	81 FT from centerline of Kai Hele Ku St. (10/3/12)	1626 TO 1641	38-N.Bound 48-S.Bound	1,882	40	26	42.8	44.8 *

NOTE:

* Preducted traffic noise level were based on traffic volumes shown for Honoapiilani Highway.

TABLE 2
TABULATION OF TRAFFIC AND BACKGROUND AMBIENT NOISE MEASUREMENT RESULTS

LOCATION: SITES AT LAHAINA BYPASS SOUTHERN TERMINUS EXTENSION
DATE: October 2, 2012

Start Time	End Time	LOC	Lmax	Leq	Lmin						Event Description
0700	0800	A1	88.6	72.6	43.3						
0700	0800	A2	85.2	69.3	40.4						
1545	1645	A1	84.2	72.0	48.1						
1545	1645	A2	81.7	68.9	44.7						
0831	0848	B	58.4	44.5	36.4						Distant construction noise. Otherwise, very low background noise.
0901	0916	C	58.7	38.9	27.2						Birds and distant trucks on highway are audible.
1017	1043	D1	79.9	62.7	52.8						Approx. 104 feet from highway C.L. Highway traffic noise.
1034	1041	D2	68.8	60.6	53.8						Approx. 194 feet from highway C.L. Surf plus highway traffic noise.
1111	1128	E	56.0	38.0	29.6						Birds and jet aircraft audible. Otherwise, very low background noise.
1132	1150	F	59.6	40.8	30.0						Local traffic & distant highway trucks audible. Otherwise, very low background noise.

Notes:

a. Leq = Average A-Weighted Sound Level (in dBA)
b. Lmax = Maximum A-Weighted Sound Level (in dBA)
c. Lmin = Minimum A-Weighted Sound Level (in dBA)

TABLE 2 (CONTINUED)
TABULATION OF TRAFFIC AND BACKGROUND AMBIENT NOISE MEASUREMENT RESULTS

LOCATION: SITES AT LAHAINA BYPASS SOUTHERN TERMINUS EXTENSION
DATE: October 3, 2012

Start Time	End Time	LOC	Lmax	Leq	Lmin		Delta	NLeq			Event Description
0700	0800	A1	91.4	72.2	47.0						
1132	1232	A1	85.5	70.4	45.1						
1545	1645	A1	92.7	71.3	46.5						
0700	0715	A1	88.0	72.4	48.2						
0721	0736	A1	85.9	72.3	48.2						
0743	0758	A1	91.4	72.3	52.3						
1133	1148	A1	83.2	70.3	45.8						
1149	1204	A1	85.4	71.0	45.1						
1207	1222	A1	83.8	70.4	47.4						
1228	1243	A1	87.3	71.0	47.8						
1545	1600	A1	83.3	71.1	46.5						
1607	1622	A1	92.7	71.1	52.3						
1626	1641	A1	86.5	71.7	52.9						
0700	0715	G	62.9	43.2	34.6		-29.2	43.4			
0721	0736	H	50.7	39.0	29.4		-33.3	39.3			Without traffic noise from Kai Hele Ku
0743	0758	I	56.9	43.5	35.0		-28.8	43.8			Without traffic noise from Kai Hele Ku
1133	1148	J	85.3	66.7	50.2		-3.6	69.0			
1149	1204	K	69.7	54.4	42.2		-16.6	56.0			
1207	1222	L	52.0	47.2	41.1		-23.2	49.4			Without traffic noise from Kai Hele Ku
1228	1243	M	61.7	49.7	42.5		-21.3	51.3			Without traffic noise from Kai Hele Ku
1545	1600	G	55.6	39.6	30.0		-31.5	41.1			
1607	1622	H	47.0	36.5	30.8		-34.6	38.0			Without traffic noise from Kai Hele Ku
1626	1641	I	54.9	42.8	36.9		-28.9	43.7			Without traffic noise from Kai Hele Ku

Notes:

a. Leq = Average A-Weighted Sound Level (in dBA)
b. Lmax = Maximum A-Weighted Sound Level (in dBA)
c. Lmin = Minimum A-Weighted Sound Level (in dBA)
d. Delta = Difference between sound level at measurement location and at Location A1.
e. NLeq = Leq Normalized to highest value of 72.6 dBA measured at Location A1 on 10/2/12 during AM peak hour.

TABLE 2 (CONTINUED)
TABULATION OF TRAFFIC AND BACKGROUND AMBIENT NOISE MEASUREMENT RESULTS

LOCATION: SITES AT LAHAINA BYPASS SOUTHERN TERMINUS EXTENSION
DATE: October 3, 2012

Start Time	End Time	LOC	Lmax	Leq	Lmin						Event Description
0700	0715	G	62.9	43.2	34.6						
0721	0736	H	62.3	45.8	29.4						Includes traffic noise from Kai Hele Ku
0743	0758	I	70.1	52.8	35.0						Includes traffic noise from Kai Hele Ku
0935	0950	D1	80.2	63.7	54.9						
1004	1019	C	58.8	40.9	28.1						
1027	1042	E	66.9	42.2	31.8						
1045	1100	F	64.4	47.4	32.3						
1133	1148	J	85.3	66.7	50.2						
1149	1204	K	69.7	54.4	42.2						
1207	1222	L	68.8	51.0	41.1						Includes traffic noise from Kai Hele Ku
1228	1243	M	82.9	60.9	42.5						Includes traffic noise from Kai Hele Ku
1545	1600	G	55.6	39.6	30.0						
1607	1622	H	73.3	52.1	30.8						Includes traffic noise from Kai Hele Ku
1626	1641	I	72.4	53.9	36.9						Includes traffic noise from Kai Hele Ku

Notes:

a. Leq = Average A-Weighted Sound Level (in dBA)
b. Lmax = Maximum A-Weighted Sound Level (in dBA)
c. Lmin = Minimum A-Weighted Sound Level (in dBA)

measurement results. For the purposes of this study, the AM peak hour (as indicated by the data in Table 1 was used to model the period with the highest traffic noise levels.

The Equivalent (or Average) Hourly Sound Level [Leq(h)] noise descriptor was used to calculate the Base Year and CY 2035 traffic noise levels as required by Reference 3. Aerial photo maps, topographic maps, and project highway plans and profiles (where available) were used to determine terrain, ground cover, and local shielding effects and distances from building structures, which were entered into the noise prediction model. Where topographic contours were not available, receptor elevations were estimated from the closest available elevation contours.

Future year (2035) traffic noise levels were then developed for the three Build (roadway improvement) Alternatives (see Figure 2) using the future traffic assignments of Reference 2. Under the three Build Alternatives, it was assumed that the proposed Lahaina Bypass - Southern Terminus could be constructed along one of the alignments shown in Figure 2. Build Alternative 1 depicts the location of the Lahaina Bypass - Southern Terminus as originally evaluated in Reference 4. Build Alternatives 2 and 3 extend the proposed southern terminus of the Lahaina Bypass further south. The future traffic volumes obtained from Reference 2 were identical for Build Alternatives 1, 2, and 3.

Forecast mixes of vehicle types were assumed to be identical for both existing and future traffic, and vehicle speeds for Year 2035 along existing roadways were assumed to be identical to their Base Year values. Future traffic speeds along the new sections of the Lahaina Bypass - Southern Terminus were modeled as 50 miles per hour to be consistent with the modeling assumptions of Reference 4. Modeled traffic speeds along the existing streets were assumed to be approximately 10 miles per hour greater than their posted speed limits. The No Action Alternative (i.e., no bypass highway) was not considered, but, for the purposes of this study, was represented by Build Alternative 1.

Impact Assessments and Mitigation. Following the calculation of the future traffic noise levels associated with the three Build Alternatives, evaluations of the future traffic noise levels and impacts at existing and potential receptor locations along the Lahaina Bypass - Southern Terminus and within the limits of project construction were made. Comparisons of predicted future traffic noise levels with FHWA and HDOT noise abatement criteria (see Table 3) were made to determine specific locations where the noise abatement criteria are expected to be exceeded.

The HDOT "equal to or greater than 66 Leq(h)" noise abatement criteria and the HDOT "equal to or greater than 15 dB increase" criteria were applied to all noise sensitive receptor locations (Category B in Table 3) in the project environs. By Reference 5, the HDOT has replaced the FHWA 67 Leq(h) criteria with their 66 Leq(h) criteria for noise sensitive receptors in Activity Categories B and C. Along the project roadway corridors, the locations of the 66 Leq(h) traffic noise contours, without the

TABLE 3

FHWA & HDOT NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level– –Decibels (dBA)]

ACTIVITY CATEGORY	LEQ (h) (Note 2)	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B (Note 1)	67 (Exterior)	Residential.
C (Note 1)	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non profit institutional structures, radio studios, recording studios, schools, and television studios.
E (Note 1)	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other develped lands, properties or activities not included in A–D or F.
F	– – – – – –	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	– – – – – –	Undeveloped lands that are not permitted.

Notes:

1. Includes undeveloped lands permitted for this activity category.
2. The Hawaii State Department of Transportation, Highways Division, utilizes Leq criteria levels which are 1 Leq unit less than the FHWA values shown.

benefit of shielding from natural terrain or man-made sound barriers, were also used to identify noise sensitive receptor locations where the HDOT's "66 Leq" noise abatement criteria would not be exceeded, and which would not require more detailed evaluations. In addition, the HDOT's criteria of "equal to or greater than 15 dB increase above existing background noise levels" was also used as a noise abatement criteria for this project within the limits of project construction (from Reference 5). At receptor locations where the "66 Leq" or "15 dB increase" noise abatement criteria were exceeded, future traffic noise mitigation measures were to be evaluated in accordance with the requirements of Reference 5.

The "71 Leq" criteria is also used as a noise abatement criteria for lands which are in commercial, industrial, hotel, etc. uses as indicated in Table 3. While these land uses are not planned along the project corridor, the location of the future 71 Leq traffic noise contours was included for completeness.

CHAPTER III. EXISTING ACOUSTICAL ENVIRONMENT

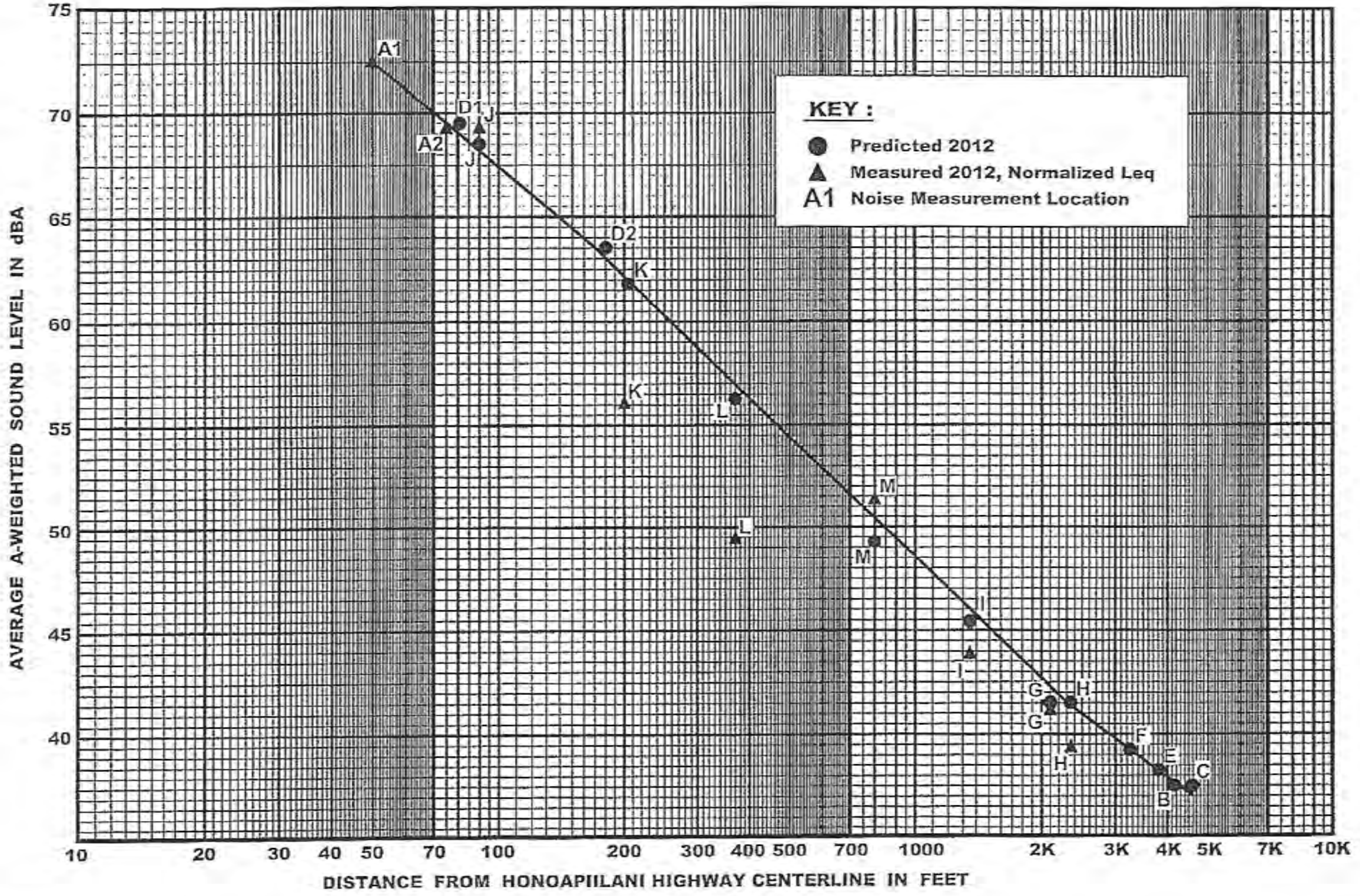
For the purposes of this study, 2012 was used as the Base Year for calculating changes in traffic noise levels associated with the future Build Alternatives. The Base Year noise environment along the project corridor was described by calculating the Hourly Equivalent Sound Level [Leq(h)] along the existing roadways during the AM peak traffic hour for the 2012 time period. The hourly sound level, expressed in decibels, represents the average level of traffic noise along the project roadway during the peak traffic hour of the study's Base Year.

Reference 2 did not provide existing or Base Year traffic volumes along the existing sections of Honoapiilani Highway, Kai Hele Ku Street, or Hokiokio Place. For this reason, traffic and background ambient noise measurements obtained in October 2012 at locations shown in Figure 1 were used to describe existing noise levels in the project environs. As indicated in Table 1 and Figure 3, measured noise levels along Kai Hele Ku Street and at the inland mauka locations correlated with predicted existing traffic noise levels from Honoapillani Highway. The predicted noise levels shown in Figure 3 were normalized to the highest hourly traffic noise level of 72.6 Leq measured at Location A1. This implied that the existing traffic on Honoapiilani Highway was the dominant background noise source in the project environs.

At the existing Launiupoko Beach Park, Puamana Community, and Puamana Beach Park, existing traffic noise levels exceed 66 Leq at approximately 90 feet from the highway centerline. These areas represent the existing noise sensitive land uses on the makai side of Honoapiiilani Highway in the project environs. While the planned Makila Ranches, Phase I, Phase II, and Phase III subdivisions are located along the alternate alignments for the Lahaina Bypass, they are all currently undeveloped.

Along the proposed bypass alignments between Hokioko Place and the southern terminus at Honoapiilani Highway, the existing lands are primarily undeveloped with several new homes located within the Makila Plantation - Phase I and 2 Subdivisions. There are no commercial or light industrial buildings along the corridor of the proposed Lahaina Bypass - Southern Terminus. Existing background noise levels along the proposed bypass corridors are controlled by traffic along Honoapiilani Highway, which ranges from approximately 72.6 Leq to 48.5 Leq at 50 and 1,000 feet distances from the highway centerline. Figure 3 depicts the measured and predicted background noise levels at various locations as a function of their distances from the centerline of Honoapiilani Highway. The existing traffic noise levels do not exceed the 66 Leq criteria for Activity Categories B and C (see Table 3) at approximately 128 feet from the centerline of Honoapiilani Highway. At existing residences closest to the proposed bypass corridors, existing background noise levels are less than 45 Leq because these residences are located at least 1,740 feet from the existing highway centerline.

Existing traffic noise levels exceed the 66 Leq criteria for Activity Category C at the Puamana Beach Park and Puamana Community lands which are located makai



NORMALIZED EXISTING TRAFFIC NOISE LEVELS VS. DISTANCES
FROM THE CENTERLINE OF HONOAPIILANI HIGHWAY

FIGURE
3

(west) of the existing Honoapiilani Highway. Existing traffic noise levels exceed 66 Leq within the parking lot area of Launiupoko Beach Park, but do not exceed 66 Leq within the picnic and beach areas of the park. It should be noted that the Lahaina Bypass project should reduce existing traffic noise levels along Honoapiilani Highway between Hokiokio Place and the southern terminus.

CHAPTER IV. DESCRIPTION OF FUTURE TRAFFIC NOISE LEVELS

The future traffic noise levels in the immediate vicinity of the project during CY 2035 were evaluated for Build Alternatives 1 through 3. The FHWA TNM was used to calculate the Year 2035 traffic noise levels using forecasted traffic volumes contained in Reference 2. For all three alternatives, the 20 percent diversion scenario was assumed, and vehicle volumes, mixes and average speeds along the Lahaina Bypass were assumed to be identical. Appendix C contains the AM and PM traffic volume forecasts for 2035 under the 20 Percent Diversion Scenario. Modeled traffic speeds along the Lahaina Bypass were 50 miles per hour (mph), 40 mph along Hokiokio Place and along Kai Hele Ku Street, and 47 mph along Honoapiilani Highway. Figure 2 depicts the three alternative alignments, with Alternative 3 (Figure 4) being the preferred extension of the southern terminus of the Lahaina Bypass.

Table 4 summarizes the traffic volumes, mixes, and noise levels at 75, 100, and 200 feet distance from the roadways' centerlines. The AM peak hour was used to model future traffic noise levels based on the results of the October 2012 sound level measurements. Table 5 provides the setback distances to the 66 and 71 Leq contours for the three alternatives during the AM peak hour in CY 2035. Both Table 4 and Table 5 results were based on flat earth and unobstructed lines of sight between the roadway lanes and the receptor locations, and do not account for noise shielding effects associated with terrain features (such as highway cuts or earth berms) or man made structures (such as buildings and walls). Tables 4 and 5 were used to estimate the future traffic noise levels at various distances from the three bypass alignments and to identify potential locations where the 66 Leq noise abatement criteria could be exceeded along the three bypass alignments. Because the existing and planned land uses in the immediate vicinity of the three bypass alignments are residential rather than commercial, the 66 Leq criteria for Activity Category B (see Table 3) was used for this project. Receptor locations along the preferred Alternative 3 where future traffic noise levels were calculated and evaluated are shown in Figure 4.

In addition to the 66 Leq criteria, the HDOT "equal to or greater than 15 dB increase" criteria was also used to identify receptor locations where future traffic noise impacts could occur under the three bypass alternatives. Receptor locations along the preferred Alternative 3 where future traffic noise levels were predicted to exceed existing background noise levels by at least 15 dB were identified as possible noise impact areas using the HDOT "equal to or greater than 15 dB increase" criteria. The existing traffic noise level vs. distance curve shown in Figure 3 was used to estimate existing background noise levels at the various receptor locations.

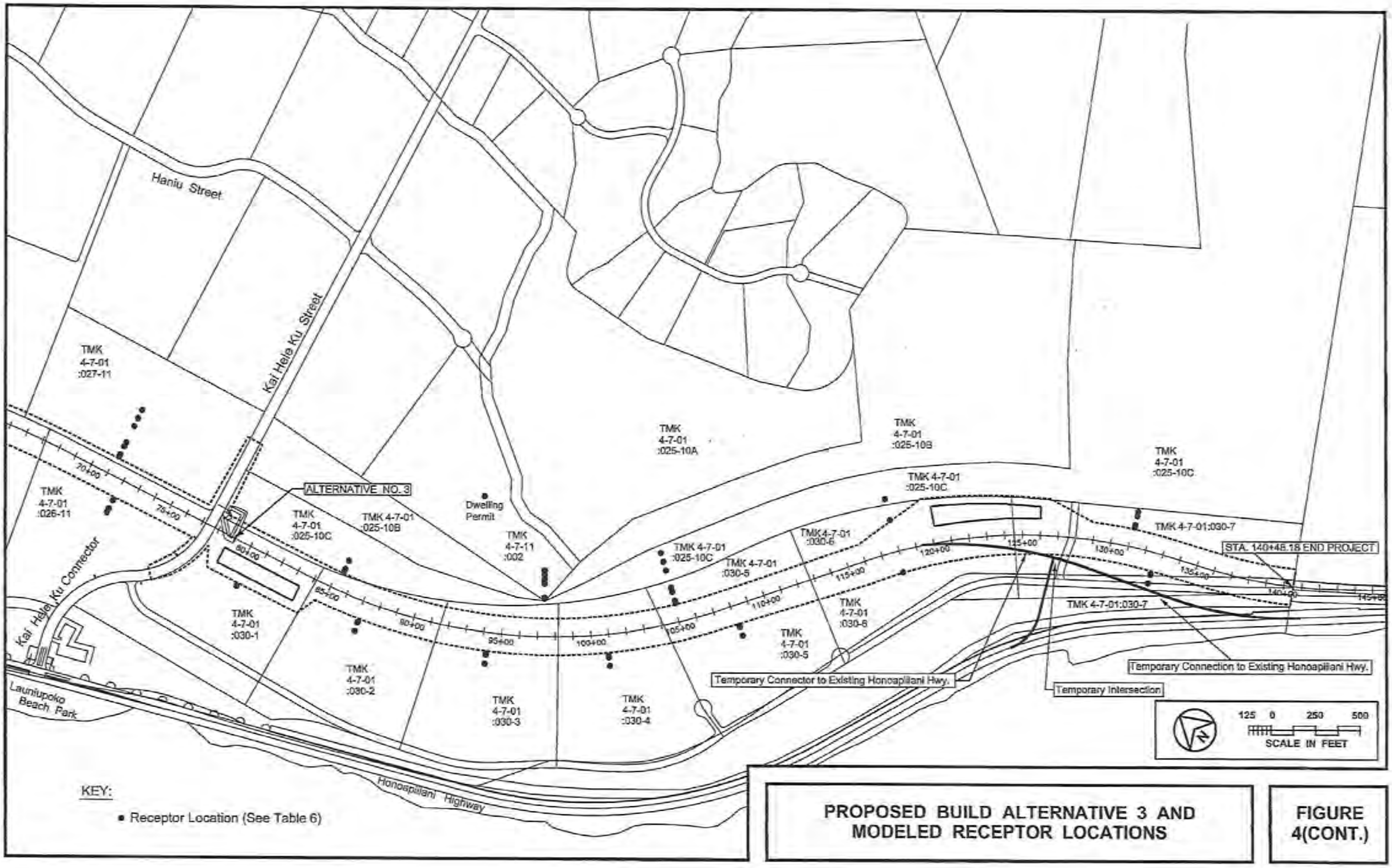
Figure 4 depicts the preferred Alternative 3 alignment's relationship to the adjacent lands mauka and makai of the alignment. Also shown in Figure 4 are the Tax Map Key's of the Makila Ranches (Phases I, II, and III) Subdivision, which is currently

KEY:

● Receptor Location (See Table 6)

PROPOSED BUILD ALTERNATIVE 3 AND MODELED RECEPTOR LOCATIONS

FIGURE 4



PROPOSED BUILD ALTERNATIVE 3 AND MODELED RECEPTOR LOCATIONS

FIGURE 4(CONT.)

TABLE 4

FUTURE (CY 2035) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS WITH 20% DIVERSION

(AM PEAK HOUR, ALTERNATIVES 1 THROUGH 3)

	SPEED	TOTAL	********* VOLUMES (VPH) ***********					
LOCATION	(MPH)	VPH	AUTOS	M TRUCKS	H TRUCKS	75' Leq	100' Leq	200' Leq
Honoapiilani Hwy. N. of Hokiokio Connector	47	1,965	1,863	51	51	69.6	66.9	61.0
Honoapiilani Hwy. Between Hokiokio & Kai Hele Ku	47	480	456	12	12	63.4	60.8	54.8
Honoapiilani Hwy. Between Kai Hele Ku & Bypass	47	400	380	10	10	62.6	60.0	54.0
Honoapiilani Hwy. S of Lahaina Bypass	50	3,595	3,409	93	93	75.2	71.6	65.1
Lahaina Bypass N. of Hokiokio Connector	50	1,728	1,638	45	45	72.0	68.7	61.9
Lahaina Bypass Between Hokiokio & Kai Hele Ku	50	3,271	3,101	85	85	74.8	71.4	64.7
Lahaina Bypass Between Kai Hele Ku & Honoapiilani	50	3,215	3,047	84	84	74.7	71.4	64.6
Hokiokio Connector E. of Lahaina Bypass	40	17	17	0	0	43.5	40.8	34.4
Hokiokio Con. Between Bypass & Honoapiilani	40	1,547	1,490	34	23	64.4	61.8	55.9
Kai Hele Ku E. of Lahaina Bypass	40	225	217	5	3	55.9	53.3	47.4
Kai Hele Ku Between Bypass & Honoapiilani	40	24	23	1	0	45.8	43.1	37.0

Notes:

1. Assumed traffic mix on Honoapiilani Highway and Lahaina Bypass: 94.8% automobiles; 2.6% medium trucks; and 2.6% heavy trucks.
2. Assumed traffic mix on Hokiokio Place and Kai Hele Ku Street: 96.3% automobiles; 2.2% medium trucks; and 1.5% heavy trucks.

TABLE 5

YEAR 2035 DISTANCES TO 66 AND 71 LEQ CONTOURS (20% DIVERSION; AM PEAK HOUR)

STREET SECTION	66 LEQ SETBACK (FT)	71 LEQ SETBACK (FT)
Honoapiilani Hwy. N. of Hokiokio Connector	111	65
Honoapiilani Hwy. Between Hokiokio & Kai Hele Ku	56	32
Honoapiilani Hwy. Between Kai Hele Ku & Bypass	51	30
Honoapiilani Hwy. S of Lahaina Bypass	182	107
Lahaina Bypass N. of Hokiokio Connector	132	82
Lahaina Bypass Between Hokiokio & Kai Hele Ku	175	104
Lahaina Bypass Between Kai Hele Ku & Honoapiilani	173	104
Hokiokio Connector E. of Lahaina Bypass	7	4
Hokiokio Con. Between Bypass & Honoapiilani	63	36
Kai Hele Ku E. of Lahaina Bypass	25	14
Kai Hele Ku Between Bypass & Honoapiilani	9	5

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See Table 4 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.

being developed. Receptor locations where future traffic noise levels were calculated using the FHWA TNM are also shown in Figure 4 as solid circles within each of the subdivision lots. Figure 4 also includes the closest locations where an existing dwelling unit (TMK 4-7-03 :026) and future structures with pending building permit applications (TMK 4-7-03 :026 and TMK 4-7-11 :002) are located in relationship to the preferred Alignment 3. The pending building permit for TMK 4-7-03 :026 is for a "shade house", and the pending building permit for TMK 4-7-11 :002 is for a dwelling and detached garage, whose locations are marked in Figure 4.

Table 6 presents the predicted traffic noise levels at various receptor locations along the Lahaina Bypass - Southern Terminus Extension, Alternative 3. The locations of these receptors are shown in Figure 4, and are identified as being either mauka (east) or makai (west) of the bypass, and with distances (in feet) from the highway centerline. Also included in Table 6 are the existing background noise levels at the receptor locations. In Table 6, the traffic noise level contributions from both the Lahaina Bypass - Southern Terminus Extension are combined with the traffic noise levels from the intersecting connector roads at receptor locations near the two connector roads. From Tables 5 and 6, it was concluded that the HDOT "66 Leq" noise abatement criteria will typically be exceeded at 133 to 200+ feet from the bypass highway's centerline, or within approximately 33 to 100 feet of the Right-of-Way. From Table 6, it was concluded that the HDOT "15 dB increase" criteria may be exceeded at up to 600+ feet from the bypass highway's centerline, or within 500+ feet of the Right-of-Way at the Hokiokio Place end of the project. As the bypass highway approaches Honoapiilani Highway at the south end of the project, as well as on the makai side of the bypass highway (where the existing noise levels from Honoapiilani Highway are higher) the "15 dB increase" criteria will typically not be exceeded at 300 feet setback distances from the highway centerline.

It should be noted that the receptor locations in Table 6 which were identified where the HDOT "66 Leq" noise abatement criteria would be exceeded are all presently located on undeveloped lands, with no building permits pending or issued as of the date of this noise study. By current HDOT noise policy (Reference 5), these receptor location where 66 Leq are exceeded should all be considered as being in Category G ("Undeveloped land that are not permitted") as indicated in Table 3. For this reason, it was concluded that the preferred Alternative 3 should not result in future traffic noise levels which equal or exceed 66 Leq at noise sensitive receptor locations in Category B.

For those receptor locations shown in Figure 4 where the "15 dB increase" criteria may be exceeded, only two lots (TMK: 4-7-03 :026 and TMK: 4-7-11 :002) contain existing dwellings or planned dwellings where building permit applications are pending. All of the remaining lots on the mauka and makai sides of the preferred Alignment 3 where the "15 dB increase" criteria is exceeded are in Category G. Within these two potentially affected lots, the predicted future traffic noise levels at the existing and future dwelling units were also determined to not exceed the "15 dB increase" criteria. A building permit for a new 80 feet x 160 feet "shade house" supported by

TABLE 6

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS ALTERNATIVE 3 WITH 20 PERCENT DIVERSION (4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq	
LAHAINA BYPASS (MAUKA, BETWEEN HOKIOKO PL. AND PUAMANA):			
Receiver 4-7-03:027 @ 110'	43.7	72.1 /28.4	(1)
Receiver 4-7-03:027 @ 125'	43.6	71.3 /27.7	(1)
Receiver 4-7-03:027 @ 175'	43.4	69.3 /25.9	(1)
Receiver 4-7-03:027 @ 200'	43.3	67.7 /24.4	(1)
Receiver 4-7-03:027 @ 300'	42.8	63.1 /20.3	(2)
Receiver 4-7-03:027 @ 400'	42.4	59.5 /17.1	(2)
Receiver 4-7-03:026 @ 500'	42.0	57.3 /15.3	(2)
Receiver 4-7-03:026 @ 600'	41.7	55.9 /14.2	
Receiver 4-7-01:027-2 @ 110'	43.6	71.3 /27.7	(1)
Receiver 4-7-01:027-2 @ 125'	43.5	70.4 /26.9	(1)
Receiver 4-7-01:027-2 @ 175'	43.3	68.0 /24.7	(2)
Receiver 4-7-01:027-2 @ 200'	43.2	66.9 /23.7	(2)
Receiver 4-7-01:027-2 @ 300'	42.8	63.4 /20.6	(2)
Receiver 4-7-01:027-2 @ 400'	42.3	60.4 /18.1	(2)
Receiver 4-7-01:027-2 @ 500'	42.0	58.2 /16.2	(2)
Receiver 4-7-01:027-2 @ 600'	41.5	56.8 /15.3	(2)
Receiver 4-7-01:027-2 @ 700'	41.3	55.6 /14.3	
LAHAINA BYPASS (MAUKA, BETWEEN PUAMANA AND KAI HELE KU ST.):			
Receiver 4-7-01:027-5 @ 110'	45.1	71.5 /26.4	(1)
Receiver 4-7-01:027-5 @ 125'	45.0	70.6 /25.6	(1)
Receiver 4-7-01:027-5 @ 175'	44.7	68.0 /23.3	(1)
Receiver 4-7-01:027-5 @ 200'	44.6	67.0 /22.4	(1)
Receiver 4-7-01:027-5 @ 300'	44.1	63.1 /19.0	(2)
Receiver 4-7-01:027-5 @ 400'	43.6	60.3 /16.7	(2)
Receiver 4-7-01:027-5 @ 500'	43.1	58.6 /15.5	(2)
Receiver 4-7-01:027-5 @ 550'	42.9	57.8 /14.9	
Receiver 4-7-01:027-8 @ 110'	44.9	68.9 /24.0	(1)
Receiver 4-7-01:027-8 @ 125'	44.8	67.5 /22.7	(1)
Receiver 4-7-01:027-8 @ 175'	44.5	65.1 /20.6	(2)
Receiver 4-7-01:027-8 @ 200'	44.4	63.9 /19.5	(2)
Receiver 4-7-01:027-8 @ 300'	43.9	61.1 /17.2	(2)
Receiver 4-7-01:027-8 @ 350'	43.7	60.0 /16.3	(2)
Receiver 4-7-01:027-8 @ 400'	43.4	59.1 /15.7	(2)
Receiver 4-7-01:027-8 @ 450'	43.2	57.9 /14.7	

TABLE 6 (CONTINUED)

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS ALTERNATIVE 3 WITH 20 PERCENT DIVERSION (4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq
LAHAINA BYPASS (MAUKA, BETWEEN PUAMANA AND KAI HELE KU ST.):		
Receiver 4-7-01:027-10 @ 110'	45.3	70.9 /25.6 (1)
Receiver 4-7-01:027-10 @ 125'	45.2	69.8 /24.6 (1)
Receiver 4-7-01:027-10 @ 175'	44.9	65.9 /21.0 (2)
Receiver 4-7-01:027-10 @ 200'	44.8	65.6 /20.8 (2)
Receiver 4-7-01:027-10 @ 300'	44.3	62.3 /18.0 (2)
Receiver 4-7-01:027-10 @ 350'	44.0	60.9 /16.9 (2)
Receiver 4-7-01:027-10 @ 400'	43.8	59.6 /15.8 (2)
Receiver 4-7-01:027-10 @ 450'	43.5	58.2 /14.7
Receiver 4-7-01:027-11 @ 110'	46.4	69.8 /23.4 (1)
Receiver 4-7-01:027-11 @ 125'	46.3	67.3 /21.0 (1)
Receiver 4-7-01:027-11 @ 175'	46.0	66.0 /20.0 (1)
Receiver 4-7-01:027-11 @ 200'	45.8	65.4 /19.6 (2)
Receiver 4-7-01:027-11 @ 300'	45.2	62.7 /17.5 (2)
Receiver 4-7-01:027-11 @ 350'	44.9	60.5 /15.6 (2)
Receiver 4-7-01:027-11 @ 400'	44.7	58.6 /13.9
LAHAINA BYPASS (MAUKA, BETWEEN KAI HELE KU ST. AND HONOAPIILANI HWY.)		
Receiver 4-7-01:025-10C @ 110'	48.5	66.5 /18.0 (1)
Receiver 4-7-01:025-10C @ 125'	48.3	65.0 /16.7 (2)
Receiver 4-7-01:025-10C @ 175'	47.9	62.5 /14.6
Receiver 4-7-11:002 @ 220'	47.2	66.1 /18.9 (1)
Receiver 4-7-11:002 @ 300'	46.7	63.3 /16.6 (2)
Receiver 4-7-11:002 @ 325'	46.5	62.4 /15.9 (2)
Receiver 4-7-11:002 @ 350'	46.3	61.7 /15.4 (2)
Receiver 4-7-11:002 @ 375'	46.2	61.1 /14.9
Receiver 4-7-01:030-5 @ 110'	47.9	71.9 /24.0 (1)
Receiver 4-7-01:030-5 @ 125'	47.8	70.6 /22.8 (1)
Receiver 4-7-01:030-5 @ 175'	47.4	67.6 /20.2 (1)
Receiver 4-7-01:030-5 @ 200'	47.2	66.5 /19.3 (1)
Receiver 4-7-01:025-10C @ 300'	46.5	64.1 /17.6 (2)
Receiver 4-7-01:025-10C @ 350'	46.2	62.1 /15.9 (2)
Receiver 4-7-01:025-10C @ 400'	45.9	60.8 /14.9
Receiver 4-7-01:030-6 @ 10' Away from ROW	49.2	65.6 /16.4 (2)
Receiver 4-7-01:025-10C @ 300'	48.1	62.4 /14.3

TABLE 6 (CONTINUED)

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS
ALTERNATIVE 3 WITH 20 PERCENT DIVERSION
(4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq	
LAHAINA BYPASS (MAUKA, BETWEEN KAI HELE KU ST. AND HONOAPIILANI HWY.):			
Receiver 4-7-01:030-7 @ 110'	53.7	70.1 /16.4	(1)
Receiver 4-7-01:030-7 @ 125'	53.5	68.9 /15.4	(1)
Receiver 4-7-01:030-7 @ 175'	52.8	66.6 /13.8	(1)
Receiver 4-7-01:030-7 @ 200'	52.4	65.4 /13.0	
LAHAINA BYPASS (MAKAI, BETWEEN HOKIOKO PL. AND PUAMANA):			
Receiver 4-7-03:027 @ 120'	44.8	70.1 /25.3	(1)
Receiver 4-7-03:027 @ 125'	44.9	69.7 /24.8	(1)
Receiver 4-7-03:027 @ 175'	45.1	67.5 /22.4	(1)
Receiver 4-7-03:027 @ 200'	45.3	66.3 /21.0	(1)
Receiver 4-7-03:027 @ 300'	45.9	62.4 /16.5	(2)
Receiver 4-7-03:028 @ 375'	46.5	58.5 /12.0	
Receiver 4-7-01:026-1 @ 135'	44.9	64.3 /19.4	(2)
Receiver 4-7-01:026-1 @ 175'	45.1	63.1 /18.0	(2)
Receiver 4-7-01:026-1 @ 200'	45.2	62.7 /17.5	(2)
Receiver 4-7-01:026-1 @ 300'	45.5	60.6 /15.1	(2)
Receiver 4-7-01:026-1 @ 350'	46.0	59.8 /13.8	
Receiver 4-7-01:026-2 @ 135'	44.9	64.9 /20.0	(2)
Receiver 4-7-01:026-2 @ 175'	45.1	63.9 /18.8	(2)
Receiver 4-7-01:026-2 @ 200'	45.2	62.9 /17.7	(2)
Receiver 4-7-01:026-2 @ 300'	45.8	60.8 /15.0	(2)
Receiver 4-7-01:026-2 @ 350'	46.0	59.7 /13.7	
Receiver 4-7-01:026-3 @ 10' Away from ROW	45.2	64.4 /19.2	(2)
Receiver 4-7-01:026-3 @ 175'	45.3	63.7 /18.4	(2)
Receiver 4-7-01:026-3 @ 200'	45.5	63.4 /17.9	(2)
Receiver 4-7-01:026-3 @ 300'	46.1	61.7 /15.6	(2)
Receiver 4-7-01:026-3 @ 350'	46.5	59.6 /13.1	
LAHAINA BYPASS (MAKAI, BETWEEN PUAMANA AND KAI HELE KU ST.):			
Receiver 4-7-01:026-4 @ 135'	45.8	64.2 /18.4	(2)
Receiver 4-7-01:026-4 @ 175'	46.0	63.5 /17.5	(2)
Receiver 4-7-01:026-4 @ 200'	46.2	63.3 /17.1	(2)
Receiver 4-7-01:026-4 @ 300'	46.9	61.0 /14.1	
Receiver 4-7-01:026-5 @ 120'	46.4	67.3 /20.9	(1)
Receiver 4-7-01:026-5 @ 125'	46.4	67.1 /20.7	(1)
Receiver 4-7-01:026-5 @ 175'	46.8	64.4 /17.6	(2)

TABLE 6 (CONTINUED)

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS ALTERNATIVE 3 WITH 20 PERCENT DIVERSION (4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq
LAHAINA BYPASS (MAKAI, BETWEEN PUAMANA AND KAI HELE KU ST.):		
Receiver 4-7-01:026-5 @ 120'	46.4	67.3 /20.9 (1)
Receiver 4-7-01:026-5 @ 125'	46.4	67.1 /20.7 (1)
Receiver 4-7-01:026-5 @ 175'	46.8	64.4 /17.6 (2)
Receiver 4-7-01:026-5 @ 200'	46.9	63.7 /16.8 (2)
Receiver 4-7-01:026-5 @ 300'	47.7	60.8 /13.1
Receiver 4-7-01:026-6 @ 120'	46.6	71.8 /25.2 (1)
Receiver 4-7-01:026-6 @ 125'	46.6	71.5 /24.9 (1)
Receiver 4-7-01:026-6 @ 175'	47.0	68.7 /21.7 (1)
Receiver 4-7-01:026-6 @ 200'	47.1	67.6 /20.5 (1)
Receiver 4-7-01:026-6 @ 300'	47.9	59.6 /11.7
Receiver 4-7-01:026-7 @ 120'	46.4	68.7 /22.3 (1)
Receiver 4-7-01:026-7 @ 125'	46.5	68.8 /22.3 (1)
Receiver 4-7-01:026-7 @ 175'	46.8	65.9 /19.1 (2)
Receiver 4-7-01:026-7 @ 200'	47.0	63.7 /16.7 (2)
Receiver 4-7-01:026-7 @ 300'	47.7	61.2 /13.5
Receiver 4-7-01:026-8 @ 120'	46.2	67.3 /21.1 (1)
Receiver 4-7-01:026-8 @ 125'	46.2	67.1 /20.9 (1)
Receiver 4-7-01:026-8 @ 175'	46.6	64.8 /18.2 (2)
Receiver 4-7-01:026-8 @ 200'	46.7	63.7 /17.0 (2)
Receiver 4-7-01:026-8 @ 300'	47.4	60.7 /13.3
Receiver 4-7-01:026-9 @ 120'	46.4	67.0 /20.6 (1)
Receiver 4-7-01:026-9 @ 125'	46.4	66.7 /20.3 (1)
Receiver 4-7-01:026-9 @ 175'	46.8	64.5 /17.7 (2)
Receiver 4-7-01:026-9 @ 200'	46.9	63.6 /16.7 (2)
Receiver 4-7-01:026-9 @ 300'	47.7	60.7 /13.0
Receiver 4-7-01:026-10 @ 120'	46.9	66.2 /19.3 (1)
Receiver 4-7-01:026-10 @ 125'	46.9	66.1 /19.2 (1)
Receiver 4-7-01:026-10 @ 175'	47.2	63.7 /16.5 (2)
Receiver 4-7-01:026-10 @ 200'	47.4	62.7 /15.3 (2)
Receiver 4-7-01:026-10 @ 300'	48.2	59.9 /11.7
Receiver 4-7-01:026-11 @ 120'	48.0	67.4 /19.4 (1)
Receiver 4-7-01:026-11 @ 125'	48.1	67.2 /19.1 (1)
Receiver 4-7-01:026-11 @ 175'	48.5	64.1 /15.6 (2)
Receiver 4-7-01:026-11 @ 200'	48.7	63.1 /14.4

TABLE 6 (CONTINUED)

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS
ALTERNATIVE 3 WITH 20 PERCENT DIVERSION
(4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq	
LAHAINA BYPASS (MAKAI, BETWEEN KAI HELE KU ST. AND HONOAPIILANI HWY.):			
Receiver 4-7-01:030-1 @ 10' Away from ROW	50.8	62.6 /11.8	
Receiver 4-7-01:030-2 @ 120'	50.8	71.3 /20.5	(1)
Receiver 4-7-01:030-2 @ 125'	50.9	70.3 /19.4	(1)
Receiver 4-7-01:030-2 @ 175'	51.4	65.9 /14.5	
Receiver 4-7-01:030-3 @ 120'	50.6	66.9 /16.3	(1)
Receiver 4-7-01:030-3 @ 125'	50.7	66.6 /15.9	(1)
Receiver 4-7-01:030-3 @ 175'	51.3	64.4 /13.1	
Receiver 4-7-01:030-4 @ 120'	49.8	66.7 /16.9	(1)
Receiver 4-7-01:030-4 @ 125'	49.9	66.5 /16.6	(1)
Receiver 4-7-01:030-4 @ 175'	50.4	64.4 /14.0	
Receiver 4-7-01:030-5 @ 120'	50.2	67.6 /17.4	(1)
Receiver 4-7-01:030-5 @ 125'	50.2	67.3 /17.1	(1)
Receiver 4-7-01:030-5 @ 175'	50.7	64.3 /13.6	
Receiver 4-7-01:030-6 @ 120'	52.2	65.7 /13.5	
Receiver 4-7-01:030-7 @ 120'	59.0	70.4 /11.4	(1)
Receiver 4-7-01:030-7 @ 125'	59.1	69.4 /10.3	(1)
Receiver 4-7-01:030-7 @ 175'	60.7	65.4 /4.7	

Notes:

(1) Denotes exceedance of HDOT "66 Leq" Criteria for Category B.

(2) Denotes exceedance of HDOT "15 dB Increase" Criteria.

approximately 33 posts and guy wires has been pending with no activity for approximately three years. Predicted future traffic noise levels at this location was approximately 56 to 57 Leq, and slightly above the "15 dB increase" noise criteria. Because the "shade house" is not on a front row lot along the Bypass Right-of-Way, has had no activity on the building permit for approximately three years, is located within the prior limits of project construction for the Lahaina Bypass, and does not appear to be a structure for noise sensitive uses, noise abatement measures were not evaluated for this parcel.

Receptor locations which are mauka (east) of those shown in Figure 4 and Table 6 should not experience future traffic noise levels which exceed the "66 Leq" or "15 dB increase" noise abatement criteria. From the results shown in Figure 4 and Table 6, it was concluded that future traffic noise levels at existing residences mauka of the receptor locations shown in Figure 4 should not exceed the "66 Leq" or "15 dB increase" noise abatement criteria by CY 2035 under the Preferred Alternative 3.

Because there are no existing residences or permitted residential structures makai of the preferred Alternative 3 alignment, it can be concluded that selection of Alternative 1 and 2 should also not result in exceedances of the "66 Leq" or "15 dB increase" noise abatement criteria by CY 2035. Selection of Alternative 1 or Alternative 2 should result in generally lower future traffic noise levels for lots mauka of the preferred Alternative 3 alignment if they are also south of the Puamana extension from Punakea Loop. Their future traffic noise levels should be similar to those shown in Tables 4 and 6 at similar distances from the centerline of the preferred Alternative 3.

The following general conclusions can be made in respect to the impacted structures and lands which can be expected by CY 2035 under Alternative 3. These conclusions are valid as long as the future vehicle mixes and average speeds do not differ from the assumed values.

- The HDOT's "15 dB increase" criteria for substantial change in traffic noise levels will not be exceeded at any existing or permitted noise sensitive or public use structure in the project environs or within the limits of project construction. Maximum increases in traffic noise levels at any existing noise sensitive receptor location within the limits of project construction should not exceed 15 dB as a result of the Lahaina Bypass - Southern Terminus Extension project.

- Within the limits of project construction, exceedances of the "66 Leq" noise abatement criteria are not expected to occur at any existing or permitted noise sensitive structure in the project environs or within the limits of project construction.

- Within the limits of project construction, exceedances of the "66 Leq" noise abatement criteria are not expected to occur at existing park lands as a result of traffic noise associated with the Lahaina Bypass - Southern Terminus Extension.

Exceedance of the "15 dB increase" criteria are also not expected to occur due to the relatively high existing traffic noise levels from Honoapiilani Highway.

- Future traffic noise levels at Puamana and Launiupoko Beach Parks will decrease from existing traffic noise levels due to the reduction in traffic along Honoapiilani Highway. The distances to the 66 Leq contour from the centerline of Honoapiilani Highway at these two parks should decrease from approximately 120 feet to 56 feet.

- Future traffic noise levels at the Puamana Community residences south of Hokiokio Road should also decrease from existing traffic noise levels due to the reduction in traffic along Honoapiilani Highway. The distances to the 66 Leq contour from the centerline of Honoapiilani Highway at these residences should also decrease from approximately 120 feet to 56 feet.

- Future traffic noise levels at the Puamana Community lots north of Hokiokio Road should be similar to existing traffic noise levels due to the diversion of future traffic from Honoapiilani Highway to the bypass.

CHAPTER V. FUTURE TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Future traffic noise levels are not expected to exceed the HDOT "66 Leq(h)" or "15 dB increase" noise abatement criteria by CY 2035 at existing or permitted noise sensitive receptors under the Build Alternative within the limits of project construction. By current HDOT noise policy, traffic noise mitigation measures would not be required for the two existing or permitted dwelling units which are closest to the Lahaina Bypass - Southern Terminus.

Two existing lots (TMK: 4-7-03 :026 and TMK: 4-7-11 :002) were identified as the only two lots which could potentially have had noise impacts under the existing HDOT Noise Policy and Abatement Guidelines (Reference 5). The following should be also be noted:

1. The predicted noise levels from the Lahaina Bypass will be essentially the same at TMK: 4-7-03 :026 for all three alternatives because the bypass alignments are identical in the immediate vicinity of that lot (see Figure 2).

2. At TMK: 4-7-11 :002, the potential traffic noise impacts have been reduced by a change in the alignment of Alternative 3 in the immediate vicinity of this lot. The buffer distance between the southwest corner of this lot and the bypass highway centerline was increased from approximately 100 to 200 feet, with a subsequent reduction in future traffic noise levels at this lot.

Future noise sensitive facilities or housing units which may be planned alongside the new Lahaina Bypass - Southern Terminus represent areas of potential noise impacts if adequate noise mitigation measures are not incorporated into the planning of these future projects. It is possible that the project's roadway improvements may be completed prior to any development of the presently open areas adjacent to the roadway, and that noise abatement measures such as adequate setbacks, sound attenuating walls or berms, or closure and air conditioning will be incorporated into these new developments along the roadway as required. In any event, new structures whose building permits were obtained after the date of public knowledge of this project will not qualify for federal participation in future highway noise abatement measures under existing HDOT policy.

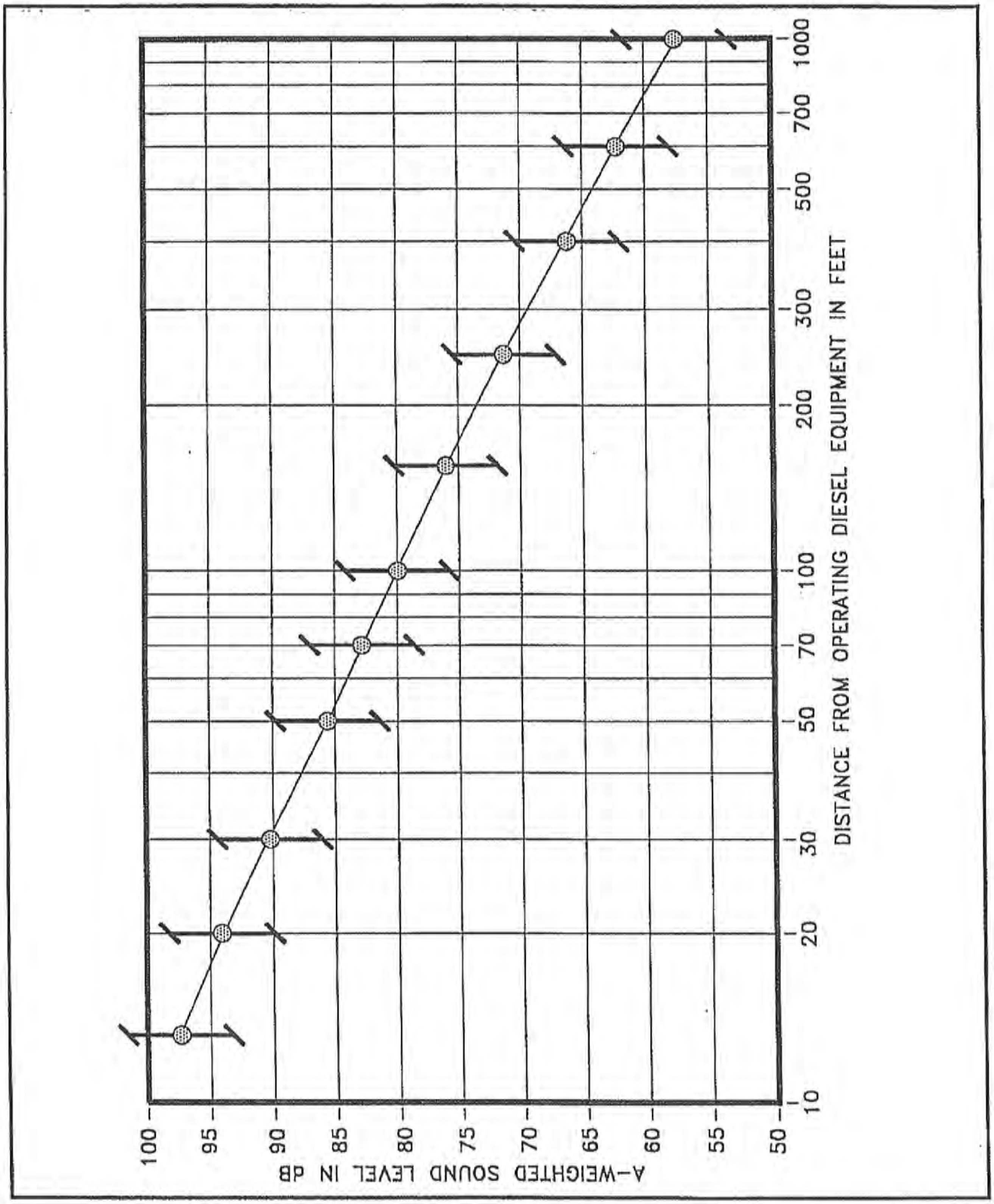
CHAPTER VI. CONSTRUCTION NOISE IMPACTS

Short-term noise impacts associated with construction activities along the existing and future roadway sections may occur. These impacts can occur but are not expected to be severe due to the buffer distances (approximately 650 to 700 FT) between existing noise sensitive structures to the anticipated construction corridor. The total duration of the construction period for the proposed project is not known, but noise exposure from construction activities at any one receptor location is not expected to be continuous during the total construction period.

Noise levels of diesel powered construction equipment typically range from 80 to 90 dB at 50 FT distance. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 5. The maximum impulsive noise levels of rock breaking equipment (such as hoe rams) can be 5 to 8 dB greater than those shown in Figure 5. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project work areas.

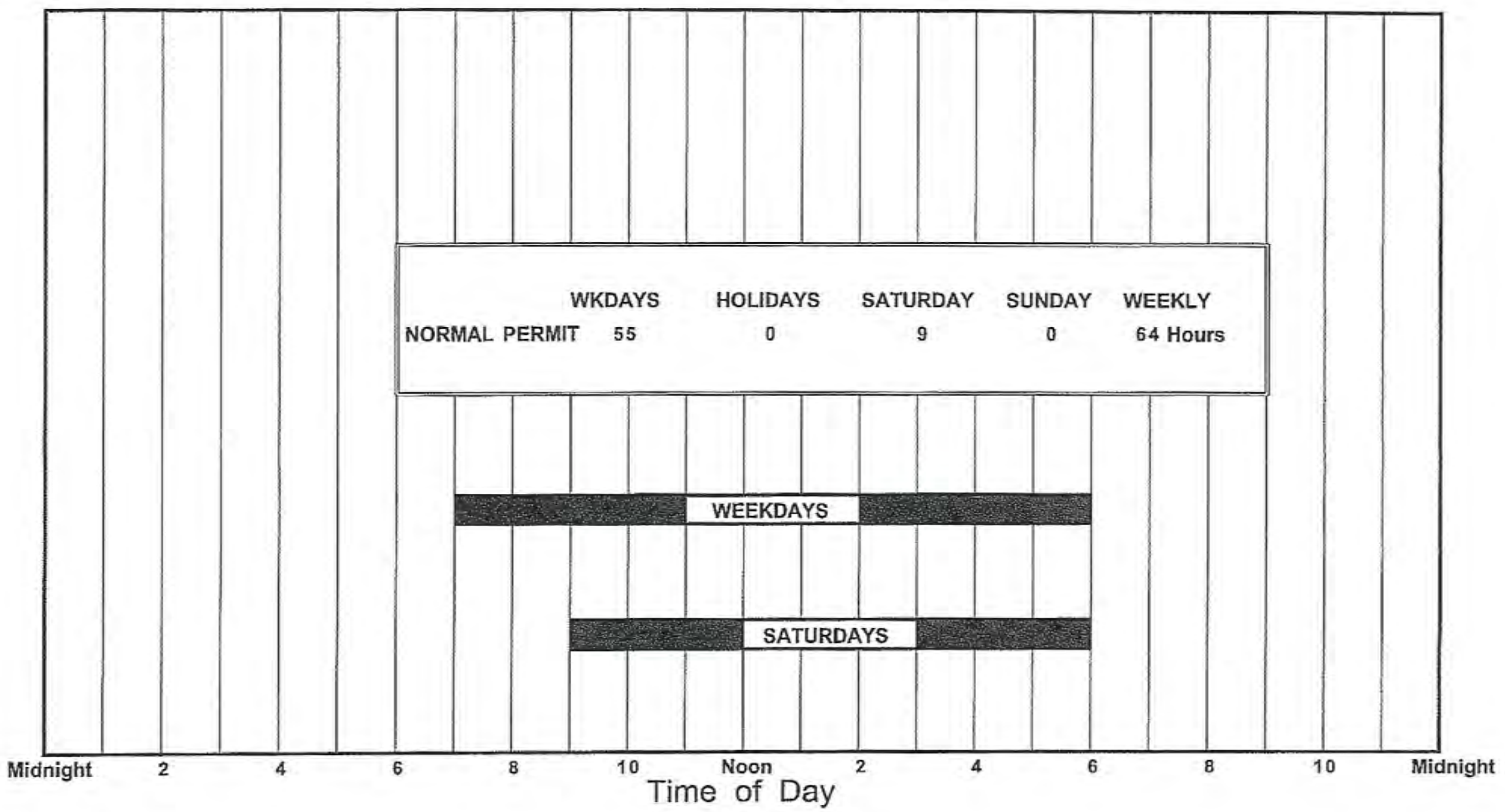
Construction noise levels at the closest existing structures can intermittently exceed 70 dB when work is being performed at the Bypass highway's closest points to these structures. These noise levels are not unusually high and are similar to an automobile at 50 feet. The State Department of Health currently regulates noise from construction activities under a permit system (Reference 6). Under current permit procedures (see Figure 6), noisy construction activities are restricted to hours between 7:00 AM and 6:00 PM, from Monday through Friday, and exclude certain holidays. Noisy construction activities are normally restricted to the hours of 9:00 AM to 6:00 PM on Saturdays, with construction not permitted on Sundays. These restrictions minimize construction noise impacts on noise sensitive receptors (such as residences) along the roadway project corridor, and have generally been successfully applied. In this way, construction noise impacts on noise sensitive receptors can be minimized.

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



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 5



AVAILABLE WORK HOURS UNDER DOH PERMIT
PROCEDURES FOR CONSTRUCTION NOISE

FIGURE
6

APPENDIX A. REFERENCES

(1) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(2) "Traffic Impact Analysis Report for the Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway;" SSFM International, Inc.; November 2009; with revisions to Figures 4 and 6 to reflect Hokiokio Place Connector, July 2013.

(3) Federal Highway Administration; "Procedures for Abatement of Highway Traffic Noise and Construction Noise;" 23 CFR Chapter I, Subchapter H, Part 772;" April 1, 1995.

(4) "Traffic Noise Study Update for the Proposed Lahaina Bypass Highway;" Y. Ebisu & Associates; June, 1995.

(5) "Highway Noise Policy and Abatement Guidelines;" State of Hawaii, Department of Transportation, Highways Division and U.S. Department of Transportation, Federal Highway Administration; April 25, 2011 and List of Corrections dated November 29, 2011.

(6) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

	TERM	SYMBOL
1.	A-Weighted Sound Level	L_A
2.	A-Weighted Sound Power Level	L_{WA}
3.	Maximum A-Weighted Sound Level	L_{max}
4.	Peak A-Weighted Sound Level	L_{Apk}
5.	Level Exceeded x% of the Time	L_x
6.	Equivalent Sound Level	L_{eq}
7.	Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8.	Day Sound Level	L_d
9.	Night Sound Level	L_n
10.	Day-Night Sound Level	L_{dn}
11.	Yearly Day-Night Sound Level	$L_{dn(Y)}$
12.	Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

	TERM	A-WEIGHTING	ALTERNATIVE$^{(1)}$ A-WEIGHTING	OTHER$^{(2)}$ WEIGHTING	UNWEIGHTED
1.	Sound (Pressure)$^{(3)}$ Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2.	Sound Power Level	L_{WA}		L_{WB}	L_W
3.	Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4.	Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5.	Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6.	Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7.	Equivalent Sound Level $^{(4)}$ Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8.	Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9.	Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10.	Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11.	Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12.	Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13.	Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14.	Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15.	Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF FUTURE YEAR (2035) TRAFFIC VOLUMES ALONG ROADWAYS IN PROJECT ENVIRONS

ROADWAY LANES	CY 2035 (BASELINE)		CY 2035 (20% DIV.)	
	AM VPH	PM VPH	AM VPH	PM VPH
Honoapiilani Hwy. - North of Hokiokio Con. (NB)	1,060	810	1,060	810
Honoapiilani Hwy. - North of Hokiokio Con. (SB)	905	1,240	905	1,240
Two-Way	1,965	2,050	1,965	2,050
Honoapiilani Hwy. - Btwn. Hokiokio Con. & Kai Hele Ku (NB)	78	83	270	235
Honoapiilani Hwy. - Btwn. Hokiokio Con. & Kai Hele Ku (SB)	35	50	210	293
Two-Way	113	133	480	528
Honoapiilani Hwy. - Btwn. Kai Hele Ku & Lahaina Bypass (NB)	0	0	200	218
Honoapiilani Hwy. - Btwn. Kai Hele Ku & Lahaina Bypass (SB)	0	0	200	330
Two-Way	0	0	400	548
Honoapiilani Hwy. - South of Lahaina Bypass (NB)	1,935	1,535	1,940	1,755
Honoapiilani Hwy. - South of Lahaina Bypass (SB)	1,670	2,270	1,655	2,350
Two-Way	3,605	3,805	3,595	4,105
Lahaina Bypass - North of Hokiokio Con. (NB)	1,045	807	990	752
Lahaina Bypass - North of Hokiokio Con. (SB)	738	1,035	738	1,035
Two-Way	1,783	1,842	1,728	1,787
Lahaina Bypass - Btwn. Hokiokio Con. & Kai Hele Ku (NB)	2,011	1,542	1,819	1,395
Lahaina Bypass - Btwn. Hokiokio Con. & Kai Hele Ku (SB)	1,628	2,299	1,453	2,057
Two-Way	3,639	3,841	3,271	3,451
Lahaina Bypss - Btwn. Kai Hele Ku & Honoapiilani Hwy. (NB)	1,950	1,573	1,753	1,465
Lahaina Bypss - Btwn. Kai Hele Ku & Honoapiilani Hwy. (SB)	1,670	2,325	1,463	2,035
Two-Way	3,620	3,898	3,215	3,500
Hokiokio Con. - East of Lahaina Bypass (EB)	4	15	4	15
Hokiokio Con. - East of Lahaina Bypass (WB)	13	7	13	7
Two-Way	17	22	17	22
Hokiokio Con. - Between Lahaina Bypass & Honoapiilani (EB)	921	1,271	746	1,031
Hokiokio Con. - Between Lahaina Bypass & Honoapiilani (WB)	999	779	801	628
Two-Way	1,919	2,049	1,547	1,658
Kai Hele Ku St. - East of Lahaina Bypass (EB)	75	135	75	135
Kai Hele Ku St. - East of Lahaina Bypass (WB)	150	105	150	105
Two-Way	225	240	225	240
Kai Hele Ku St. - Between Lahaina Bypass & Honoapiilani (EB)	28	93	10	33
Kai Hele Ku St. - Between Lahaina Bypass & Honoapiilani (WB)	16	73	14	28
Two-Way	44	165	24	60

From:	Rory Frampton <Rory@westmauiland.com>
Sent:	Friday, December 04, 2015 12:49 PM
To:	EBISUYASSOC@aol.com
Cc:	darell.young@hawaii.gov; Bryan Esmeralda; Mark Roy
Subject:	Lahaina Bypass Southern Extension - building permit status update
Attachments:	Lot 2 site plan.pdf; Lot 2 ag exemption site plan.pdf; Lot 10B site plan.pdf; Fig 4 scan with 10B dwelling location.pdf

Aloha Yoichi

As I mentioned to you in our phone call, this email will provide an update on the status of building permits for "noise sensitive structures" in the proximity of the Lahaina Bypass Southern Terminus Extension project.

In your report "Acoustic Study for the Proposed Lahaina Bypass – Southern Terminus Project", dated July 2013, it was reported that there were no existing noise sensitive structures within the vicinity of the noise abatement criteria thresholds. At the time, an examination of building permit records at the County of Maui showed that building permit applications had been made for structures on two parcels which were located in relative close proximity to the Preferred Alternative Route (Alternative No. 3). The following provides an update on the status of the building permits which were evaluated in your report as well as information on two other recently approved structures.

A. TMK (2) 4-7-003 : 026
   1. Previously evaluated permit. In 2013, there was record of a Building Permit application for a proposed "shade house" (B T20100501). The shade house was to be for agricultural purposes and consisted of anchored poles and cables to suspend shade cloth. Your report concluded that the predicted noise levels at the shade house location were slightly above the "15 dB increase" but that the structure was not evaluated for noise abatement measures for a number of reasons, one of which was that it was not considered a structure for noise sensitive uses. The County's current records indicate that the building permit was never issued and that the permit application has since expired. A recent site visit confirmed that the shade house structure was never constructed on the parcel. In sum, the discussion in your report on the "shade house" structure is no longer applicable since the structure has not been built and the building permit has expired.

B. TMK (2) 4-7-011: 002
   1. Previously evaluated permits. In 2013, there were two active building permit applications which were evaluated in your report: one for a proposed dwelling (B T20121216) and one for a detached garage (B T20121217). In 2015, these two permit applications were approved and building permits issued (B 20150141 and B 20150142). A recent check of the approved site plans for these building permits indicate that the location of the proposed structures are the same as in the original applications which your report considered. See attached Lot 2 Site plan which is part of the approved building permit set. Because the approved location of the buildings has not changed, the conclusions of your report would appear to remain valid. (The conclusion being that the predicted noise levels at the future location of these structures were determined to not exceed the noise abatement criteria.) Please confirm, clarify or state otherwise.

   2. New Building Permit Exemption for Agricultural Structure. A building permit exemption for an agricultural structure was recently accepted by the County (BX 20150096). The on-line description for the exemption application describes the proposed structure as a "garage workshop". The law which allows these types of exemptions states that the building permit exemption is for nonresidential agricultural buildings or structures. The definition of Agricultural building reads ""*Agricultural building" means a nonresidential building or structure, built for agricultural or aquacultural purposes, located on a commercial farm or ranch constructed*

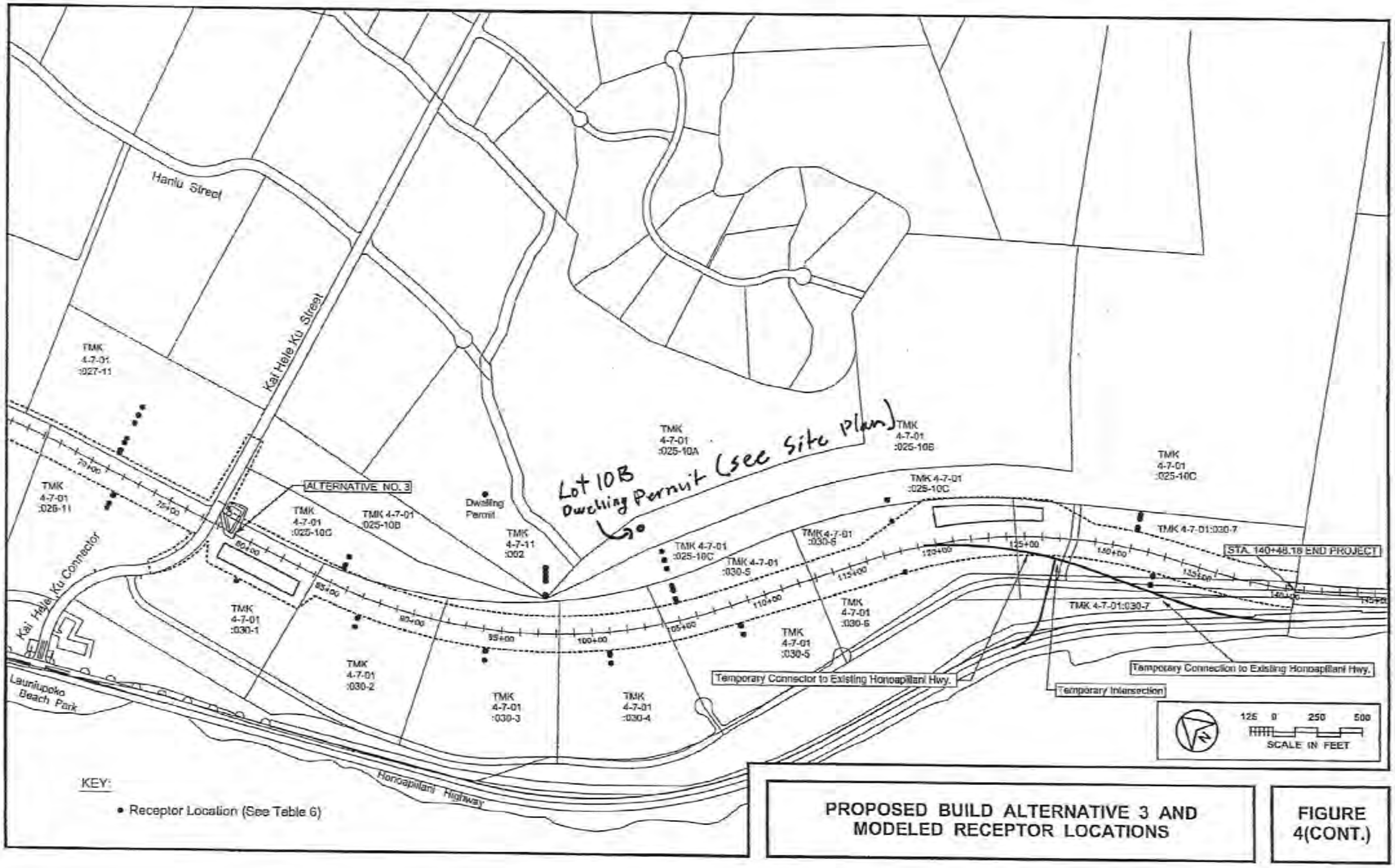
or installed to house farm or ranch implements, agricultural or aquacultural feeds or supplies, livestock, poultry, or other agricultural or aquacultural products, used in or necessary for the operation of the farm or ranch, or for the processing and selling of farm or ranch products." Section 46-88(d), HRS. The definition for nonresidential building or structure reads " *"Nonresidential building or structure" means a building or structure, including an agricultural building, that is used only for agricultural or aquacultural operations and is not intended for use as, or used as, a dwelling"*. Section 46-88(d), HRS. The location of the proposed structure shown on the accepted site plan indicates that it is no closer to the Bypass than the other two previously evaluated structures. See attached Lot 2 Ag Exemption Site Plan. Based on the foregoing, it would appear that the Agricultural building as defined in HRS 46-88 is not considered a structure for noise sensitive uses. Also, even if it were a noise sensitive use, the predicted noise levels would not exceed the noise abatement criteria based on the proposed location. Please confirm, clarify or state otherwise.

C. TMK (2) 4-7-001:057 (referred to as parcel 4-7-001: 025-10B in the 2013 Acoustic Study)

1. New Building Permit. Since the completion of your report in 2013, there has been a new permit issued on this parcel which was not considered in your report. The permit is for a second farm dwelling to be used for residential purposes. The location of the proposed dwelling is shown on the attached Lot 10B Site Plan and is in the proximity of the receptor location transect in your report which started on TMK 4-7-01: 030: 5 (see attached Figure 4 scan with approximate dwelling location). Based on Table 6, the noise criteria was not exceeded at a location on parcel 10C (the abutting parcel) at a point 400 feet from the Lahaina Bypass centerline. Since the location of the proposed structure is on Lot 10B and at a distance greater than 400 feet from the centerline, it would appear that the recently proposed dwelling on Parcel 10B is in a location where the predicted noise levels would not exceed the noise abatement criteria. Please confirm, clarify or state otherwise.

Thank you very much for your assistance, please do not hesitate to contact me if you have any questions or need further information.

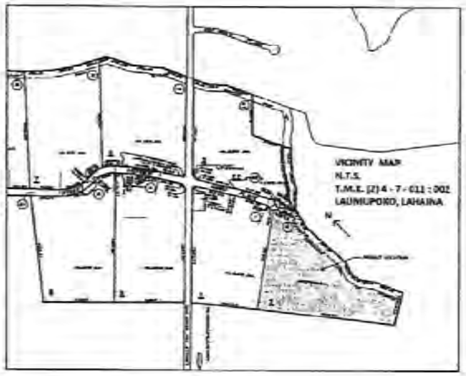
Rory Frampton
Land Use Planner

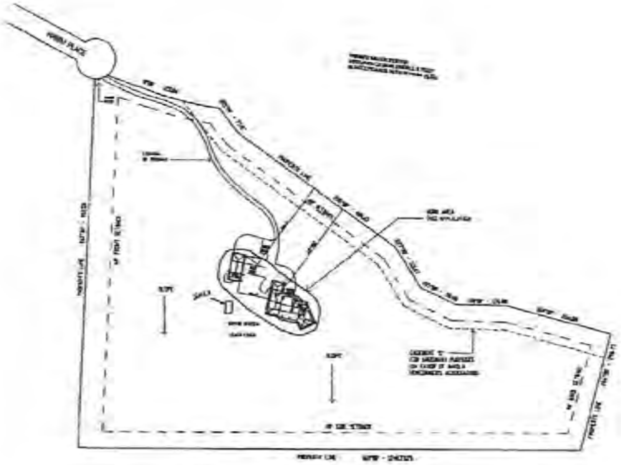


Lot 10B
Dwelling Permit (see site plan)

PROPOSED BUILD ALTERNATIVE 3 AND MODELED RECEPTOR LOCATIONS

FIGURE 4(CONT.)





SITE PLAN

SCALE: 1" = 100'

MAKILA PLANTATION - [illegible]
[illegible] PLACE, LAUNIUPOKO, LAHAINA
T.M.K. (2) 4 - 7 - 011 : 002
[illegible] ACRES

AREA SUMMARY :

RESIDENCE:
LIVING AREA = [illegible] SQ. FT.
DECK = [illegible] SQ. FT.
GARAGE = [illegible] SQ. FT.

DETACHED GARAGE:
GARAGE = [illegible] SQ. FT.
CARPORT = [illegible] SQ. FT.
WORKSHOP = [illegible] SQ. FT.
DECK = [illegible] SQ. FT.

CONSTRUCTION NOTES

GENERAL

1. Details, Sections, and notes shown on drawings are typical and shall apply to similar situations elsewhere unless otherwise noted.

2. Contractor shall verify all dimensions and conditions at project site prior to commencement of construction.

3. [illegible]

4. All work shall conform to the requirements of the [illegible] Code [illegible] Edition with local amendments.

5. Contractor shall notify the Architect and Designer of any condition which may endanger the stability of the structure [illegible]

7. Contractor shall provide adequate bracing and shoring for all structural members during all phases of construction.

8. Contractor shall ensure proper placement of all openings, [illegible] prior to placing concrete.

9. All conditions of potential instability of [illegible] shall be brought to the attention of the architect.

FOUNDATION

[illegible]

CONCRETE AND REINFORCING

[illegible]

CONCRETE MASONRY UNIT

[illegible]

LUMBER

[illegible]

NAILING NOTES

[illegible]

APPROVED

REVISED

LEGEND :		
SHEET NO.	SHEET TITLE	SCALE
A-1	SITE PLAN VICINITY MAP GENERAL NOTES	AS SHOWN
A-2	RESIDENCE: FLOOR PLAN	AS SHOWN
A-3	RESIDENCE: BUILDING ELEVATIONS	AS SHOWN
A-4	RESIDENCE: ROOF FRAMING PLAN FOUNDATION AND FLOOR FRAMING PLANS DETAILS	AS SHOWN
A-5	RESIDENCE: FOOTING DETAILS	AS SHOWN
A-6	RESIDENCE: BUILDING SECTIONS [illegible]	AS SHOWN
A-7	RESIDENCE: ELECTRIC PLAN [illegible]	AS SHOWN
A-8	DETACHED GARAGE: FLOOR PLAN BUILDING ELEVATIONS	AS SHOWN
A-9	DETACHED GARAGE: ROOF FRAMING PLAN FOUNDATION AND FLOOR FRAMING PLANS FOOTING DETAILS	AS SHOWN
A-10	DETACHED GARAGE: ELECTRIC PLAN BUILDING SECTIONS STAIR SECTION #1 RESIDENCE: STAIR SECTION #2	AS SHOWN
A-11	DOOR AND WINDOW SCHEDULES	AS SHOWN

T12/R16 – 1217

COUNTY OF MAUI

X

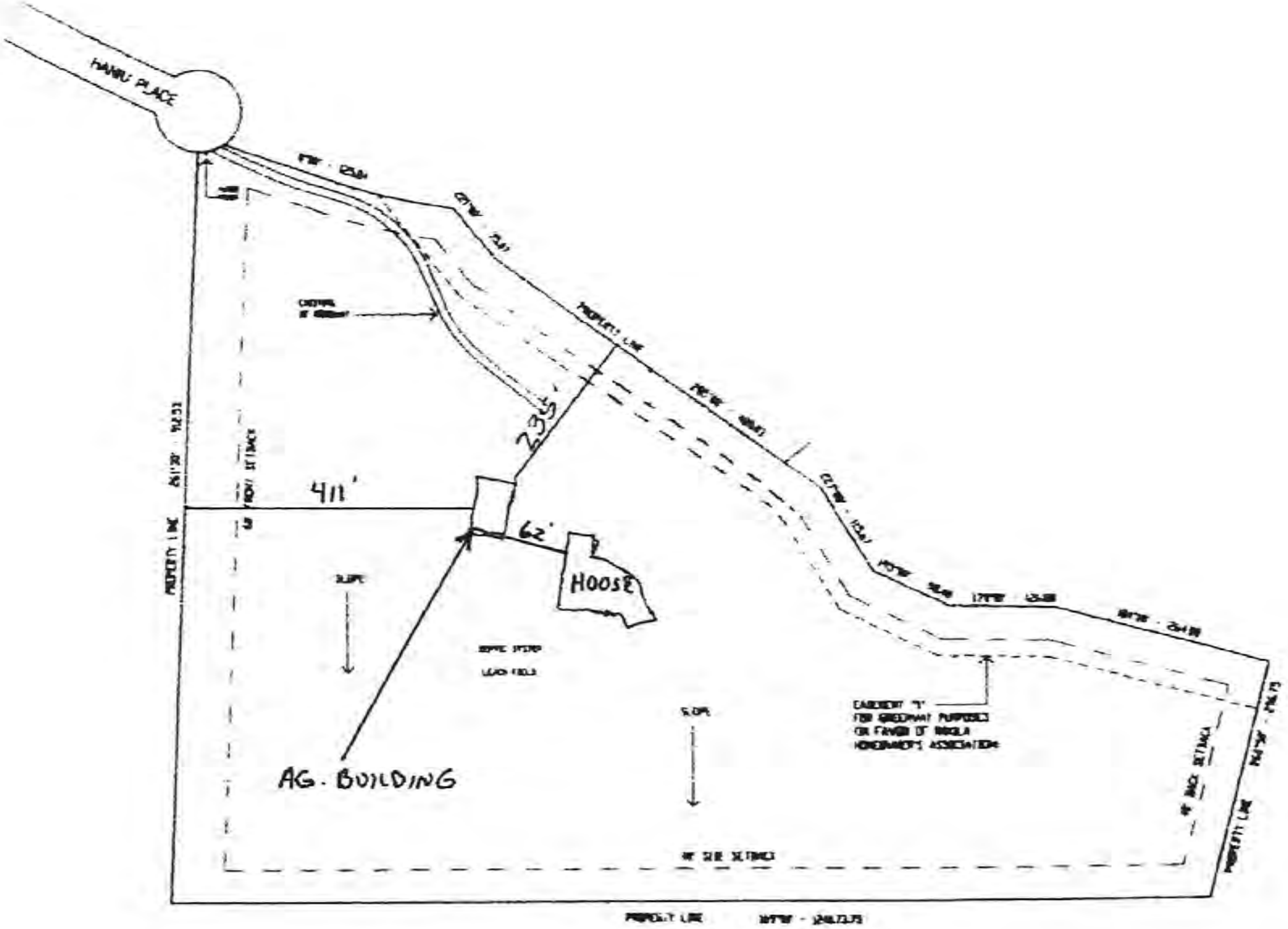
BP2015/0141,147

NEW RESIDENCE AND DETACHED GARAGE FOR:
RICHARD HOEHN
HANIU STREET - MAKILA PLANTATION LOT #2
LAUNIUPOKO, LAHAINA, MAUI HAWAII 96761
TMK (2) 4 - 7 - 011 : 002

SITE PLAN
VICINITY MAP
GENERAL NOTES
SHEET LEGEND

SCALE: AS SHOWN

A-1

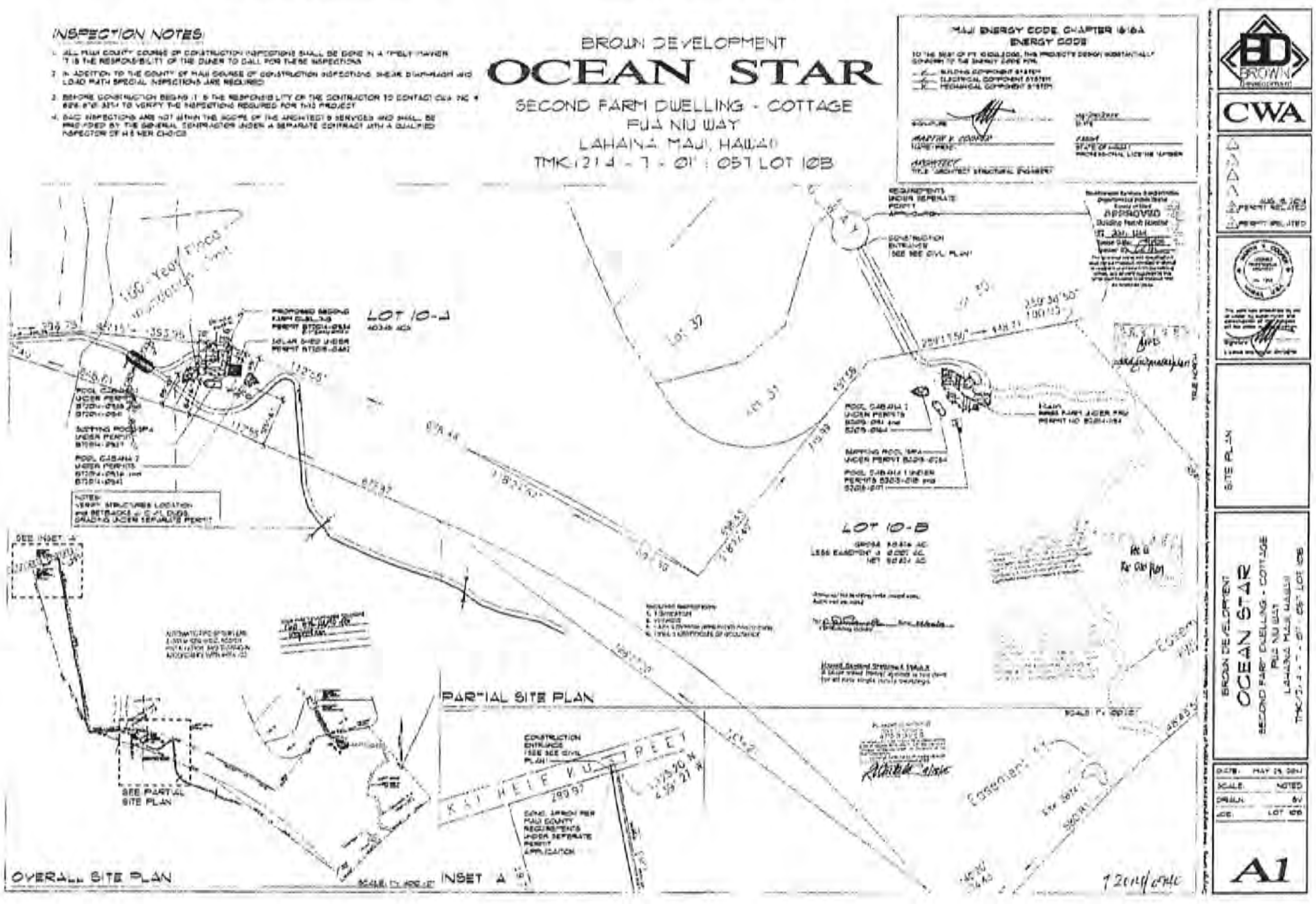


SITE PLAN

SCALE 1" = 235'

MANILA PLANTION - B, LUCA # 4,825
HANIU PLACE, LAUNIUPOKO, LAHAINA
T.M.K. (2) 4-7-011 : 002
16.906 ACRES

RICHARD HOEHN
80 HANIU PLACE, LAHAINA



BROWN DEVELOPMENT

OCEAN STAR

SECOND FARM DWELLING - COTTAGE

PUA NIU WAY

LAHAINA, MAUI, HAWAII

TMK (2) 4 - 7 - 01 : 057 LOT 10B

INSPECTION NOTES:

1. ALL MAUI COUNTY COURSE OF CONSTRUCTION INSPECTIONS SHALL BE DONE IN A TIMELY MANNER. IT IS THE RESPONSIBILITY OF THE OWNER TO CALL FOR THESE INSPECTIONS.
2. IN ADDITION TO THE COUNTY OF MAUI COURSE OF CONSTRUCTION INSPECTIONS, SHEAR DIAPHRAGM AND LOAD PATH SPECIAL INSPECTIONS ARE REQUIRED.
3. BEFORE CONSTRUCTION BEGINS IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT CWA INC. @ [illegible] TO VERIFY THE INSPECTIONS REQUIRED FOR THIS PROJECT.
4. SPECIAL INSPECTIONS ARE NOT WITHIN THE SCOPE OF THE ARCHITECT'S SERVICES AND SHALL BE PROVIDED BY THE GENERAL CONTRACTOR UNDER A SEPARATE CONTRACT WITH A QUALIFIED INSPECTOR OF HIS/HER CHOICE.

MAUI ENERGY CODE, CHAPTER 16.16A
ENERGY CODE

TO THE BEST OF MY KNOWLEDGE, THIS PROJECT'S DESIGN SUBSTANTIALLY CONFORMS TO THE ENERGY CODE FOR:

- ✓ BUILDING COMPONENT SYSTEM
- ✓ ELECTRICAL COMPONENT SYSTEM
- ✓ MECHANICAL COMPONENT SYSTEM

SIGNATURE ______ DATE ______

MARTIN V. COOPER
NAME PRINT

ARCHITECT
TITLE (ARCHITECT, STRUCTURAL ENGINEER)

STATE OF HAWAII
PROFESSIONAL LICENSE NUMBER

NOTES:
VERIFY STRUCTURES LOCATION
AND SETBACKS W/ CIVIL DWGS.
GRADING UNDER SEPARATE PERMIT

LOT 10-B

GROSS [illegible] AC.
LESS EASEMENT [illegible] AC.
NET [illegible] AC.

From: EBISUYASSOC@aol.com [EBISUYASSOC@aol.com]
Sent: Friday, December 04, 2015 4:46 PM
To: Rory Frampton
Subject: Re: Lahaina Bypass Southern Extension - building permit status update

Rory:

The following are my responses to your questions. I have attached a markup of my report Table 6 which shows the calculation results for the two dwellings.

A. TMK (2) 4-7-003 : 026. My Response: I concur.

B. TMK (2) 4-7-011 : 002. My Response: Predicted traffic noise level should not exceed either the 66 Leq or "15 dB increase" noise criteria at dwelling. We have about a 4 dB margin for error.

Agricultural Structure: My Response: If we all agree than it is not for a noise sensitive use, and primarily for agricultural uses, the HDOT Noise Policy excludes such structures from any noise analysis (see Page 10 of the Noise Policy when describing Activity Category F, or agricultural activities).

C. TMK (2) 4-7-001 : 057. My Response: This proposed farm dwelling required a closer evaluation because there was a possibility that the "15 dB increase" criteria could be exceeded, as was the case with the closest other noise analysis receptor location in my report Table 6, Page 25. We calculated the existing and future noise levels at this location and the results are shown in the attached Table 6. I used a conservative estimate of the existing noise level at 43.5 dB (vs. 45 dB from my report Figure 3), and we still did not exceed the "15 dB increase" criteria at this location. So, your conclusion on this dwelling was confirmed.

Yoichi Ebisu

TABLE 6 (CONTINUED)

EXISTING AND CY 2035 TRAFFIC NOISE LEVELS ALTERNATIVE 3 WITH 20 PERCENT DIVERSION (4.92 FT HIGH RECEPTOR, AM PEAK HOUR)

	RECEPTOR LOCATION AND DISTANCE FROM LAHAINA BYPASS CENTERLINE	EXISTING (CY 2012) Leq	FUTURE (CY 2035) / CHANGE Leq
	LAHAINA BYPASS (MAUKA, BETWEEN PUAMANA AND KAI HELE KU ST.):		
	Receiver 4-7-01:027-10 @ 110'	45.3	70.9 /25.6 (1)
	Receiver 4-7-01:027-10 @ 125'	45.2	69.8 /24.6 (1)
	Receiver 4-7-01:027-10 @ 175'	44.9	65.9 /21.0 (2)
	Receiver 4-7-01:027-10 @ 200'	44.8	65.6 /20.8 (2)
	Receiver 4-7-01:027-10 @ 300'	44.3	62.3 /18.0 (2)
	Receiver 4-7-01:027-10 @ 350'	44.0	60.9 /16.9 (2)
	Receiver 4-7-01:027-10 @ 400'	43.8	59.6 /15.8 (2)
	Receiver 4-7-01:027-10 @ 450'	43.5	58.2 /14.7
	Receiver 4-7-01:027-11 @ 110'	46.4	69.8 /23.4 (1)
	Receiver 4-7-01:027-11 @ 125'	46.3	67.3 /21.0 (1)
	Receiver 4-7-01:027-11 @ 175'	46.0	66.0 /20.0 (1)
	Receiver 4-7-01:027-11 @ 200'	45.8	65.4 /19.6 (2)
	Receiver 4-7-01:027-11 @ 300'	45.2	62.7 /17.5 (2)
	Receiver 4-7-01:027-11 @ 350'	44.9	60.5 /15.6 (2)
	Receiver 4-7-01:027-11 @ 400'	44.7	58.6 /13.9
	LAHAINA BYPASS (MAUKA, BETWEEN KAI HELE KU ST. AND HONOAPIILANI HWY.)		
	Receiver 4-7-01:025-10C @ 110'	48.5	66.5 /18.0 (1)
	Receiver 4-7-01:025-10C @ 125'	48.3	65.0 /16.7 (2)
	Receiver 4-7-01:025-10C @ 175'	47.9	62.5 /14.6
	Receiver 4-7-11:002 @ 220'	47.2	66.1 /18.9 (1)
	Receiver 4-7-11:002 @ 300'	46.7	63.3 /16.6 (2)
	Receiver 4-7-11:002 @ 325'	46.5	62.4 /15.9 (2)
	Receiver 4-7-11:002 @ 350'	46.3	61.7 /15.4 (2)
	Receiver 4-7-11:002 @ 375'	46.2	61.1 /14.9
12/4/15	Receiver 4-7-11:002C "Dwelling Permit"	44.0	55.2/10.8
Y.C.	Receiver 4-7-01:030-5 @ 110'	47.9	71.9 /24.0 (1)
	Receiver 4-7-01:030-5 @ 125'	47.8	70.6 /22.8 (1)
	Receiver 4-7-01:030-5 @ 175'	47.4	67.6 /20.2 (1)
	Receiver 4-7-01:030-5 @ 200'	47.2	66.5 /19.3 (1)
	Receiver 4-7-01:025-10C @ 300'	46.5	64.1 /17.6 (2)
	Receiver 4-7-01:025-10C @ 350'	46.2	62.1 /15.9 (2)
	Receiver 4-7-01:025-10C @ 400'	45.9	60.8 /14.9
12/4/15	Receiver 4-7-01:025-10B @ "Proposed Farm Dwelling"	43.5	58.0/14.5
Y.C.	Receiver 4-7-01:030-6 @ 10' Away from ROW	49.2	65.6 /16.4 (2)
	Receiver 4-7-01:025-10C @ 300'	48.1	62.4 /14.3

From: Rory Frampton <Rory@westmauiland.com>
To: "darell.young@hawaii.gov" <darell.young@hawaii.gov>,
Date: 12/07/2015 09:13 AM
Subject: FW: Lahaina Bypass Southern Extension - building permit status update

---

Darell
Please respond to the question regarding the Agricultural Structure in Yoichi's email below. See my email below for the description of the Agricultural structures under the portion of state law that was used to approve this structure. In addition, note that on the accepted site plan, the structure is shown at a distance further away from the Bypass than the dwelling on the same parcel referenced by Yoichi below.
Rory

From: Darell.Young@hawaii.gov [mailto:Darell.Young@hawaii.gov]
Sent: Monday, December 07, 2015 2:31 PM
To: Rory@westmauiland.com
Cc: Bryan Esmeralda <bryan@munekiyohiraga.com>
Subject: Re: FW: Lahaina Bypass Southern Extension - building permit status update

Rory,

Given that agricultural structure is not a noise sensitive use and it does not exceed either the 66 Leq or "15 dB increase" noise criteria at dwelling, I agree that the HDOT Noise Policy exclude this agricultural structure from any noise analysis.

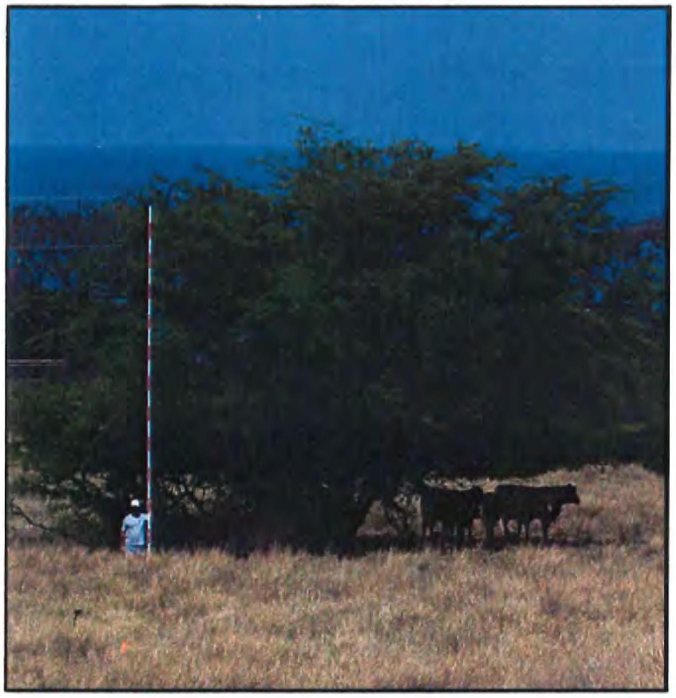
Darell Young
State of Hawaii
Department of Transportation
Highways Division, Planning Branch
Tel: 808-587-1835

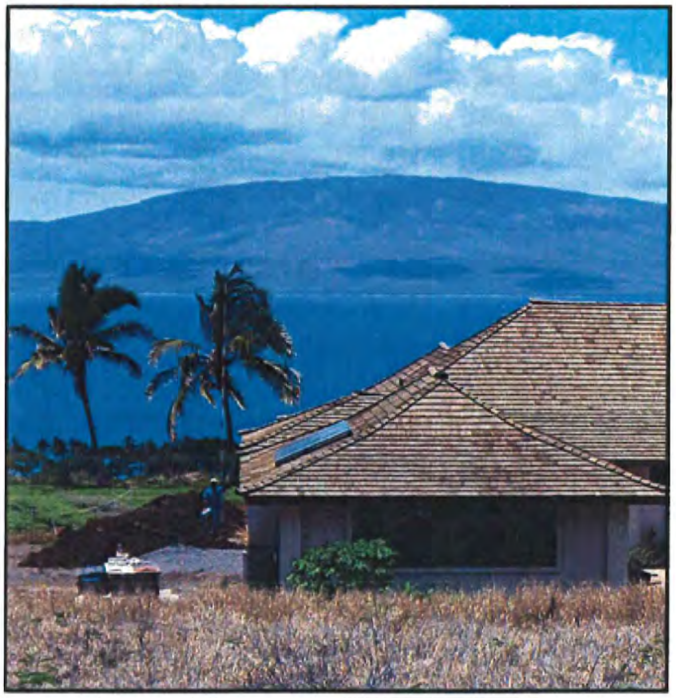
APPENDIX H.

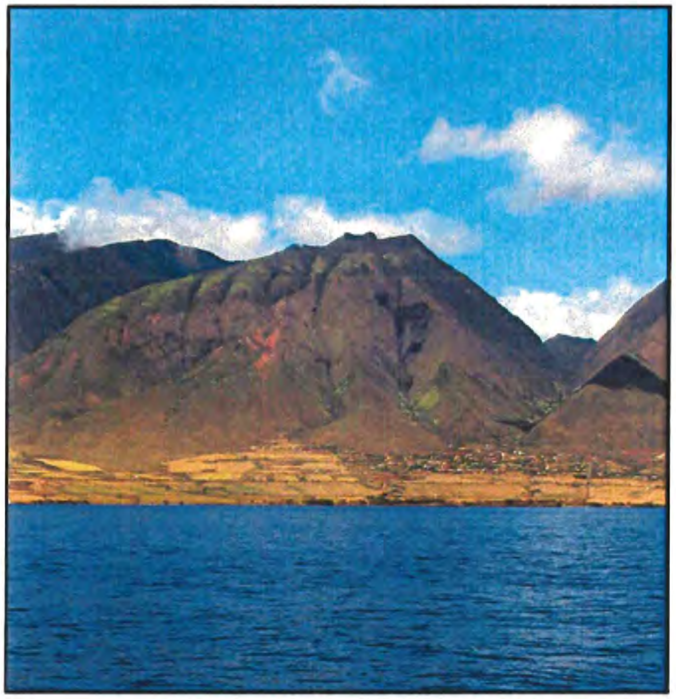
Massing and Viewplane Simulation Study for Proposed Makila Phase II and Phase III Subdivisions

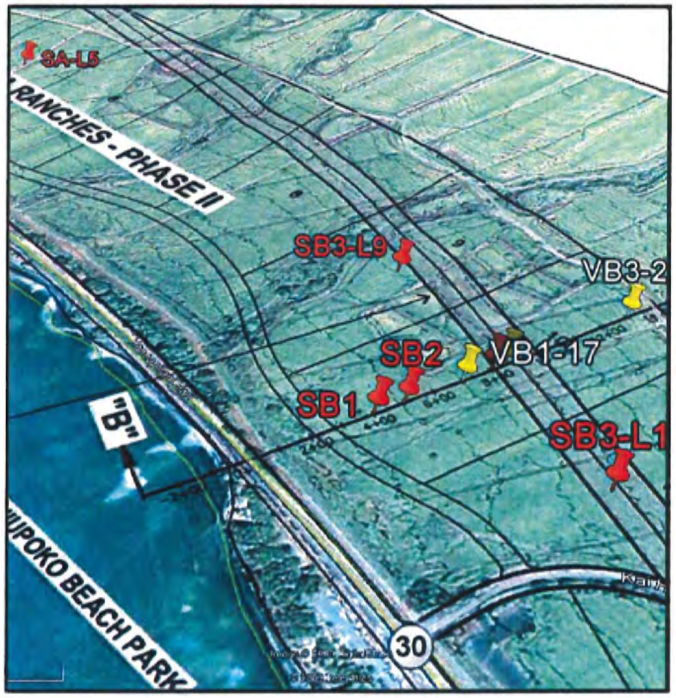
LAHAINA BYPASS - SOUTHERN EXTENSION / MAKILA RANCHES II SUBDIVISION

MASSING / VIEWPLANE SIMULATION









PREPARED FOR
MAKILA LAND CO., LLC

PREPARED BY
HAWAII LAND USE GROUP LLC
MARCH 2009

HAWAII LAND USE GROUP LLC
PO BOX 880779 PUKALANI HI 96788

March 2009

Proposed Lahaina Bypass Southern Terminus Relocation & Makila Ranches II Development Massing / Viewplane Simulation

Overview

This visual study has been prepared to simulate views towards the ocean with regard to two developments are being proposed in the Launiupoko ahupua`a just east of Lahiana Town in the West Maui region. The projects evaluated are the proposed extension of the Lahaina Bypass Southern Terminus and the subdivision known as the 11-lot Makila Ranches II subdivision.

The study consists of four (4) exhibits; of which each contains:

- A photographic simulation of the coastal viewplane from one of four selected vantages associated with the future highway alignment alternatives within the proposed Ranches II subdivision. The simulation depicts the coastal views over the subject subdivision from the proposed highway corridor.
- A plan-view map identifying the location of the vantage, the proposed highway alignment, and the locations of simulated dwellings.

Purpose

The visual study has been developed for the primary purposes of:

- Provide an elevation-correct simulation the coastal views from the 3 proposed Highway Alignments
- Provide a scale-accurate simulation of development massing in the proposed subdivision from pre-selected highway vantages and building locations

Mapping and View/Vantage Selection

In preparation for selecting the views and vantages to be included in the study, the preparer met with Mr. Rory Frampton, a consultant to Makila Land Co., LLC (landowner) to review background information and choose representative locations for vantage points and dwelling-simulation locations.

Source mapping of lot boundaries, topography, aerial photography, and proposed highway alignments were provided in exhibits entitled "Honoapiilani Highway Realignment Alternatives" prepared by Warren S. Unemori Engineering Inc. prepared on February 27th and March 18th 2008.

Four shoreline-perpendicular transects labeled A through D were selected and mapped as a baseline for photographic simulations. Transects A and B occur within the Makila Ranches II subdivision.

Locations for the simulated agricultural dwellings were selected by Makila in locations deemed representative of natural homeowner selection, and generally in the middle of the developable area, as bound by the proposed coastal roads and respective highway realignment.

Upon selection, vantage and simulation locations were located by GPS and flagged on site.

Vantages – Panoramic Photos

Vantage shots were taken along each transect at a point representing the approximate middle of the seaward traffic lane of the respective highway alignment. The elevations of the vantage photographs were established 5 feet above the proposed elevation of the highway to mimic the view of a pedestrian, cyclist, or occupant in a vehicle.

Because the proposed highway alternatives would be constructed above grade, vantages were photographed from a calculated elevated position above existing grade. Calculations were based upon the profile data included in the 2008 Unemori exhibits. A telescoping survey pole with a camera mount was utilized to provide the correct elevation for the photographs.

Elevations of the vantages were as follows:

A-0	Transect A Alignment 1,2,3	8 feet above existing grade
B-1	Transect B Alignment 1	17 feet above existing grade
B-2	Transect B Alignment 2	14 feet above existing grade
B-3	Transect B Alignment 3	21 feet above existing grade

A second 25-foot stadia pole was hand held or erected at the pre-designated dwelling simulation locations during vantage photography to provide ground reference scale in photographic panoramas. Three simulated dwelling locations were photographed in the vantage shots of Transect A and that of Transect B-3. Vantages B-1 and B-2 contained one simulation point.

Vantage Photographs were taken on 5/15/08, 5/20/08, 6/18/08, and 7/14/08. Vantage photographs were assembled into panoramic photographs utilizing Photomerge/Photoshop application software made by Adobe Systems Incorporated.

Views - Simulated Dwellings

The regional neighborhood was surveyed for a photographic "source" "Specimen Dwelling" that would represent a large-sized single story dwelling or a two-story structure no greater than 25 feet in height. A suitable one-story dwelling with a significant roof height was selected from the abutting neighborhood. The specimen is a 5215 s.f. (per County RPT, TMK (2) 4-7-011:004) dwelling over 100 feet in width and having a peak roof height (along width) of approximately 23.5 feet (as observed). The specimen was photographed from various angles. A 25-foot graduated stadia pole was aligned with the peak of the roof to serve for future reference when the photographs were scaled to the ground controls photographed in the vantage panoramas.

Vegetation

Vegetation / Landscape Planting associated with agricultural dwellings or large-scale farming was not simulated in the viewplane simulations. It was felt that the State and County land use controls specifying agricultural use of the subject property would permit the planting of obstructive crops (trees) with or without the proposed subdivision or the development of dwellings. Because the viewplane obstruction due to farming or landscape planting had infinite possibilities with or without the proposed subdivision, the scope of the study focused on the finite and measurable differences due to the subdivision, specifically the view impacts due to the siting and massing of agricultural dwellings.

Viewplane Simulations

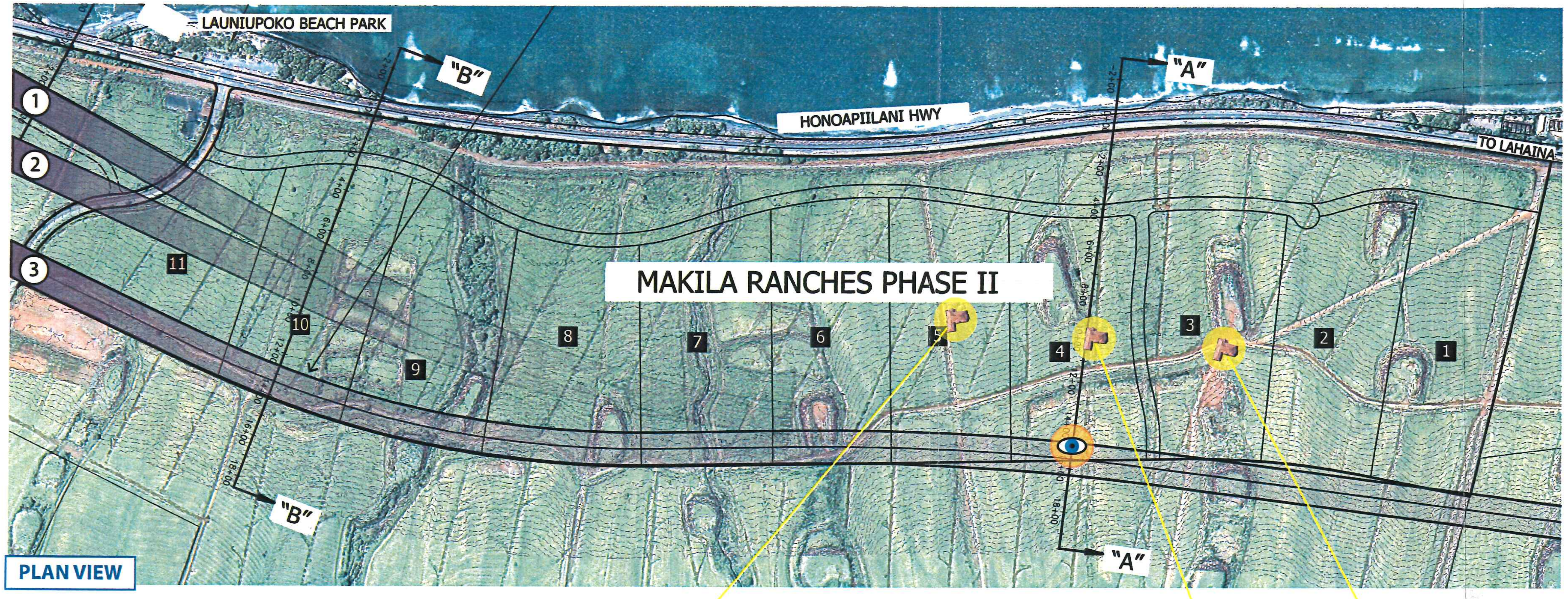
Four simulations were created from the four selected vantage points. One simulation was created along Transect A, the point of divergence of the three highway alignments. Three simulations were created along Transect B, one for each of the alternative highway alignments.

In each simulation, photographs of the specimen dwelling were inserted into the vantage panorama and scaled to the correct size utilizing the physical ground controls photographed in both photographs. Lighting levels in the dwelling photograph were adjusted to match those in the panorama. Where the simulated dwelling was obstructed by existing topography, the simulated dwelling was cropped to provide a realistic view. Where cropping was significant, the outline of the pre-cropped structure was provided to retain visual scale despite the obstruction by topography.

LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

TRANSECT : A

HWY ALIGNMENT # : ALL



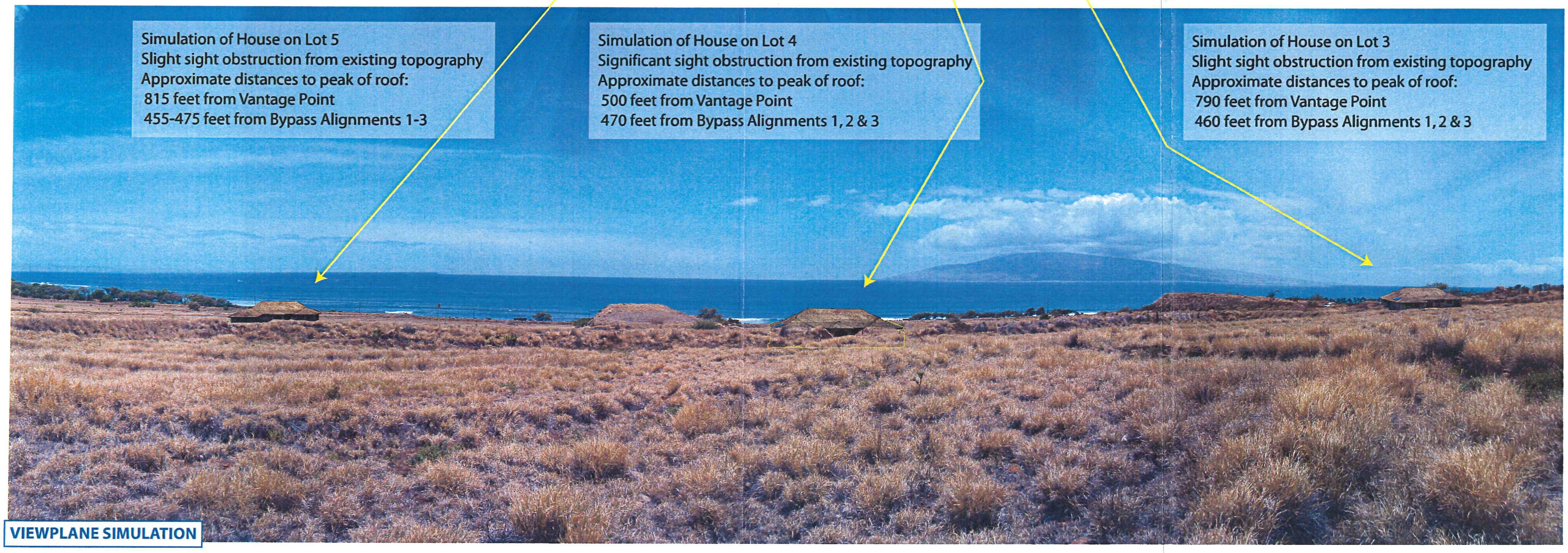
PLAN VIEW

Ⓧ LAHAINA BYPASS ALTERNATIVE NUMBER

■ MAKILA SUBDIVISION LOT NUMBER

● LOCATIONS OF SIMULATED HOMES

◉ VANTAGE POINT OF SIMULATION



Simulation of House on Lot 5
Slight sight obstruction from existing topography
Approximate distances to peak of roof:
815 feet from Vantage Point
455-475 feet from Bypass Alignments 1-3

Simulation of House on Lot 4
Significant sight obstruction from existing topography
Approximate distances to peak of roof:
500 feet from Vantage Point
470 feet from Bypass Alignments 1, 2 & 3

Simulation of House on Lot 3
Slight sight obstruction from existing topography
Approximate distances to peak of roof:
790 feet from Vantage Point
460 feet from Bypass Alignments 1, 2 & 3

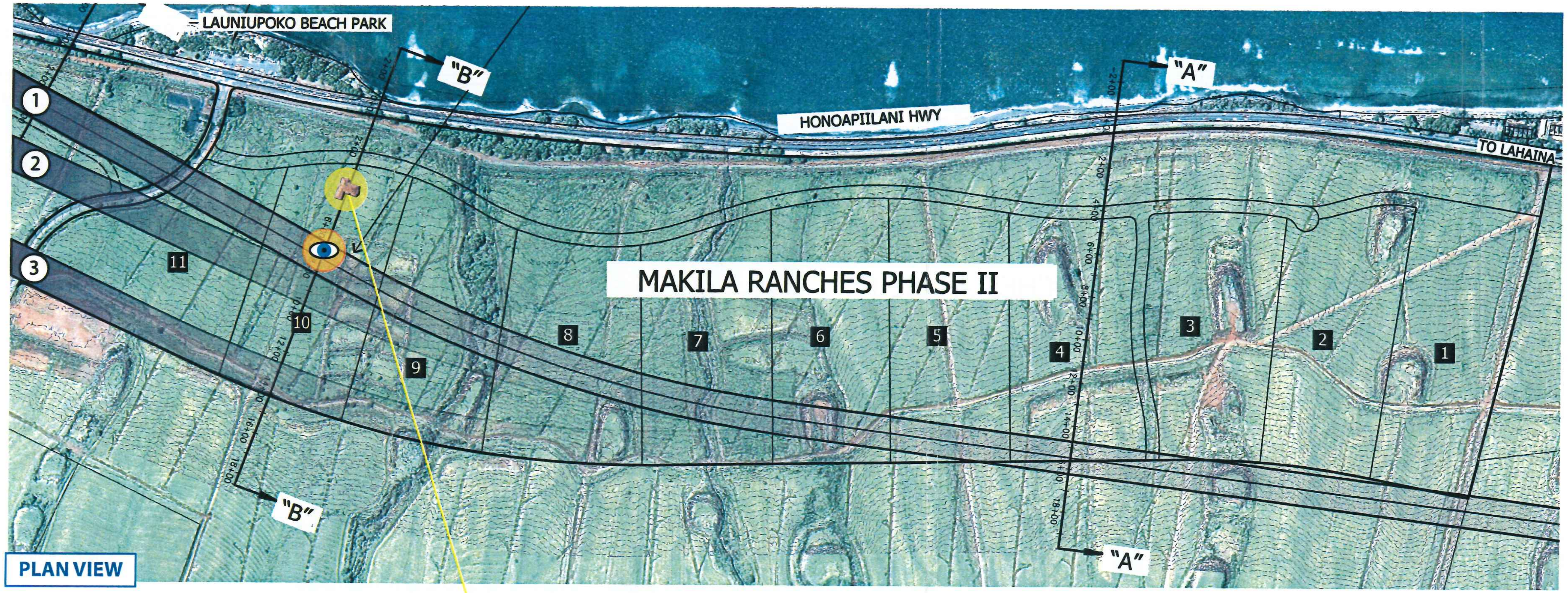
VIEWPLANE SIMULATION

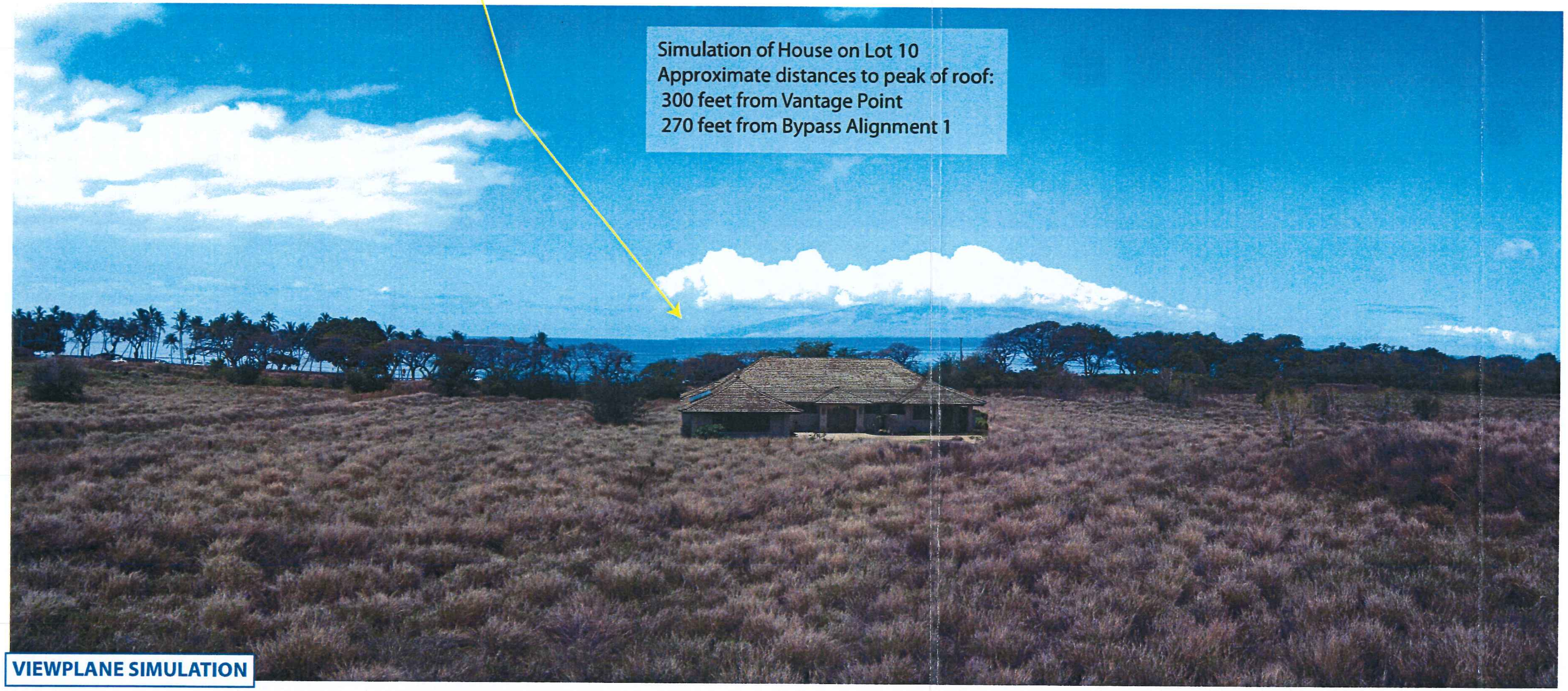
LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

TRANSECT : B

HWY ALIGNMENT # : 1

#	LAHAINA BYPASS ALTERNATIVE NUMBER
#	MAKILA SUBDIVISION LOT NUMBER
●	LOCATIONS OF SIMULATED HOMES
◉	VANTAGE POINT OF SIMULATION





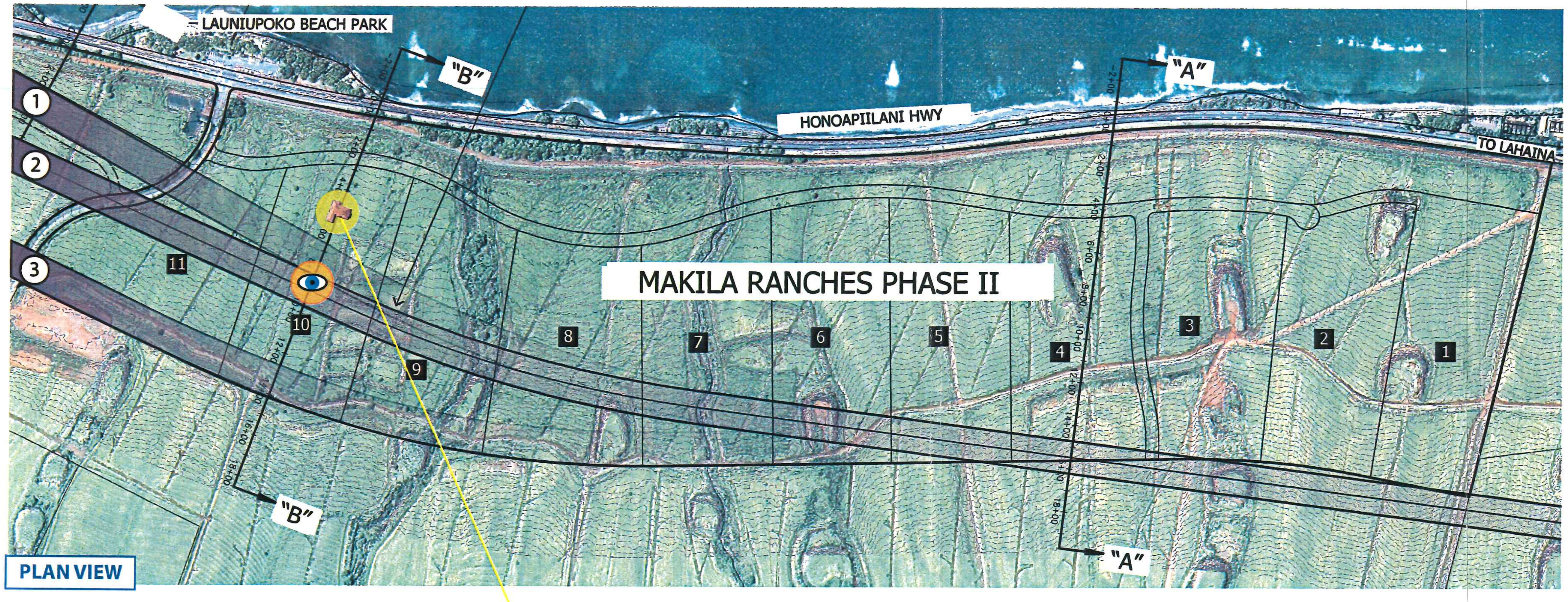
Simulation of House on Lot 10
Approximate distances to peak of roof:
300 feet from Vantage Point
270 feet from Bypass Alignment 1

LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

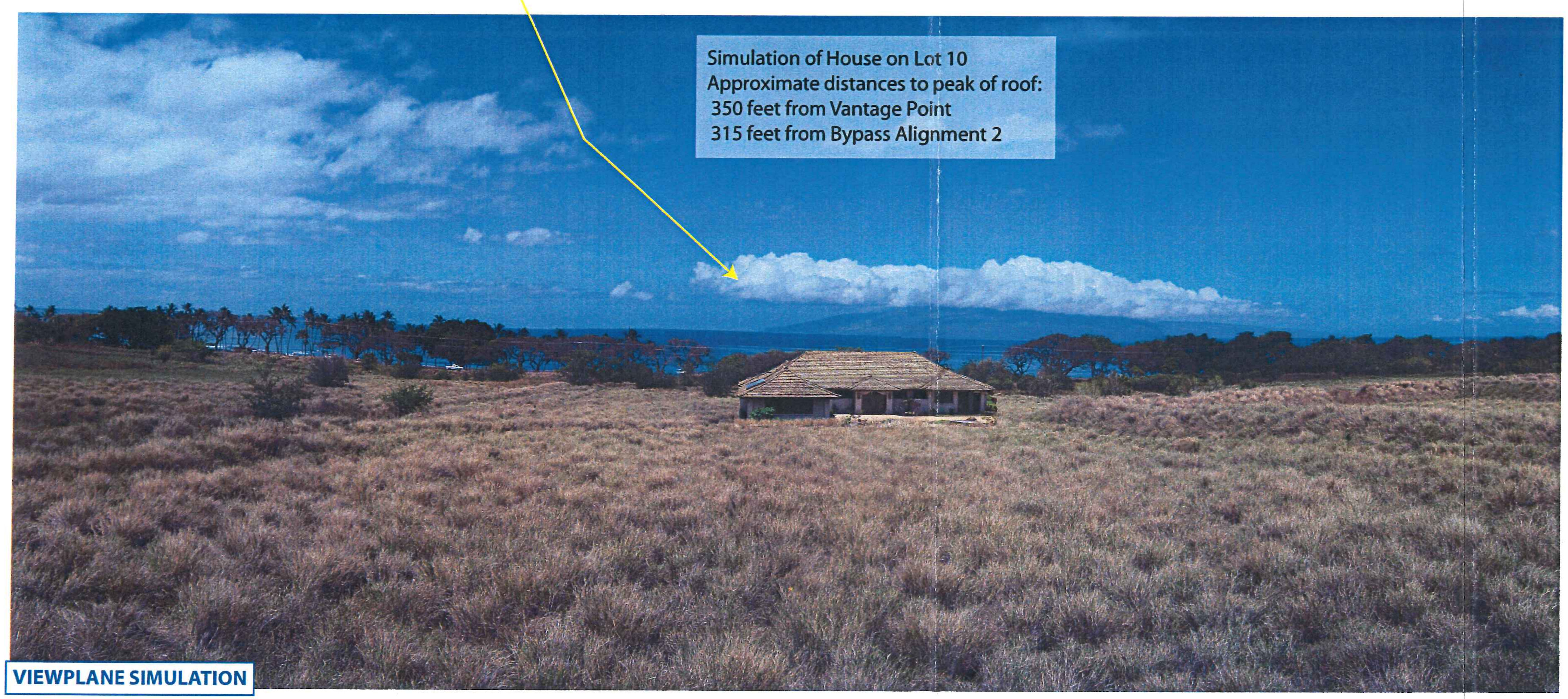
TRANSECT : B

HWY ALIGNMENT # : 2

- ① LAHAINA BYPASS ALTERNATIVE NUMBER
- ▪ MAKILA SUBDIVISION LOT NUMBER
- ● LOCATIONS OF SIMULATED HOMES
- ◉ VANTAGE POINT OF SIMULATION



PLAN VIEW



Simulation of House on Lot 10
Approximate distances to peak of roof:
350 feet from Vantage Point
315 feet from Bypass Alignment 2

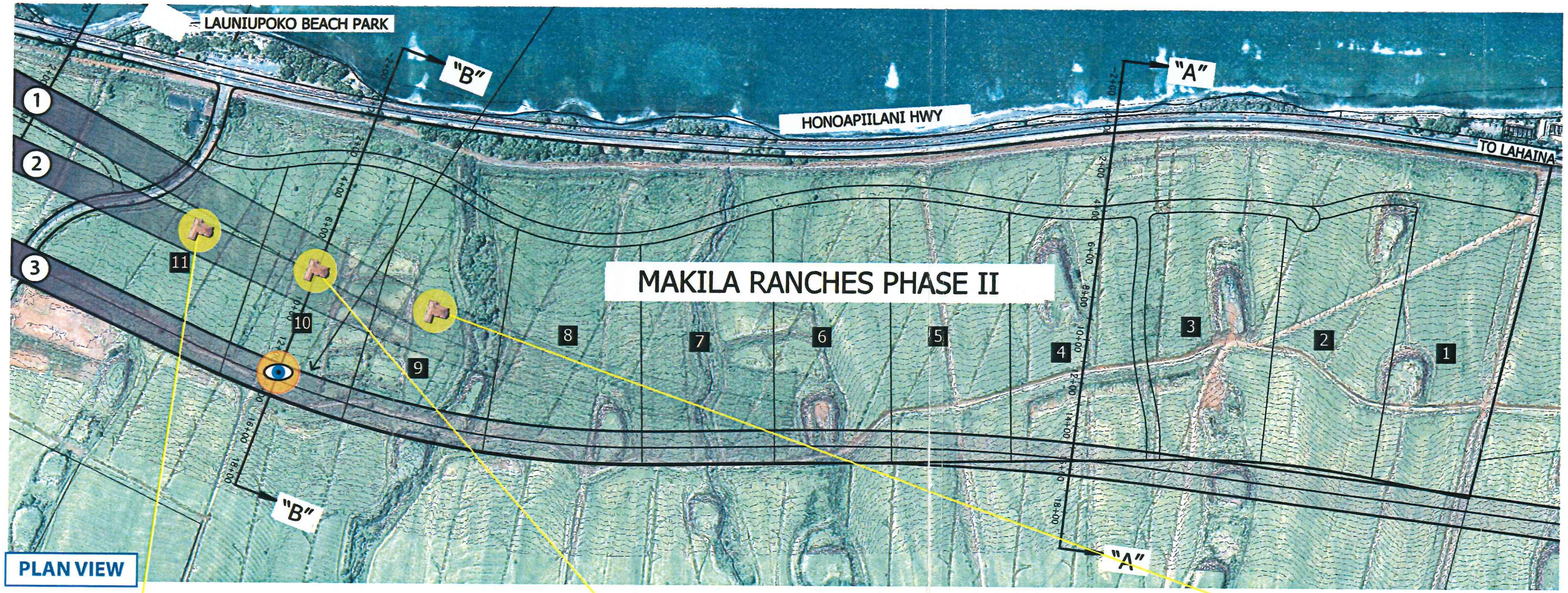
VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

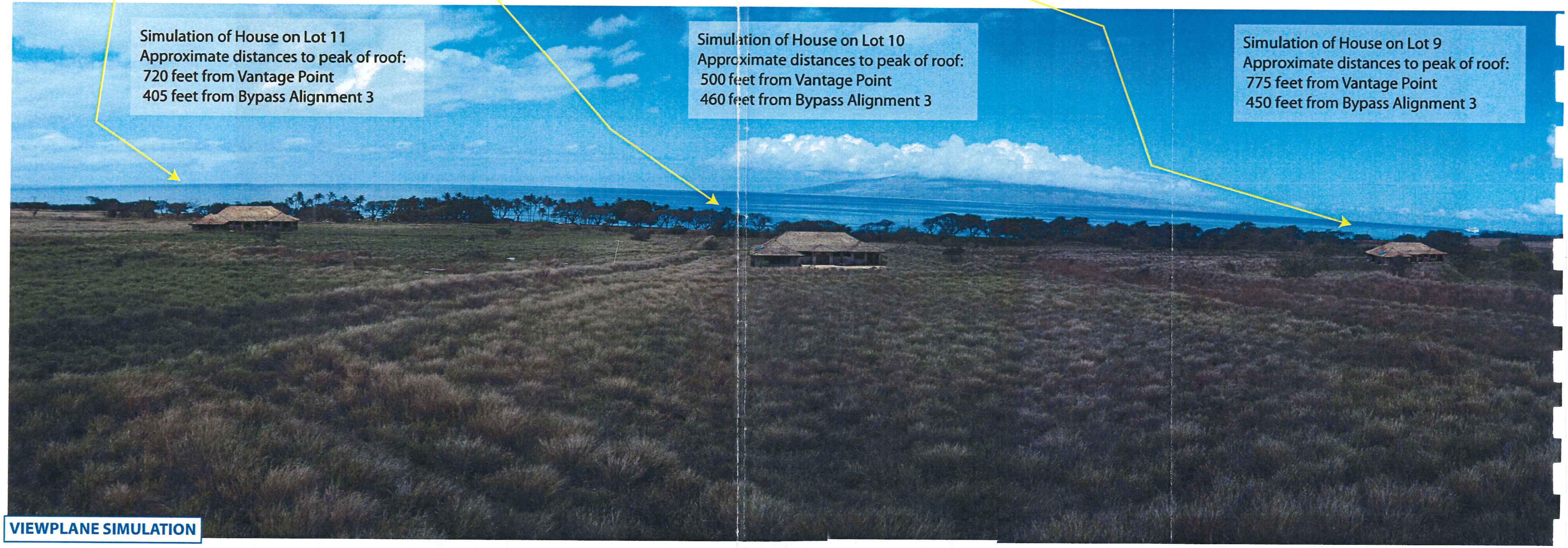
TRANSECT : B

HWY ALIGNMENT # : 3

#	LAHAINA BYPASS ALTERNATIVE NUMBER
#	MAKILA SUBDIVISION LOT NUMBER
●	LOCATIONS OF SIMULATED HOMES
◉	VANTAGE POINT OF SIMULATION



PLAN VIEW



Simulation of House on Lot 11
Approximate distances to peak of roof:
720 feet from Vantage Point
405 feet from Bypass Alignment 3

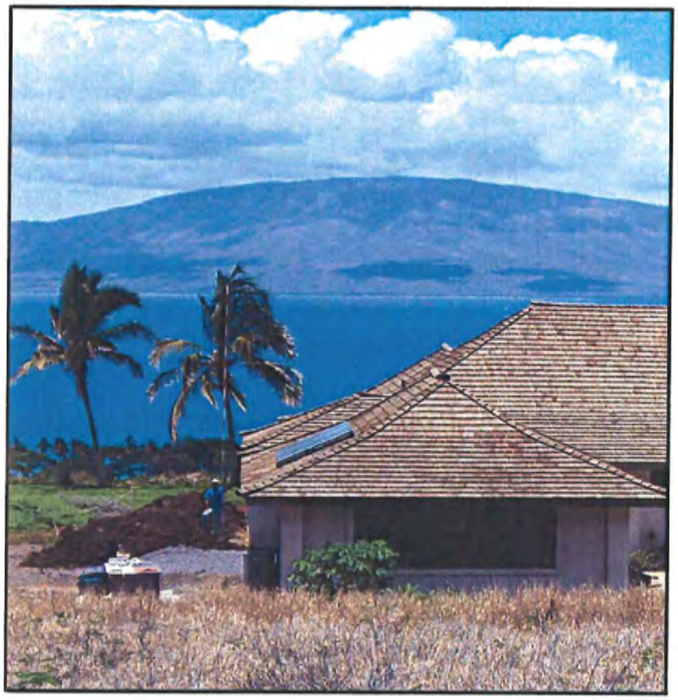
Simulation of House on Lot 10
Approximate distances to peak of roof:
500 feet from Vantage Point
460 feet from Bypass Alignment 3

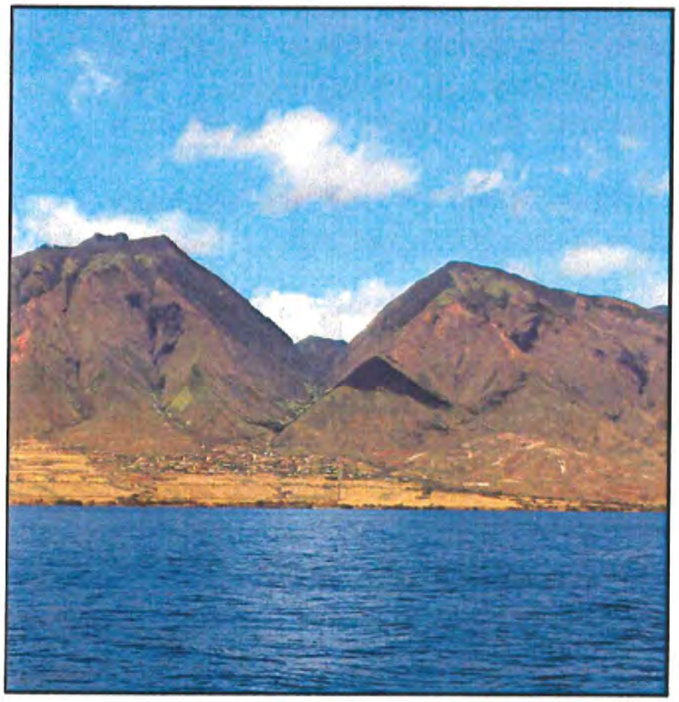
Simulation of House on Lot 9
Approximate distances to peak of roof:
775 feet from Vantage Point
450 feet from Bypass Alignment 3

VIEWPLANE SIMULATION

LAHAINA BYPASS - SOUTHERN EXTENSION / MAKILA RANCHES III SUBDIVISION

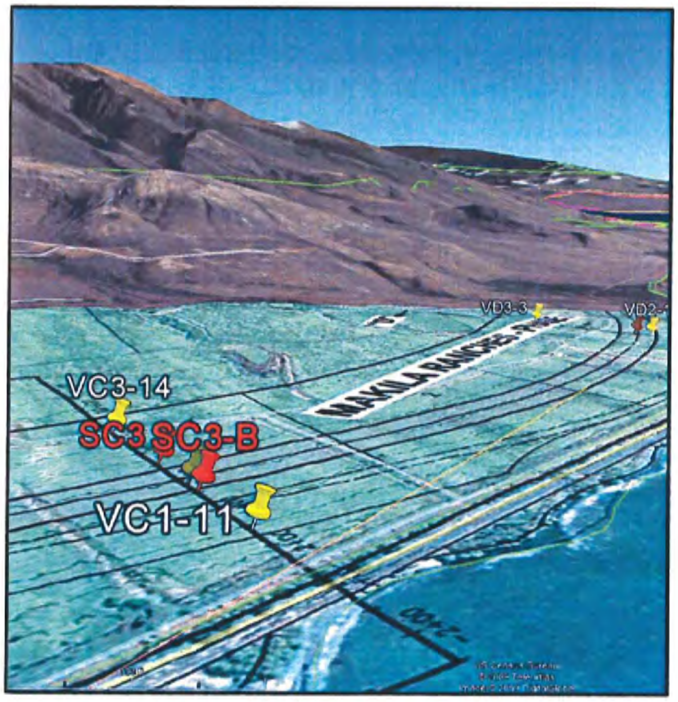
MASSING / VIEWPLANE SIMULATION





PREPARED FOR
MAKILA LAND CO., LLC

PREPARED BY
HAWAII LAND USE GROUP LLC
MARCH 2009



HAWAII LAND USE GROUP LLC
PO BOX 880779 PUKALANI HI 96788

March 2009

Proposed Lahaina Bypass Southern Terminus Relocation & Makila Ranches III Development Massing / Viewplane Simulation

Overview

This visual study has been prepared to simulate views towards the ocean with regard to two developments are being proposed in the Launiupoko Ahupua`a just east of Lahiana Town in the West Maui region. The projects evaluated are the proposed extension of the Lahaina Bypass Southern Terminus and the subdivision known as the 7-lot Makila Ranches III subdivision.

The study consists of six (6) exhibits; of which each contains:

- A photographic simulation of the coastal viewplane from one of six selected vantages associated with the future highway alignment alternatives within the proposed Ranches III subdivision. The simulation depicts the coastal views over the subject subdivision from the proposed highway corridor.
- A plan-view map identifying the location of the vantage, the proposed highway alignment, and the locations of simulated dwellings.

Purpose

The visual study has been developed for the primary purposes of:

- Provide an elevation-correct simulation the coastal views from the 3 proposed Highway Alignments
- Provide a scale-accurate simulation of development massing in the proposed subdivision from pre-selected highway vantages and building locations

Mapping and View/Vantage Selection

In preparation for selecting the views and vantages to be included in the study, the preparer met with Mr. Rory Frampton, a consultant to Makila Land Co., LLC (landowner) to review background information and choose representative locations for vantage points and dwelling-simulation locations.

Source mapping of lot boundaries, topography, aerial photography, and proposed highway alignments were provided in exhibits entitled "Honoapiilani Highway Realignment Alternatives" prepared by Warren S. Unemori Engineering Inc. prepared on February 27th and March 18th 2008.

Four shoreline-perpendicular transects labeled A through D were selected and mapped as a baseline for photographic simulations. Transects A and B occur within the Makila Ranches II subdivision.

Locations for the simulated agricultural dwellings were selected by Makila in locations deemed representative of natural homeowner selection, and generally in the middle of the developable area, as bound by the proposed coastal roads and respective highway realignment.

Upon selection, vantage and simulation locations were located by GPS and flagged on site.

Vantages – Panoramic Photos

Vantage shots were taken along each transect at a point representing the approximate middle of the seaward traffic lane of the respective highway alignment. The elevations of the vantage photographs were established 5 feet above the proposed elevation of the highway to mimic the view of a pedestrian, cyclist, or occupant in a vehicle.

Because the proposed highway alternatives would be constructed above grade, vantages were photographed from a calculated elevated position above existing grade. Calculations were based upon the profile data included in the 2008 Unemori exhibits. A telescoping survey pole with a camera mount was utilized to provide the correct elevation for the photographs.

Elevations of the vantages were as follows:

C-1	Transect C Alignment 1	11 feet above existing grade
C-2	Transect C Alignment 2	16 feet above existing grade
C-3	Transect C Alignment 3	14 feet above existing grade
D-1	Transect D Alignment 1	13 feet above existing grade
D-2	Transect D Alignment 2	19 feet above existing grade
D-3	Transect D Alignment 3	3 feet above existing grade

A second 25-foot stadia pole was hand held or erected at the pre-designated dwelling simulation locations during vantage photography to provide ground reference scale in photographic panoramas. Dwelling locations were photographed in the vantage shots C-3 and D-3. No dwellings were simulated for Bypass alternatives 1 or 2 based upon the presumption that the buildable area of the lot would be above, not below the bypass due to the alternative's proximity to the ocean.

Vantage Photographs were taken on 5/15/08, 5/20/08, 6/18/08, and 7/14/08. Vantage photographs were assembled into panoramic photographs utilizing

Photomerge/Photoshop application software made by Adobe Systems Incorporated.

Views - Simulated Dwellings

The regional neighborhood was surveyed for a photographic "source" "Specimen Dwelling" that would represent a large-sized single story dwelling or a two-story structure no greater than 25 feet in height. A suitable one-story dwelling with a significant roof height was selected from the abutting neighborhood. The specimen is a 5215 s.f. (per County RPT, TMK (2) 4-7-011:004) dwelling over 100 feet in width and having a peak roof height (along width) of approximately 23.5 feet (as observed). The specimen was photographed from various angles. A 25-foot graduated stadia pole was aligned with the peak of the roof to serve for future reference when the photographs were scaled to the ground controls photographed in the vantage panoramas.

Vegetation

Vegetation / Landscape Planting associated with agricultural dwellings or large-scale farming was not simulated in the viewplane simulations. It was felt that the State and County land use controls specifying agricultural use of the subject property would permit the planting of obstructive crops (trees) with or without the proposed subdivision or the development of dwellings. Because the viewplane obstruction due to farming or landscape planting had infinite possibilities with or without the proposed subdivision, the scope of the study focused on the finite and measurable differences due to the subdivision, specifically the view impacts due to the siting and massing of agricultural dwellings.

Viewplane Simulations

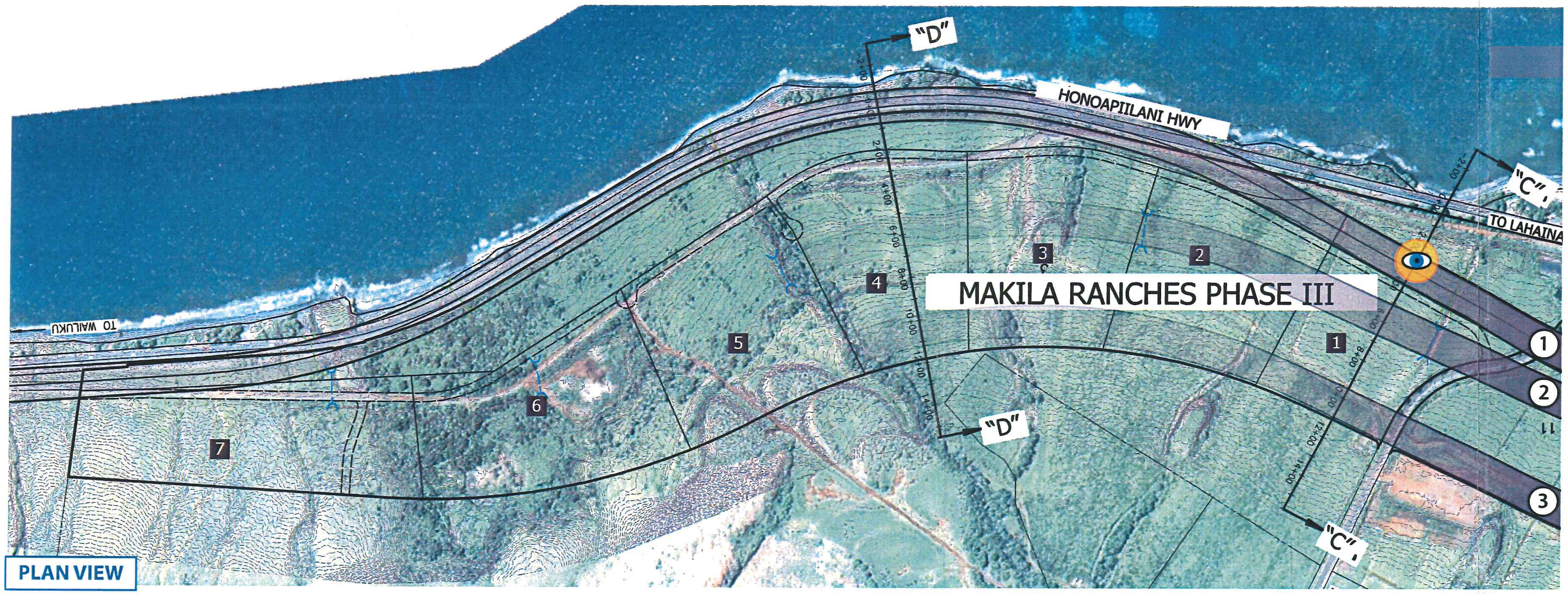
Six simulations were created from the selected vantage points.

In the two simulations from Bypass alternative 3 (C-3 and D-3), photographs of the specimen dwelling were inserted into the vantage panorama and scaled to the correct size utilizing the physical ground controls photographed in both photographs. Lighting levels in the dwelling photograph were adjusted to match those in the panorama. Where the simulated dwelling was obstructed by existing topography, the simulated dwelling was cropped to provide a realistic view. Where cropping was significant, the outline of the pre-cropped structure was provided to retain visual scale despite the obstruction by topography.

LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

TRANSECT : C

HWY ALIGNMENT # : 1



PLAN VIEW

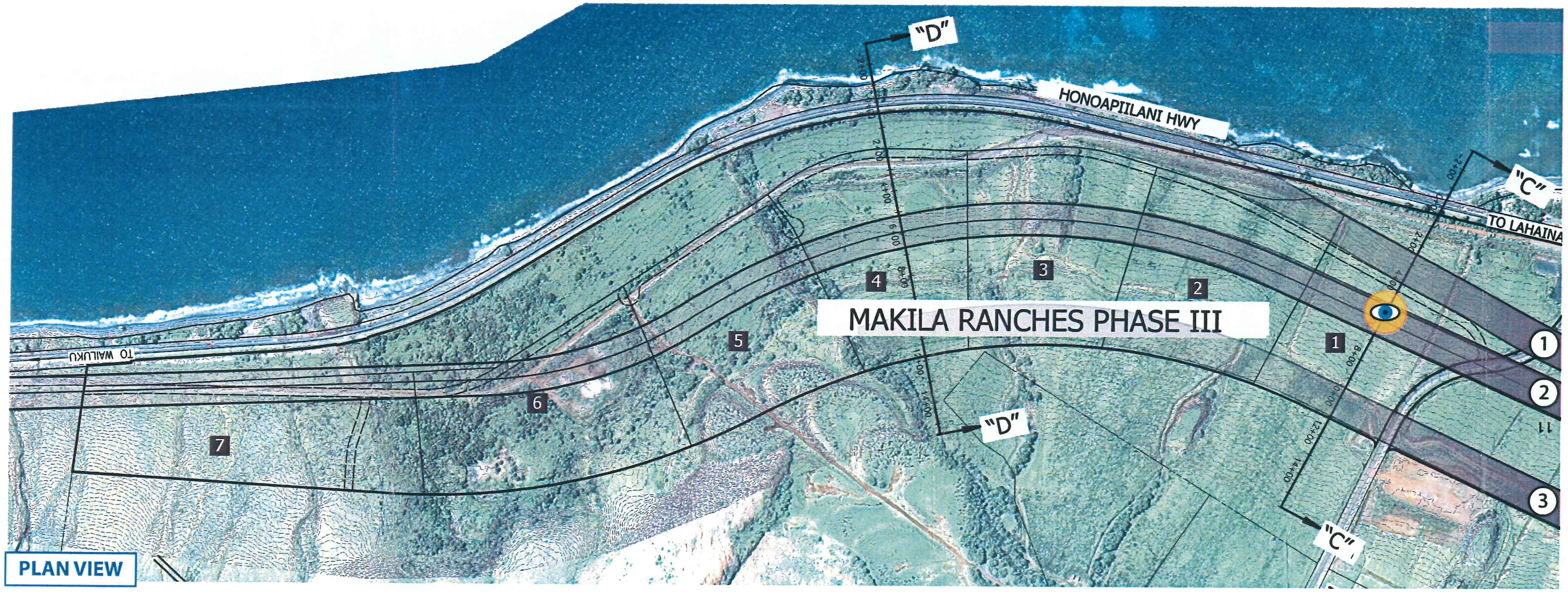
⓪#	LAHAINA BYPASS ALTERNATIVE NUMBER
■#	MAKILA SUBDIVISION LOT NUMBER
●	LOCATIONS OF SIMULATED HOMES
◉	VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : C

HWY ALIGNMENT # : 2



PLAN VIEW

①	LAHAINA BYPASS ALTERNATIVE NUMBER
#	MAKILA SUBDIVISION LOT NUMBER
●	LOCATIONS OF SIMULATED HOMES
●	VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

TRANSECT : C

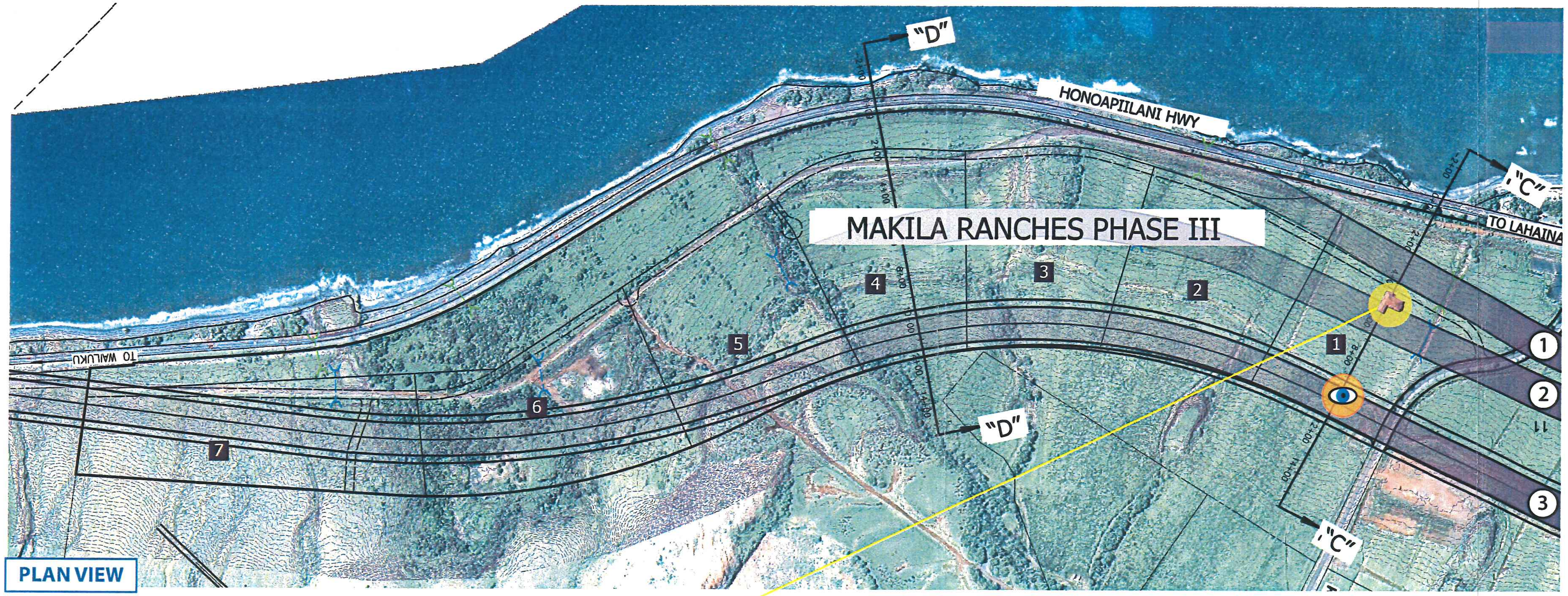
HWY ALIGNMENT # : 3

(#) LAHAINA BYPASS ALTERNATIVE NUMBER

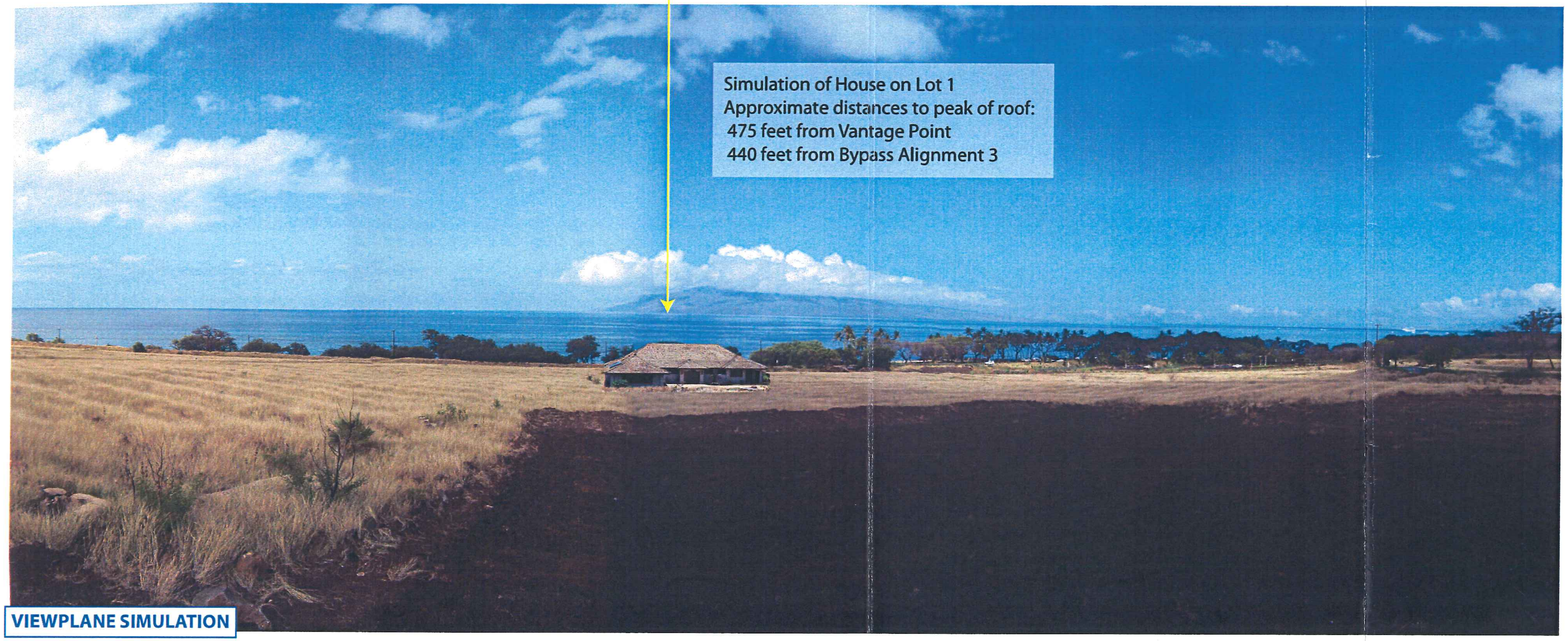
■# MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

VANTAGE POINT OF SIMULATION



PLAN VIEW



Simulation of House on Lot 1
Approximate distances to peak of roof:
475 feet from Vantage Point
440 feet from Bypass Alignment 3

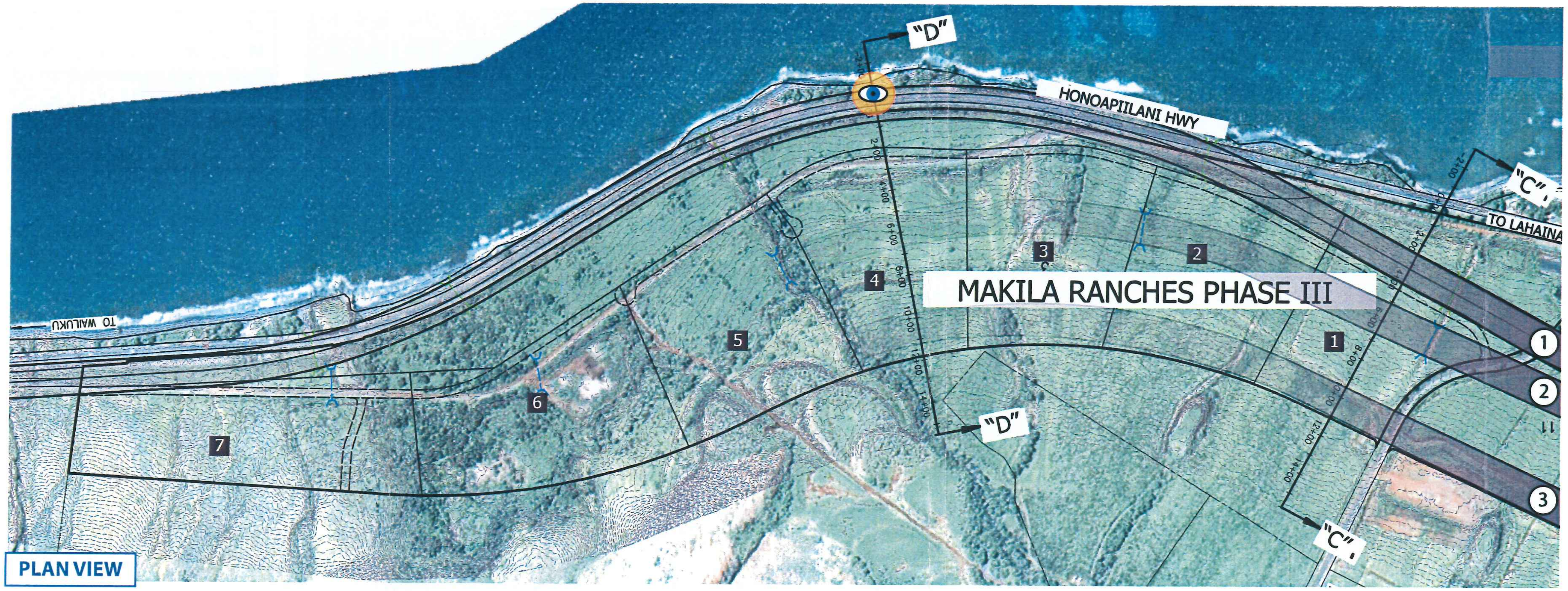
VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : D

HWY ALIGNMENT # : 1

(#)	LAHAINA BYPASS ALTERNATIVE NUMBER
#	MAKILA SUBDIVISION LOT NUMBER
	LOCATIONS OF SIMULATED HOMES
	VANTAGE POINT OF SIMULATION



PLAN VIEW

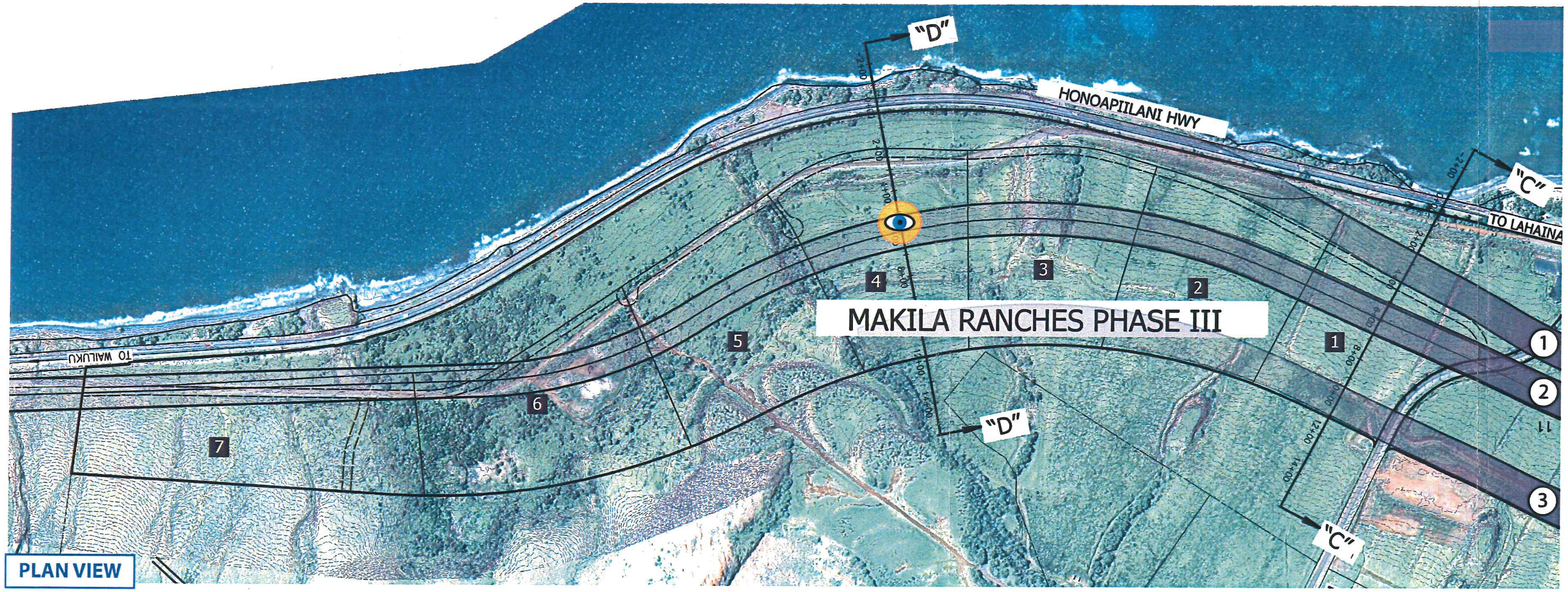
VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : D

HWY ALIGNMENT # : 2

#	LAHAINA BYPASS ALTERNATIVE NUMBER
#	MAKILA SUBDIVISION LOT NUMBER
🏠	LOCATIONS OF SIMULATED HOMES
👁	VANTAGE POINT OF SIMULATION



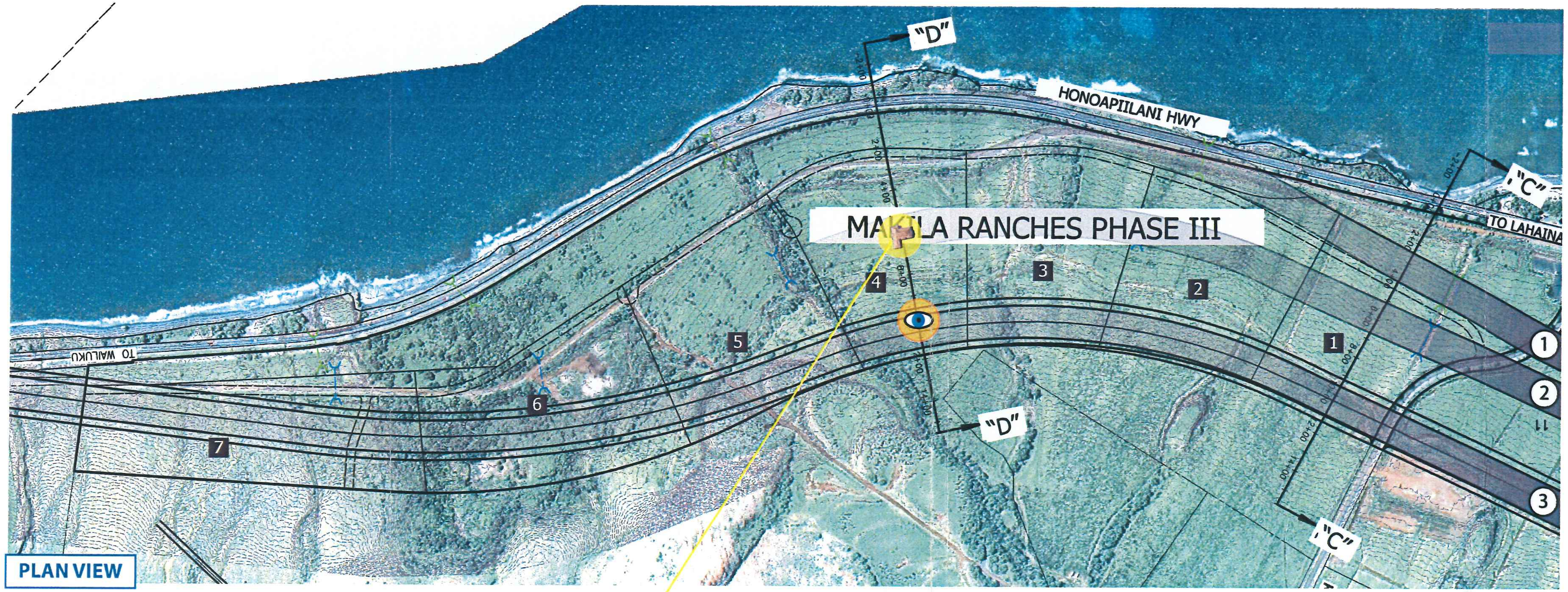
PLAN VIEW

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION MASSING / VIEWPLANE SIMULATION

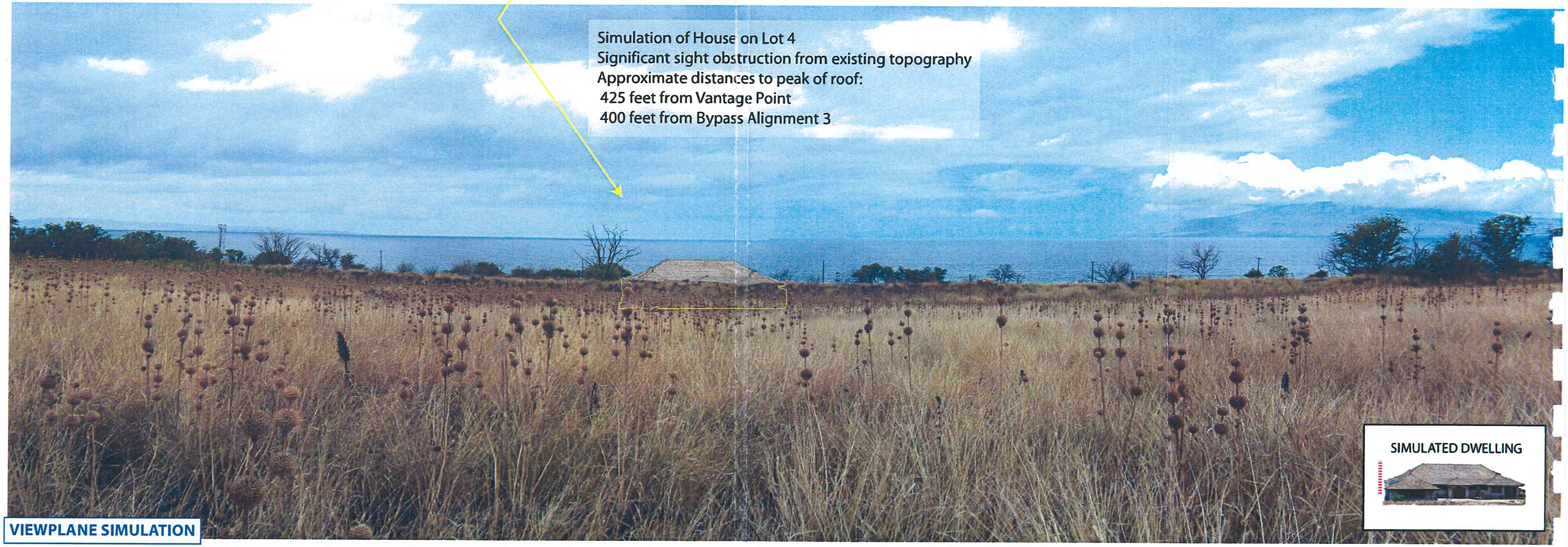
TRANSECT : D

HWY ALIGNMENT # : 3



PLAN VIEW

- ⓘ# LAHAINA BYPASS ALTERNATIVE NUMBER
- ■# MAKILA SUBDIVISION LOT NUMBER
- ● LOCATIONS OF SIMULATED HOMES
- ◉ VANTAGE POINT OF SIMULATION



Simulation of House on Lot 4
Significant sight obstruction from existing topography
Approximate distances to peak of roof:
425 feet from Vantage Point
400 feet from Bypass Alignment 3

VIEWPLANE SIMULATION

APPENDIX I.

Archaeological Inventory Survey

SCS Project Number 652-3

AN ARCHAEOLOGICAL INVENTORY SURVEY OF 633 ACRES IN THE LAUNIUPOKO (LARGE LOT) SUBDIVISION NOS 3, 4, and 7 LAUNIUPOKO AND POLANUI AHUPUA`A DISTRICT OF LAHAINA (FORMERLY KĀ`ANAPALI) ISLAND OF MAUI, HAWAI`I [TMK (2) 4-7-01:2 por.]

Prepared by:
C. Kanani Paraso, M.A.
and
Michael Dega, Ph.D.
Revised October 2012

Prepared for:
West Maui Land Company, Inc.
33 Lono Avenue, Suite 450
Kahului, Maui, HI 96732

ABSTRACT

Scientific Consultant Services (SCS), Inc. conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District (formerly Kā`anapali District), Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.]. The project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing.

A total of ten sites were identified, the majority of which are historic in age. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the irrigation ditches was previously recorded by PHRI (2000) as State Site Number 50-50-03-4787 Feature D and is referred to as Lahaina Pump Ditch No. 1. Site 50-50-03-5950 is composed of 17 linear, large rock mounds scattered throughout the project area. Site 50-50-03-5951 consists of an irrigation ditch, water pipes, reservoir, and flume. Site 50-50-03-5952 is a terrace complex associated with the manual cultivation of sugarcane. Site 50-50-03-5957 is also a terrace associated with sugarcane cultivation. Two of the ten sites are rock walls associated with the cattle ranching era, one of which was previously recorded by Graves *et al.* (1998) and Haun *et al.* (2001) as State Site Number 50-50-03-2665. The other rock wall is designated Site 50-50-03-5954. One of the ten sites (Site 50-50-03-5953) is a scatter of slag fragments and cores interpreted to be a historic work area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites 50-50-03-5955 and 50-50-03-5956 are indeterminate but are simply referred to as activity areas. Site 50-50-03-5955 is a modestly modified rock deposit/bedrock area containing a small cache of coral fragments. This is site is simply interpreted as a modified area as disturbance, erosion, and lack of cohesiveness renders interpretations difficult. Site 50-50-03-5956 is a midden and lithic scatter that also contains historic material such as glass and metal fragments. Material was sampled during surface collection. No cultural materials were observed during subsurface testing.

All of the sites identified during Inventory Survey are significant under Criterion D. All the sites have been thoroughly mapped and recorded. No further work is recommended for these sites. SIHP 50-50-03-5950, the large plantation era clearing mounds, have been discussed within the community from a cultural perspective. Oral documentation by former plantation employees suggests that the mounds may have been constructed upon existing stone structures, and cultural materials were periodically placed within the mounds during field clearing (Kirkendall 2006). If development of the area requires any deconstruction of these mounds, Site 5950, a qualified archaeologist should monitor these activities. In general the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits is very low. Other then Archaeological Monitoring at Site 50-50-03-5950, no further work is recommended in the project area.

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INTRODUCTION

At the request of West Maui Land Company, Inc., Scientific Consultant Services (SCS), Inc. conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District (formerly Kā`anapali District), Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.] (Figures 1 and 2). The project area includes Large Lots 3 (214 acres), 4 (271 acres), and 7 (148 acres). The lands are currently owned by Makila Land Company, LLC. The majority of the project area was used for sugarcane cultivation and subsequently for cattle ranching; a portion of the project area (Lot 4) is still used for ranching.

This Inventory Survey included historic background research and settlement pattern analysis prior to fieldwork, systematic pedestrian survey of the entire project area, mapping and recording of identified features, and representative manual and mechanical testing of sites. Mechanical testing through trenching was also conducted in areas without surface sites to assess the presence/absence of subsurface cultural deposits in representative portions of the project area. Fieldwork was conducted between January 23, 2006 and February 28, 2006 by SCS employees Tomasi Patolo, B.A. (Field Director), Jennifer Frey, B.A., Eric Pope, B.A, and Donna Shefcheck, B.A. The Principle Investigator for this project is Michael Dega, Ph.D.

Archaeological Inventory Survey of the project area was conducted to determine the presence/absence of archaeological sites and features in surface and subsurface contexts through complete systematic pedestrian survey and representative subsurface testing. The ultimate goals were to identify archaeological sites, adequately record and document all of the sites present, determine the significance of the sites, and to provide recommendations to the State Historic Preservation Division (SHPD) regarding site significance and mitigation in regards to future land use in the project area.

ENVIRONMENTAL SETTING

LOCATION

The project area consists of 633 acres of "undeveloped" land located on the western slopes of the West Maui range situated between coastal areas to the west and mountainous terrain to the east. The land is "undeveloped" per current housing but has been formerly developed through sugar cane cultivation (see below). The majority of the project area falls within the bounds of Launiupoko Ahupua`a. The northern portion of the project area extends into the southern half of Polanui Ahupua`a. Elevation of the project area ranges from sea level to

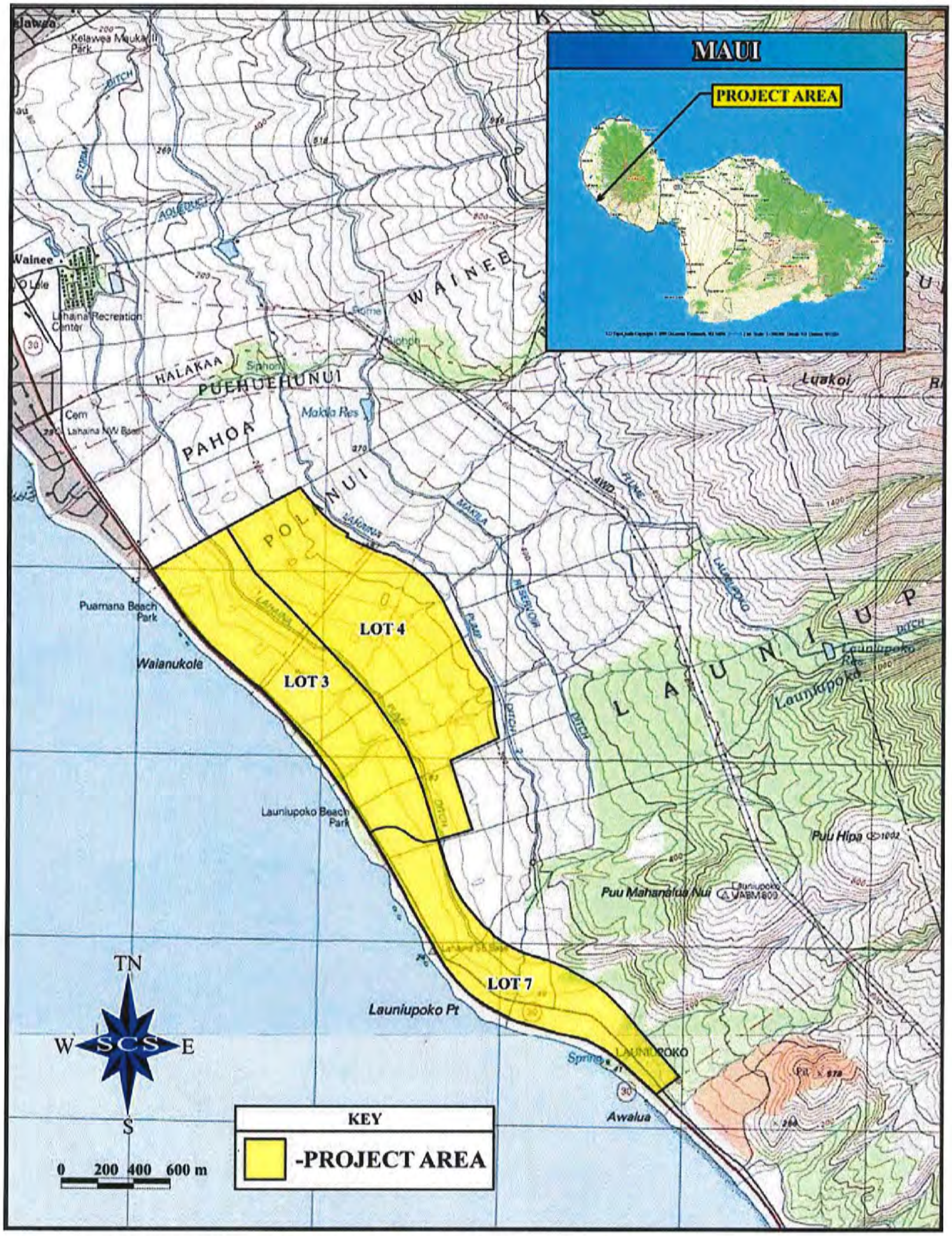

Figure 1: USGS Lahaina Quadrangle Map Showing Project Area.

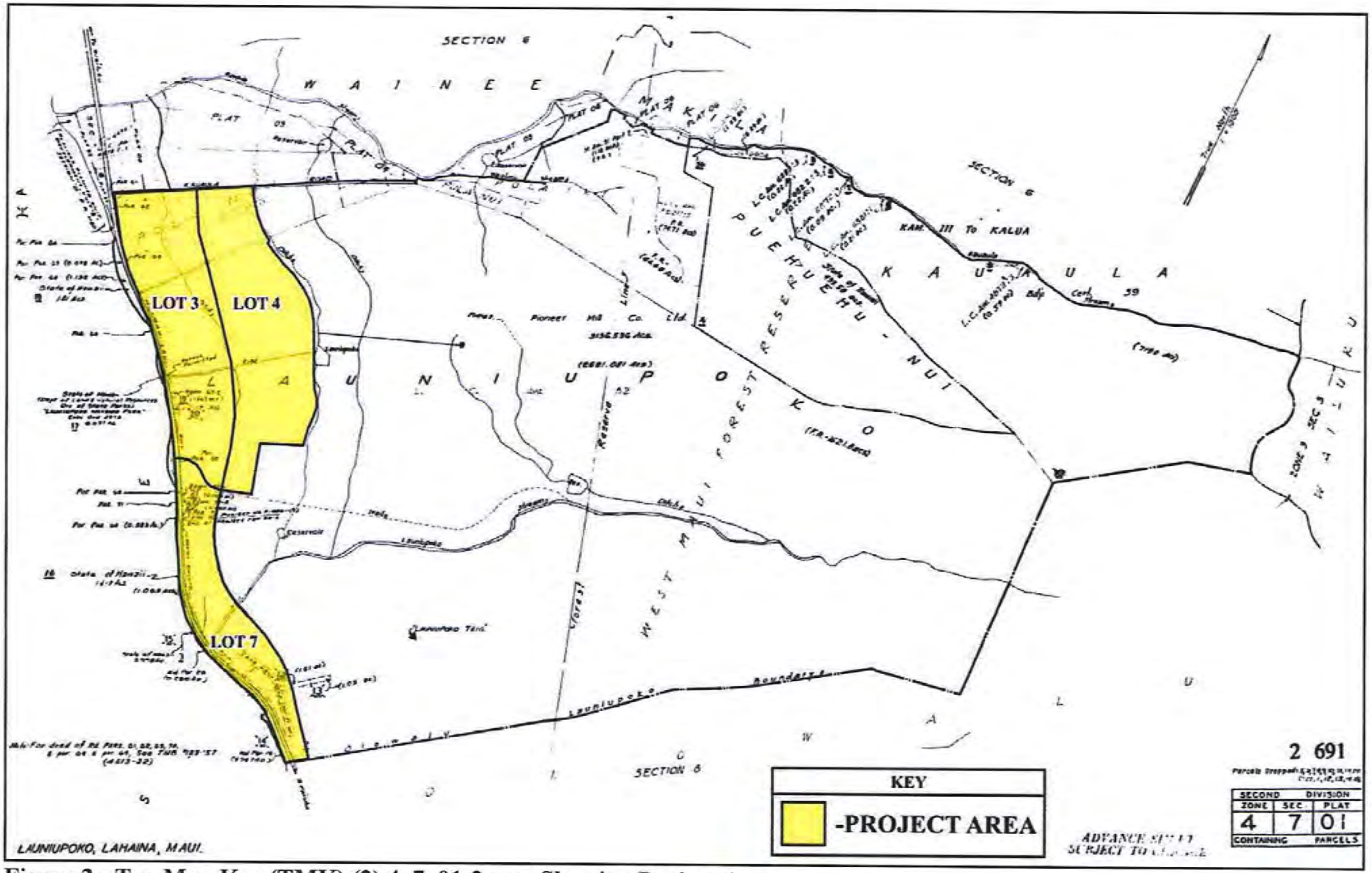

Figure 2: Tax Map Key (TMK) (2) 4–7–01:2 por. Showing Project Area.

approximately 250 feet above mean sea level (amsl). The project area is bound on the west by Honoapi`ilani Highway and on the north by Kaua`ula Road. Hāniu Street forms the eastern boundary in the northern half of the project area. The southern half of the project area narrows, crosses Kai Hele Ku Street, and extends to the Launiupoko and Olowalu Ahupua`a boundary.

LANDFORM AND SOILS

According to Foote *et al.* (1972), soils in the project area fall primarily into three sub-classifications of the Wainee soil series. The Wainee soil series consists of well-drained soils on alluvial fans, developed in alluvium derived from weathered basic igneous rock, and are gently to moderately sloping. These soils are used mostly for sugarcane. The Wainee Series derivatives are similar yet differ primarily by slope and stone content. Within the project area the WxB (Wainee very stony silty clay) soil is present near the coast. This soil is only mildly sloping (3–7%) with slow runoff and a slight erosion hazard. Stones cover as much as 3 percent of the surface. The WyC soil (Wainee extremely stony silty clay) is found inland of the WxB soil and along the coast in the southern portion of the project area. The WyC soil is moderately sloping (7–15%), has moderately rapid permeability, slow to medium runoff, and a slight to moderate erosion hazard. Stones cover 3 to 15 percent of the surface. The WyB soil (Wainee extremely stony silty clay) is found inland within the WyC soil. The WyB soil is only mildly sloping (3–7%), has slow runoff, and a slight erosion hazard. Stony alluvial land (rSM) is found at the very southern portion of the project area, immediately northwest of Launiupoko Gulch. This land type consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans. In most places the slope is 3 to 15 percent.

VEGETATION

The vegetation in the project area includes both indigenous and introduced species. Vegetation consists mainly of shrubs and grasses that occur rather densely in some areas. Shrubs include lantana (*Lantana camara*) and *`ilima* (*Sida fallax*). Trees such as *kiawe* (*Prosopis pallida*), java plum (*Syzygium cumini*), and *`opiuma* (*Pithecellobium dulce*) are present. *Koa haole* (*Leucaena leucocephala*) are also present as shrubs and small trees.

CLIMATE

Rainfall in this environmental zone is very low. The project area receives an average annual rainfall of only 10 to 15 inches with most of it occurring during the winter months (November through April) (Foote *et al.* 1972). Seasonal variation in rainfall amount follows normal orographic patterns for leeward-type areas of Maui (Armstrong 1983).

TRADITIONAL AND HISTORIC SETTING

Archaeological settlement pattern data indicates that initial colonization and occupation of the Hawaiian Islands first occurred on the windward shoreline areas of the main islands between the A.D. 4th and 11th centuries, with populations eventually settling in drier leeward areas during later periods (Kirch 1985). Although coastal settlement was dominant native Hawaiians began cultivating and living in the upland *kula* zones. Greater population expansion to inland areas began between A.D. 11th and 12th centuries and continued through the 16th century. Large scale or intensive agriculture was implemented in association with habitation, religious, and ceremonial activities. Coastal lands were used primarily for settlement while staple crops (i.e. *kalo*/taro) were cultivated in near-coastal reaches, as well as, in watered regions along the plain and in the uplands.

The District of Lahaina, located on the western side of the West Maui Mountains (Mauna Kahalawai), extends from Honokohau Ahupua`a on the north to Ukumehame Ahupua`a on the south. A number of traditional activities took place in this district from fishing and cultivation by early Hawaiians to residential occupation and recreational use by members of the *ali`i* (ruling) class. The district served as an important center both politically and socially during the late prehistoric and early historic period. It was the royal chiefly center for centuries (Thrum 1974; Walker 1981; Kirch 1985; Kamakau 1992; Sterling 1998) and played a key role in the intra-island warfare associated with island unification. By the late 1700s, Kamehameha I had firmly established his presence on Maui with the invasion of Lahaina. By the early 1800s, Kamehameha I designated Lahaina the capital of the Hawaiian Kingdom. Lahaina served as the capital until 1845 when it was moved to Honolulu. In 1819, the first whaling ship Bellina arrived in what would later be known as Lahaina Harbor. Lahaina served as the center of commercial whaling in the Pacific until the mid-1800s. After the decline of the whaling industry, Lahaina and surrounding areas became a base for sugarcane plantations. Most recently tourism is the main industry in Lahaina.

TRADITIONAL SETTING OF LAHAINA

Lāhainā is the traditional spelling and pronunciation of what we presently call Lahaina. Lāhainā literally translated means "cruel sun," said to be named for a time of terrible droughts (Pukui *et al.* 1974:127). Others believe the original name for Lahaina was Lele which is usually the flying piece of a *kuleana* (small piece of property) near the shore (Sterling 1998:17). As Lahaina is situated along the shoreline the name is applicable. Pukui *et al.* (1974:127) also note that Lahaina is associated with the Kaua`ula wind that caused the destruction of churches and buildings in Lahaina in 1828 and again in 1858.

Lahaina is traditionally and historically known for its verdant and abundant groves of breadfruit. Sterling's (1998) *Sites of Maui* references Lahaina as second only to Puna, Hawai`i as a favorable location for breadfruit cultivation. In *mele* (songs) Lahaina is even referred to as *ka malu ulu o Lele*, "the breadfruit shade of Lele" (Handy 1940:190). Ashdown (1970) writes that the name Lele was changed to Laha`ina when it became the home of the noted prophet, Laha`inaloa for whom all of West Maui was named.

According to Handy and Handy (1972:492), the District of Lahaina was a favored place among the high chiefs of Maui and their entourage because of its abundant resources from both land and sea, its warm climate, easy communication with other populated areas around West Maui, and close proximity to the outer islands of Moloka`i and Lāna`i.

Early descriptions of Lahaina village provided by Westerners paint a picture of idyllic tranquility and cooperation among the inhabitants. Menzies, the surgeon and naturalist on board the HMS Discovery during Captain George Vancouver's expedition, states that he and the members of his party "...observed the rugged banks of a large rivulet that came out of a chasm cultivated and watered with great neatness and industry" (Handy and Handy 1972:493). Menzies goes on to describe an afternoon tour of the village on March 17, 1793, as follows:

> I accompanied Vancouver and a party of officers, with the two Niihau women, to see the village of Lahaina, which we found scattered along shore on a low tract of land that was neatly divided into little fields and laid out in the highest state of cultivation and improvement by being planted in the most regular manner with the different esculent roots and useful vegetable of the country, and watered at pleasure by aqueducts that ran here and there along the banks of intersecting fields...In short , the whole plantation was cultivated with such studious care and artful industry as to occupy our minds and attention with a constant gaze of admiration... [Handy and Handy 1972:493].

Little had changed twenty-six years later when J. Arago visited Hawai`i with Captain Louis de Freycinet in 1819. Arago, impressed by the verdant quality of Lahaina and the skill the Hawaiians exhibited in farming, writes:

> The environs of Lahaina are like a garden. It would be difficult to find a soil more fertile, or a people who can turn it to a greater advantage; little pathways

> sufficiently raised and kept in excellent condition...These are frequently divided by trenches, through which a fresh and limpid stream flows tranquilly, giving life to the plantations...[Handy and Handy 1972:493].

In *The Hawaiian Planter*, Handy (1940:159) discusses the proliferation of fishing settlements and isolated fishermen's houses all the way from Kihei to Honokahua and mentions the cultivation of *`uala* (*Ipomea batatas*, sweet potato) in the red *lepo* (sandy soil) near the shore. Handy (1940) points out that this coast is the most favorable on Maui for fishing and that *kula* lands (uplands) were ideal for the cultivation of sweet potato. According to Handy (1940:106), the *ali`i* Kaka`alaneo lived on Keka`a Hill in Lahaina District. Keka`a became the capital of Maui during Kaka`alaneo's reign and was also an area of intense cultivation. Fornander (1918–19, Vol. 5:540–41) discusses how Kaka`alaneo planted *kukui* (*Aleurites moluccana,* candlenut) and *`ulu* (*Artocarpus incisus*, breadfruit) at Lahaina village.

According to Thrum (1974), in *Hawaiian Annual*, an infamous chief named Hua, who was born in Lahaina and reigned prior to the 10th century, is credited with the construction of the first *heiau* (temple) on Maui. Hua is also referred to as Hua-a-Pohukaina and Hua-a-Kapuaimanaku, names by which his father was also known. Hua is known for the construction of two *heiau* in Lahaina. Another Hua, two generations later, is credited with the construction of a third. Three additional *heiau* are said to date to or just prior to the reign of Kahekili (Thrum 1974).

Lahaina was known as a *pu`uhonua* or place of refuge in Maui. The *pu`uhonua* at Lahaina was associated with Ka`ahumanu who inherited her lands from her husband Kamehameha. In *Ruling Chiefs of Hawai`i*, Kamakau (1992:312) discusses how Ka`ahumanu's lands of Waipukua in Waihe`e, Kalua`aha in Moloka`i, and Pu`umau in Lahaina were deemed places where people could be saved from death.

Fornander (1969) discusses how Lahaina figured prominently in battles between various island chiefs. In the early 1700s, wars between Alapa`inui of Hawai`i, in conjunction with Kamehamehanui of Maui, and Kauhi (Kamehamehanui's brother) occurred. Alapa`inui established his headquarters at Lahaina village while the rest of his army occupied the coast extending from Honokowai to Ukumehame. With the pending arrival of Peleioholani from O`ahu, who was to assist Kauhi, Alapa`inui destroyed the *kalo* patches and broke down *`auwai* belonging to the followers of Kauhi in the vicinity of Lahaina. Eventually the forces met, Fornander writes:

> ...The fortune of the battle swayed back and forth from Honokowai to near Lahaina; and to this day heaps of human bones and skulls, half buried in various places in the sand, attest to the bitterness of the strife and carnage committed [Fornander 1969, Vol. 2:140].

Lahaina also played a crucial role in the intra-island warfare that led to island unification and the establishment of the capital of the Hawaiian Kingdom by Kamehameha I. In February of 1795, Kamehameha established his presence on Maui with the invasion of Lahaina. Kamehameha's great fleet of war canoes landed in Lahaina covering the coast from Launiupoko to Mala (Kamakau 1992). That part of Lahaina, covered in food patches and cane fields, was overrun by Kamehameha's men from the island of Hawai`i (Kamakau 1992:171). By 1802, Kamehameha I constructed the brick palace, Moku`ula, in Lahaina, from which the collection of taxes was administered. Lahaina served as the capital of the Hawaiian Kingdom from that time until 1850 when Kamehameha moved it to Honolulu.

TRADITIONAL SETTING OF THE PROJECT AREA

The project area is situated in the *ahupua`a* of Launiupoko, in the District of Lahaina, on the southwest side of West Maui. Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130). Launiupoko is known to be rocky and dry, as rainfall is scarce. In *The Hawaiian Planter*, Handy states that:

> Although there is a sizable stream bed and a deep valley here, there is no visible evidence of wet taro cultivation, and the Hawaiian planters at Olowalu say that *lo`i* never existed in Launiupoko. It is possible that there may have been a few terraces on the level land at the base of the valley, but this is wholly arid land now and covered with dense brush [Handy 1940:103].

According to Handy and Handy (1972:272), the Lahaina District is "flanked by excellent fishing grounds." Although there appears to be few legends pertaining to the Launiupoko area, a search of the literature reveals several references indicating the importance of fishing in Launiupoko Ahupua`a. In *Sites of Maui,* Sterling (1998:27) quotes A.D. Kahaulelio from an article titled "Fishing Lore," *Ka Nupepa Kuokoa*, May 30, 1902, as saying "[t]he schools of *nehu* [*Stolephorus Purpureus,* an important bait fish used to catch tuna] were accustomed to coming in to Launiupoko and Keonepoko in the District of Lahaina, and sometimes at Mala." Kahaulelio also wrote the following about shark fishing in the area:

> Hoomoemoe Fishing for Sharks—It was much practiced by old timers of this ahupua`a of Makila, and also by the people of the upland of Kauaula since we

> were children...The kinds of sharks caught by the hoomoemoe method were lalakea and hammerheads...the place where hoomoemoe fishing was done was at Pahee, in Launiupoko, Lahaina. When you arrive at the little cape of Keahuiki and down the small incline, the first stretch you come to extending over to the rocky beach and adjoining with the sand on the left side, that is the place where the nets were laid [Sterling 1998:27].

LAND TENURE

The land tenure system in prehistoric Hawai`i was rooted in a different epistemological framework than the subsequent colonially-imposed framework of private land ownership. The idea of holding land was not synonymous with owning it, but is described as closer to a trusteeship between the *ali`i nui* (ruling chiefs) of the island and the traditional Hawaiian *akua* (gods) Lono and Kāne (Handy and Handy 1972:41). Each island was divided into *moku* (districts) that were solely geographical subdivisions. The number of these *moku* depended upon the size of each island. *Moku* were partitioned into smaller landholding units known as *ahupua`a* that were governed by *ali`i* or designated *konohiki*. The *ahupua`a* varied in size but ideally encompassed land from the mountain to the sea, allowing the chiefs and *maka`āinana* (commoner) access to both land and marine resources. All persons from chiefs to commoners were entitled to portions of these resources (Chinen 1994).

The prehistoric period in the Hawaiian Islands came to an end with the arrival of Captain Cook to the island of Kaua`i in 1778. The years to follow would drastically alter the political, agricultural, and social foundation of the Hawaiian Kingdom. Destabilization of Hawaiian society was further intensified by the profound reformation of the traditional land system.

The 1848 Māhele introduced land privatization putting an end to the traditional Hawaiian land system. Under the Māhele both chiefs and commoners alike were required to obtain private land titles (Kame`eleihiwa 1992). Individuals holding land were required by new Western notions of law to submit their claims or forfeit their land. Hawaiians were permitted to claim lands on which they had lived and cared for, however, often times *maka`āinana* were ill informed of the procedures and failed to make claims, ultimately resulting in the loss of land that they had occupied for generations. Kirch discusses traditional Hawaiian land use strategies as revealed through Land Court Award testimonies and records and the effect the Māhele had on the fundamental structure of traditional Hawaiian culture:

> While LCA (Land Court Awards) establish historic land utilization in Hawai`i (during the *Māhele*), documented testimony from many land recipients have also demonstrated continuous generational occupation of the land. Settlement

> patterns illustrated in the LCA records highlight the multi-functional land use practices related to habitation and agriculture and perhaps the clear connection of these strategies. By mid-century, the fledgling [Hawaiian] Kingdom undertook the single most significant inducement to cultural change, the Great Māhele or division of lands between the king, chiefs, and government, establishing land ownership on a Western-style, fee-simple basis. From this single act, an entire restructuring of the ancient social, economic, and political order followed [Kirch 1985:309].

The Waihona `Aina database (2000) compiles land ownership data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.), and Foreign Testimony (FT n.d.). The database lists only one claim for Launiupoko. The entire *ahupua`a* of Launiupoko consisting of 3,778 acres was awarded to Thomas Phillips (Royal Patent 1358 LCA 82); no *kuleana* lands were awarded within the *ahupua`a* (Figure 3). This LCA proved to be somewhat controversial as Kekauluohi (Kamehameha III) made a stipulation that "this land shall not be conveyed to a haole and one who does not reside in Hawai`i." Testimonies concerning the boundaries reference a rock called Kohe Kili Pōhaku, which is described as "a place of one of the kohe (female genitalia) dropping diversions used by Pele's sister as she was fleeing the unwanted advances of Kamapua`a (Orr in Graves *et al.* 1998: Appendix A). The testimony also references two graveyards, one in Launiupoko and one in Polanui. Additional testimony over the boundary of Phillips's claim mentions the same rock, it states, "I have always heard the old people say that the parting here between the two lands runs down to Keahoiki, which is a point near a large rock called Kohe Kili pohaku. It is a place where the old Gods stood" (Waihona `Aina 2000). Orr's research of archival information from the Bureau of Conveyances document several mortgage transactions regarding the parcel. In 1853, Phillips mortgaged the property to Z. Kaauwai and then in 1856 to Antonio Sylvia (Graves *et al.* 1998: Appendix A). In 1857 it was mortgaged and paid off to James R. Dow. Orr (Graves *et al.* 1998: Appendix A) provides the last reference to the property, "4 pcs" in Launiupoko, from the Grantor Index 1845-1869, which shows Grantor C. Coady by Atty to Grantee Charles Lake in 1864, the year Phillips died. This same Grantor Index shows there was a record of a deed transaction between Grantor Benjamin Pittman by Atty to Grantee Campbell and Thurton concerning "various Pioneer Mill Plantation" lands in Lahaina (no date) (Graves *et al.* 1998: Appendix A). Additional Circuit Court documents concerning Phillips's landholding in Launiupoko were located by Orr at the Hawai`i State Archives. These documents describe how Phillips's Hawaiian wife and heir, Kahoomaeha, was denied rights to the property although she was named as heir in Phillips's two wills (Graves *et al.* 1998: Appendix A).

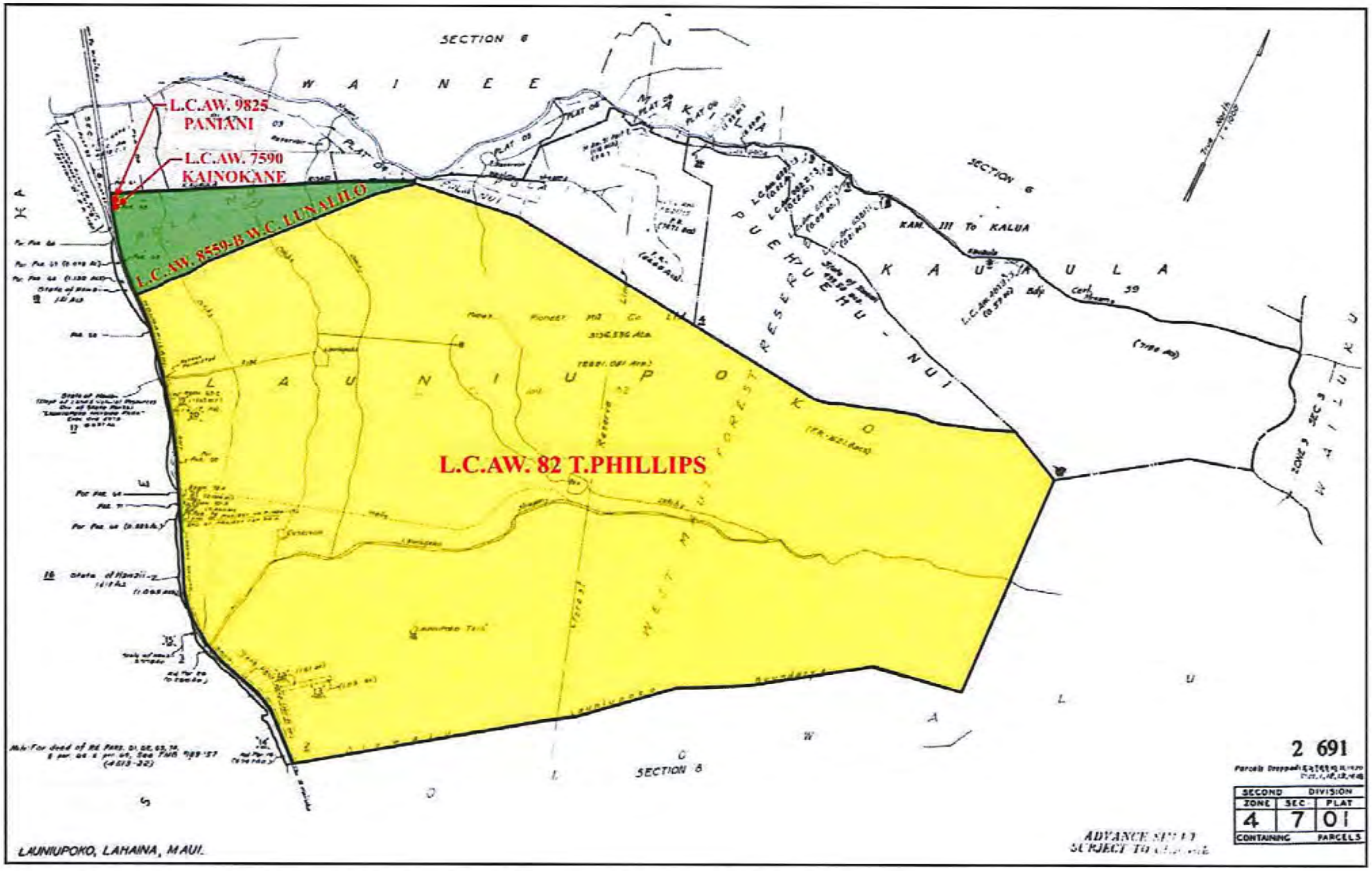

Figure 3: Tax Map Key [TMK] Showing Land Commission Awards in the Project Area.

The northern portion of the project area falls within Polanui Ahupua`a. With the exception of 66 acres of *kuleana* parcels, all 377 acres of Polanui Ahupua`a was awarded to William C. Lunalilo (Royal Patent 8395 LCA 8559-B, Apana 25) (see Figure 3). Among the *kuleana* parcels were 6.12 acres awarded to Kainokane (Royal Patent 1190, 1191 LCA 7590) and 2.7 acres awarded to Paniani (Royal Patent 1704 LCA 9825). Paniani's parcel which is in the very northwestern corner of the project area is documented as being a house lot. Kainokane's parcel, located directly south of Paniani's, is documented as having 37 *lo`i*, 5 coconut trees, and 3 *hala* (*Pandanus odoratissimus*) clumps.

HISTORIC SETTING IN THE PROJECT AREA

Land use in Launiupoko Ahupua`a in the mid 19th and early 20th century was largely devoted to the sugar industry. The Pioneer Mill Company was founded in 1860 by James Campbell, Henry Thurton, and James Dunbar. In 1864, Benjamin Pittman acquired lands in Launiupoko which he deeded to Campbell, Thurton, and Dunbar. In 1885, Thurton constructed a railroad system to transport sugarcane from the fields to the mill in Lahaina (Condé 1973). One railroad line crosses through the northeast portion of the project area and the other follows the coastline.

Between 1885 and 1895 the mill changed hands three times before finally falling under the control of Homer and Isenberg who incorporated the mill in 1895 (Goodwin and Leineweber 1997). Homer and Isenberg's agent was H. Hackfield Co. which later became Amfac, Inc.

In 1900, when the Pioneer Mill Company was reorganized, the plantation controlled a total of 12,500 acres. Although the land was believed to be "...the rockiest of the irrigated plantations in Hawaii..." the Pioneer Mill Company developed an extensive and powerful irrigation and water collection system, consisting of tunnels, ditches, and flumes that extended into the valleys of the West Maui Mountains, including Launiupoko (Graves *et al.* 1998). The terrains rockiness required that the land be cultivated by hand (Gilmore 1936). The cleared rocks were used to construct walls that formed banks of the cane row and the areas between the walls were softened and planted. The soil beneath the rocks was very fertile and produced good yields. However, by 1930, the fields at Launiupoko were no longer used for sugarcane cultivation due to labor shortages and the difficulty associated with working such rocky fields (Graves *et al.* 1998). Thereafter, the fields were used for cattle grazing by the Pioneer Mill Company. A 1939 Pioneer Mill Company map of Launiupoko (Figure 4) shows the old field designations, as well as, the ditches and reservoirs, including Lahaina Pump Ditch No. 1 which traverses the project area.

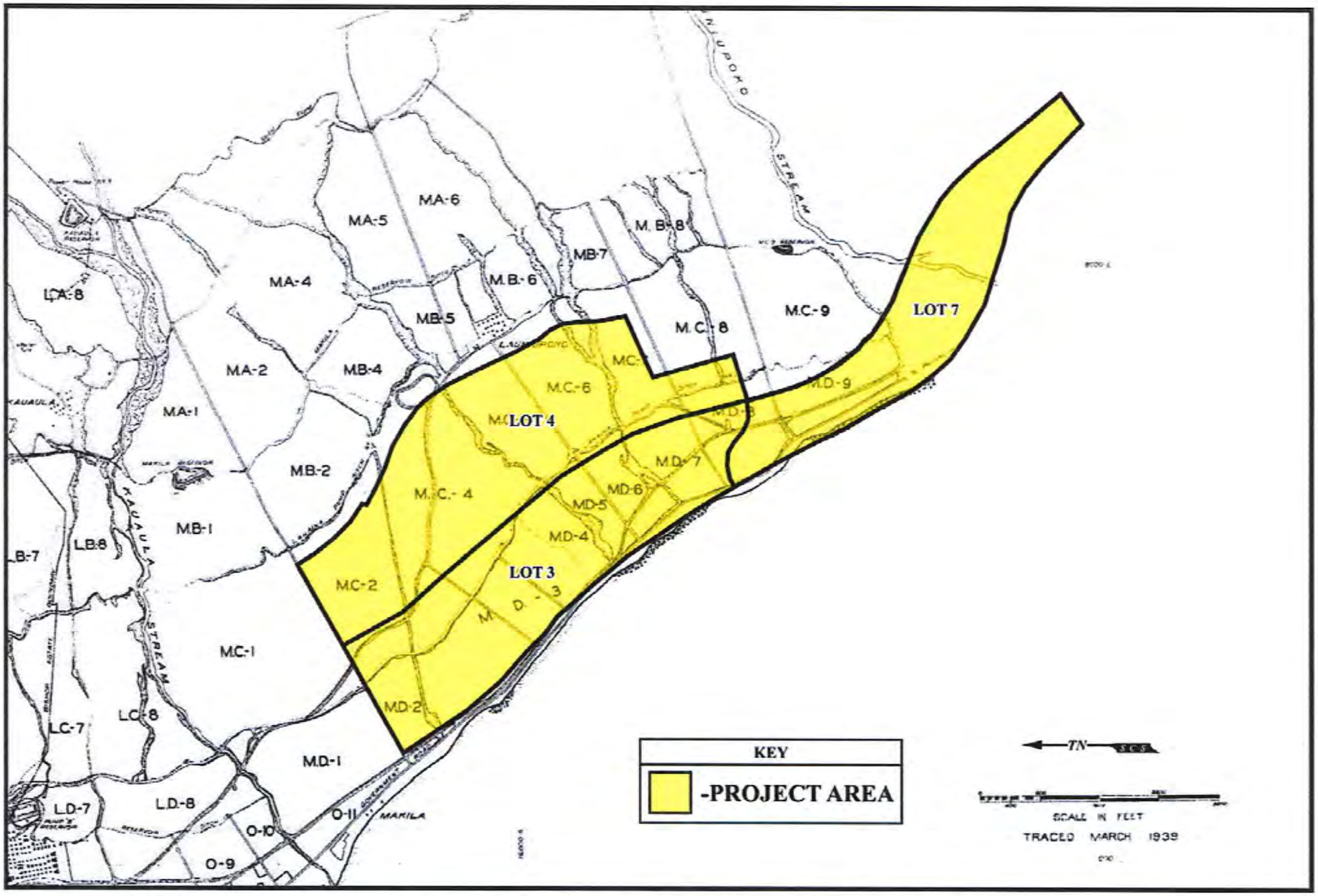

Figure 4: 1939 Pioneer Mill Company Map Showing Agricultural Fields and Irrigation Ditches.

Ranching activities which began in the 1930s continued until the mid-1970s. In a telephone interview, Herbert Kinores, former Pioneer Mill Company ranch foreman, tells Donna Graves (Graves *et al.* 1998) that a number of structures and features associated with ranching were constructed during this time. Walls and fences were built to enclose pastures. Small wooden corrals were built and used to capture free-roaming cattle. The cattle was then either herded or brought by truck to larger stone corrals. Cattle operations were halted in the mid-1970s due to an extended drought and falling market prices.

PREVIOUS ARCHAEOLOGY CONDUCTED IN THE LAUNIUPOKO AREA

A number of projects have been undertaken in the vicinity, however, only one has taken place within the project area. In 1991, as part of the Honoapi`ilani Highway Realignment Project, Paul H. Rosendahl, Ph.D., Inc. (PHRI) (Jensen 1991), surveyed a 7 mile long corridor part of which went through the current project area. No archaeological sites were recorded within the portion of the corridor that transected the project area.

Several projects have taken place in areas adjacent to the project area (Figure 5). In 1988, Chiniago, Inc. (Barrera 1988) conducted a reconnaissance survey of three alternate routes for Honoapi`ilani Highway. The routes extended from Honokowai to Lahaina. The southern portion of the surveyed corridors entered Polanui Ahupua`a and PHRI's 2000 project area (PHRI 2000). The corridors passed through a number of historic sites, including the Lahaina Historic District. An agricultural complex and a possible habitation terrace were also recorded, however, none of the sites fell within the bounds of the current project area.

In 1991, the Department of Land and Natural Resources State Historic Preservation Division (Donham 1991) surveyed a 1600 ft section of coastal zone between the shoreline and Honoapi`ilani Highway located immediately west of the current project area. No archaeological sites or features were observed.

In 1998, PHRI (Graves *et al.* 1998) conducted an inventory survey on 430 acres located *mauka* of the current project area within Launiupoko Ahupua`a. They recorded 47 sites consisting of 67+ component features. Sites associated with both permanent and temporary habitation were terraces, rock alignments, walls, enclosures, an L-shape, a C-shape, rockshelters, and a paved area. Sites associated with agricultural activities were terraces, clearing piles, agricultural plots, modified rock piles, canals, retaining walls, and a flume. Sites associated with

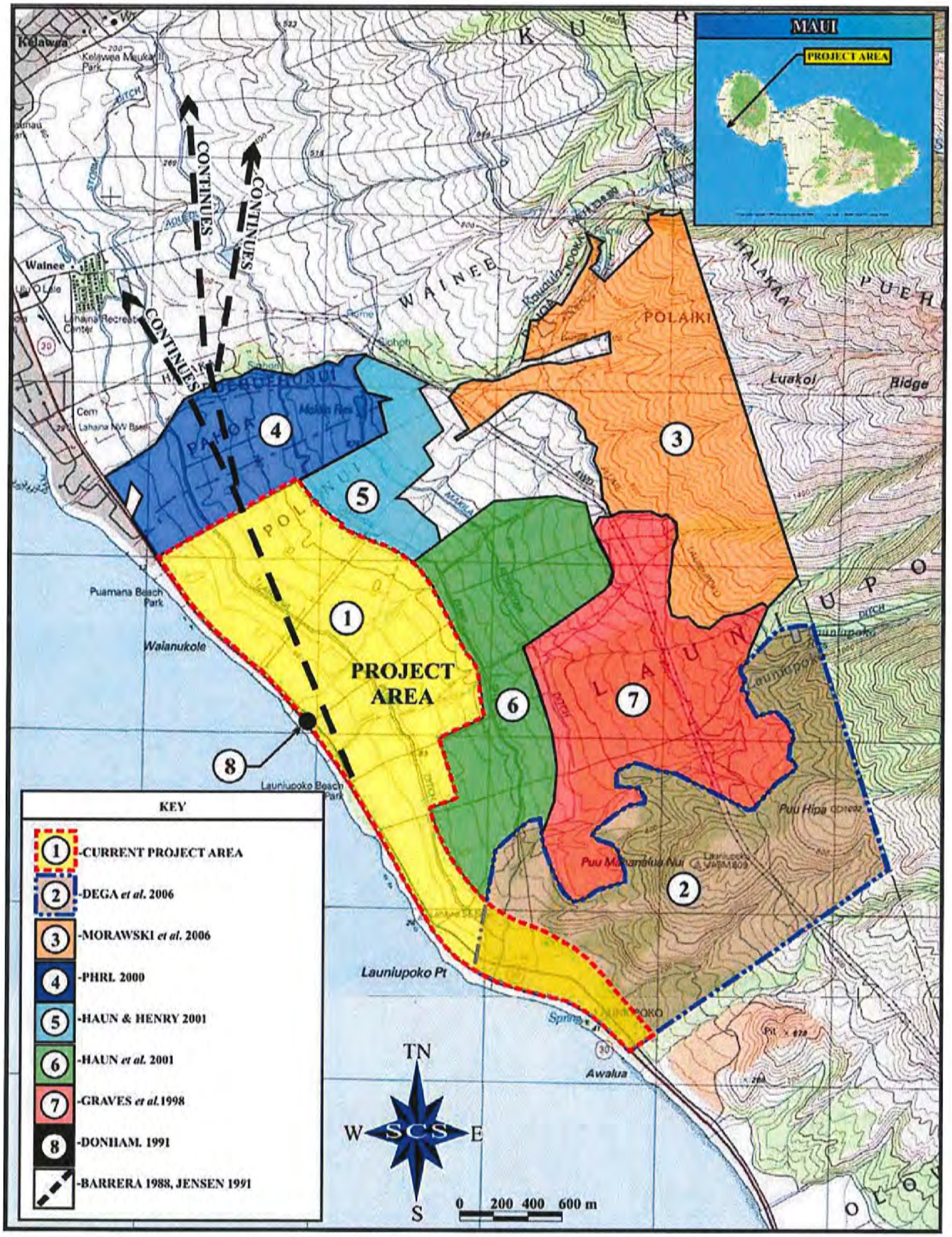

Figure 5: Previous Archaeological Work in the Vicinity of the Project Area.

animal husbandry were corrals and walls/fencelines. Additional sites recorded were cairns, uprights, one petroglyph panel, and a road.

In 2000, PHRI (2000) conducted an inventory survey on 230 acres located just north of the current project area in Polanui Ahupua`a. The entire parcel, except for three small areas, had been used for sugarcane cultivation. The area surveyed was 15 to 440 ft amsl, gently to moderately sloped, and rocky, very similar to the current project area. PHRI identified three sites (note that all site numbers are official Hawai`i state site number and are preceded by 50-50-03-): 1) two irrigated terraces (Site 4789) identified as *lo`i* situated adjacent to Kaua`ula Stream that are late prehistoric to pre-1900s in age; 2) nine historical features associated with the sugar mill operation scattered throughout the project area are collectively identified as Site 4787; and 3) a wall segment (Site 4795) along Kaua`ula Stream that probably formed part of a garden enclosure dating to the late prehistoric or early historic era. A total of 15 trenches were mechanically excavated but no cultural material was recorded.

In 2001, Haun and Associates (Haun and Henry 2001) conducted an inventory survey on 124 acres located northeast of the current project area in Launiupoko and Polanui Ahupua`a. They identified four sites consisting of six component features. One of the sites (Site 4787) was previously recorded by PHRI (2000). The remaining three sites are: 1) two linear rock piles (Site 5187); 2) a series of low terraces associated with a concrete and mortared stone ditch (Site 5188); and 3) a terrace interpreted as a *lo`i* based on appearance and proximity to Kaua`ula Stream. A test unit was excavated in the level soil surface of the terrace; no cultural material was observed.

In 2001, Haun and Associates (Haun *et al.* 2001) conducted an inventory survey on 300 acres located directly east and *mauka* of the current project area within Launiupoko Ahupua`a. They identified six sites consisting of seven component features. Two of the sites had been previously recorded by PHRI, a cattle wall (Site 2665) documented in Graves *et al.* (1998) and irrigation ditches associated with Site 4787 documented in PHRI (2000). Of the remaining four sites, two are cattle walls (Sites 5049 and 5050) from the ranching era, one is a historic roadbed (Site 5051) used to transport sugar, and the last consists of linear rock mounds or terraces (Site 5052) found along an unnamed drainage. The mounds/terraces are similar to those documented by PHRI (in Graves *et al.* 1998 and PHRI 2000) who report that these features are the result of manual sugarcane cultivation from the early 1900s, occurring in areas were mechanized cultivation was not possible.

SCS (Dega *et al.* 2006) conducted an inventory survey on 570.3 acres in Launiupoko Ahupua`a situated south and southeast of the current project area. They identified 50 sites comprised of 146+ features. Of these sites, four sites had been previously recorded by PHRI (Graves *et al.* 1998). These sites include Site 2665, Site 2674, Site 2675, and Site 2682, the latter in which two new features were documented. The sites identified generally relate to traditional pre-Contact Hawaiian settlement, sugarcane cultivation during the plantation era, and ranching. The traditional Hawaiian sites recorded are related to permanent and temporary habitation, ceremonial functions, work areas, tool manufacturing, and agriculture. Traditional pre-Contact site types identified on the parcel include: permanent habitation platforms, enclosures, paving, cupboards, and terraces; temporary habitation rockshelters and rock overhangs; a petroglyph panel; a burial; and agricultural features, including terrace complexes, modified outcrops, alignments, C-shaped enclosures, mounds, walls, and planting depressions within modified boulder fields. Sites associated with the plantation era include walls, terrace complexes with terrace alignments, pavings, borrow pits, a quarry pit, a water control gate, an incised boulder, and a road cut. Sites associated with the ranching era include walls, fences, a platform, a modified outcrop, feeding trough, metal water station for livestock, a corral, a dike, and an overhang. Sites of indeterminate age but likely related to the plantation era include terraces, retaining walls, alignments, mounds, a ditch, two markers, and a wall.

SCS (Morawski *et al.* 2006) conducted an inventory survey on 520 acres located northeast of the current project area within Launiupoko Ahupua`a. A total of thirty-five sites were identified, three of which were previously recorded by Cultural Surveys Hawai`i in Robins *et al.* (1994). The previously recorded sites are: 1) a boulder wall (Site 3173) interpreted as an irrigation ditch associated with the sugarcane plantation era; 2) a prehistoric agricultural complex (Site 3175) composed of mounds, retaining walls, and enclosures, including one C-shaped enclosure; and 3) a wall segment (Site 3176). The 32 newly recorded sites (Sites 5880 to 5911) span the pre-Contact through plantation eras. Traditional wetland taro cultivation features were recorded. Several large agricultural complexes, both traditional and post-Contact in nature, consisting of terraces, enclosures, and modified outcrops were identified within the project area.

PROJECT AREA EXPECTATIONS

A review of archival resources and the results of previous archaeological work conducted in the area was undertaken to assess the types of sites expected to be encountered during fieldwork. While Launiupoko may not have supported a sizable population during the pre-Contact period, archaeological work to the north, south, and east of the project area provides evidence of dryland and wetland agriculture and permanent and temporary habitation in the area.

These findings indicate occupation of the area began by the 11th century and continued through the plantation era. The coastal area of Launiupoko may have supported permanent habitation, ceremonial activities, fishing and other ocean activities, and work areas for tool manufacturing. However, the area has been heavily impacted by 70 years of sugarcane cultivation and subsequent cattle ranching activities. Therefore, it is highly probable that pre-Contact sites in the area are heavily disturbed and much of the remaining archaeological sites are associated with sugarcane cultivation or cattle ranching.

METHODOLOGY

FIELD METHODOLOGY

Multiple field tasks were completed during this Archaeological Inventory Survey, including pedestrian survey, site mapping and recording, and testing. Written and photographic documentation occurred during each phase of research. First, a full systematic pedestrian survey of the entire project area was conducted in order to identify any archaeological structures or surface scatters and to assess geographical and topographical features. When structures, artifacts, or unusual topographic changes were identified, they were plotted on an overall site map and flagged. Surface artifact assemblages, surface features, or anomalies were assigned temporary site numbers. Temporary site numbers were converted to State Site Numbers upon review by SHPD following completion of fieldwork.

After surveying was completed, the crew returned to each flagged location to map and record each site/feature and to assess excavation locations within sites. Limited hand-testing was conducted for sites that had the potential to be associated with the pre-Contact or early historic periods. Each unit was thoroughly documented and its location plotted on a project area map. Stratigraphic profiles were drawn and photographed. Artifacts were collected and catalogued on-site and shipped to the SCS laboratory for analysis. Charcoal samples were taken from individual features. Additionally, 10 trenches were mechanically excavated with a backhoe. Soil samples were taken from two of the backhoe trenches.

LABORATORY METHODOLOGY

All field notes, maps, photographs, and collected archaeological materials from this project are housed at the SCS laboratory in Honolulu. All artifacts and midden samples were sorted, weighed, identified, and catalogued on standard laboratory forms, then entered into a table produced in Microsoft Excel (Appendix A). Marine shell was identified to genus and to species when possible. The lithics were analyzed by Dr. Robert L. Spear of SCS. Dr. John Sinton from the Department of Geology and Geophysics at The University of Hawai`i at Mānoa identified sampled material as slag from the mill. Site location maps, plan view sketches, and stratigraphic profiles were digitally drafted at the SCS laboratory.

ARCHAEOLOGICAL INVENTORY SURVEY RESULTS

A total of ten sites, two of which were previously recorded, were identified during Inventory Survey (Figure 6)(Table 1). Several of the sites contain multiple component features.

Table 1: Sites Identified During Project 652 Inventory Survey in the Launiupoko Large Lot Subdivision No. 2 Lots 3, 4, 7 [TMK (2)4-7-01:2 por.]

State # 50-50-03-	Temp. #	# of Features	Form (include shape)	Function
5950	T-1	16	Rock mounds (linear)	Agricultural (associated with sugarcane cultivation)
5951	T-2	1	Irrigation ditch, water pipes, reservoir (irregular)	Agricultural (associated with sugarcane cultivation)
5952	T-3	1	Terraces (irregular)	Agricultural (associated with sugarcane cultivation)
5953	T-4	1	Slag scatter (50 by 35 m)	Work area
5954	T-5	1	Rock wall (linear)	Ranching
5955	T-6	1	Modified rock deposit (irregular)	Indeterminate/Activity Area
5956	T-7	1	Midden and lithic scatter (173 by 141 m)	Activity Area
5957	T-8	1	Terrace (rectangular)	Agricultural (associated with sugarcane cultivation)
2665	T-9	1	2 rock wall segments (linear)	Ranching
4787 Feature D	T-10	1	Lahaina Pump Ditch No. 1	Agricultural (associated with sugarcane cultivation)

SITE DESCRIPTIONS

STATE SITE NUMBER 50-50-03-2665

FORM:	Two (2) rock wall segments
FUNCTION:	Ranching
AGE:	Historic
DIMENSIONS:	1.2 m wide by 1.4 m high
CONDITION:	Poor
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: This wall runs along the north and south edges of Launiupoko Gulch. *Mauka* portions of this wall were previously documented by Graves *et al.* (1998) and Haun *et al.* (2001). Graves *et al.* (1998) describe it was a long core-filled wall with a barbed wire fence strung across

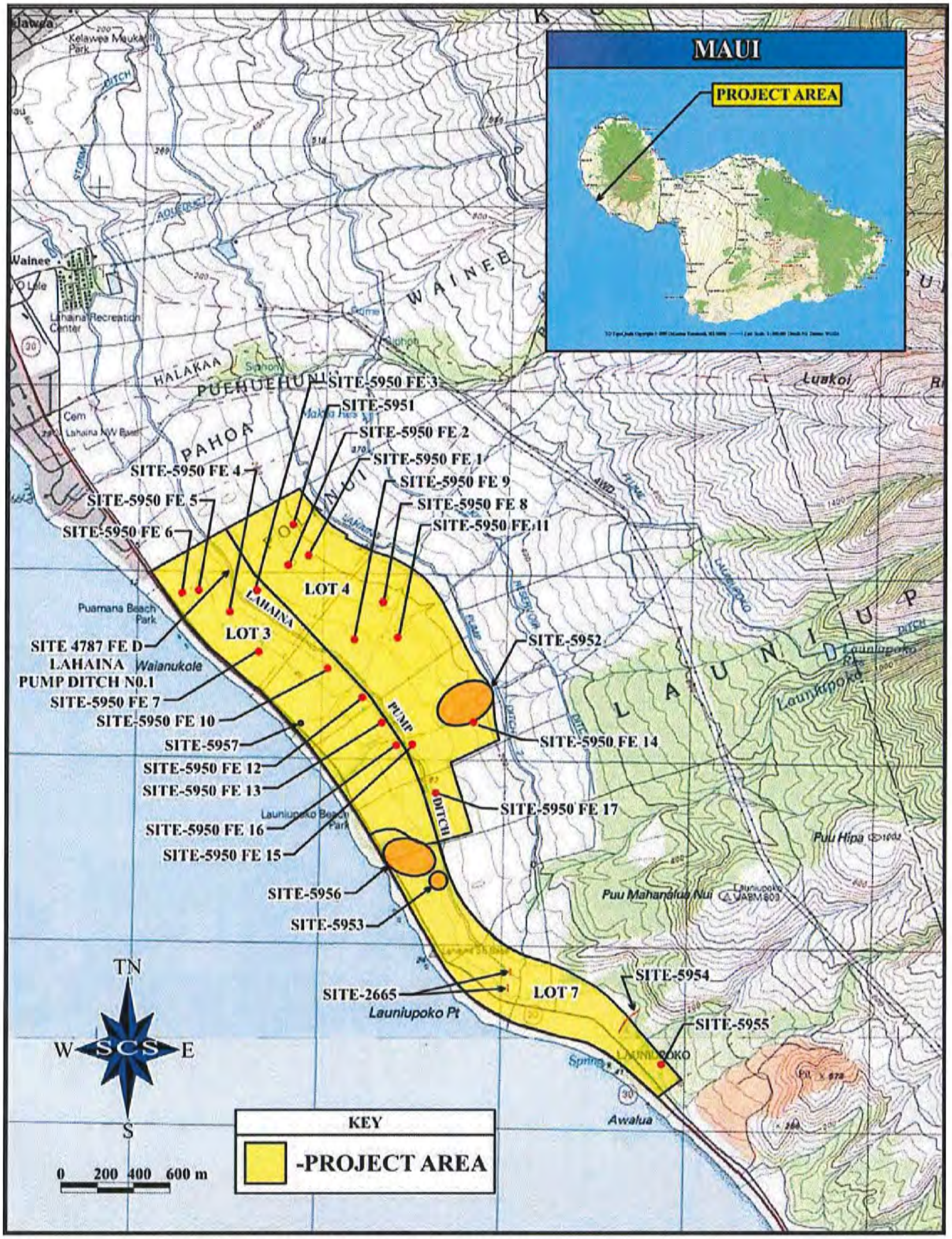

Figure 6: USGS Lahaina Quadrangle Map Showing Site Locations.

the top. It was constructed during the ranching era to keep cattle out of the gulch. The portion of the wall documented during this project consists of two rock wall segments that run along the north and south edges of lower Launiupoko Gulch. The walls are situated on the steep slopes of the gulch in areas of dense vegetation consisting of grass, *kiawe*, and lantana. The walls are largely obscured by vegetation. Not much of the walls remain and what is present is in poor condition. The wall along the south edge of the gulch extends only a very short distance. The wall along the north edge is very disturbed. It is a cobble faced, core-filled wall approximately 1.2 m wide and 1.4 m tall at its highest (Figure 7). The wall is bisected by Lahaina Pump Ditch No. 1 (Site 4787 Feature D) that spans the entire project area and is described below. Recent bulldozing has destroyed the wall 10.0 m east of the ditch.

Figure 7: Photo of Site 50-50-03-2665 Rock Wall on North Side of Launiupoko Gulch.

STATE SITE NUMBER 50-50-03-4787 Feature D

FORM:	Irrigation Ditch
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	88.0 cm wide by 60.0 cm deep
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: This concrete ditch is identified as the *makai* most Lahaina Pump Ditch on the USGS map (see Figure 1) and as Lahaina Pump Ditch No. 1 on the 1939 Pioneer Mill Company map (see Figure 4). It is also known as the Mill Ditch or the Lahaina Mill Ditch (PHRI 2000). This ditch was one of nine features previously recorded by PHRI (2000). It extends the entire length of the project area through grass covered terrain and crosses over Launiupoko Gulch as a large metal pipe (Figure 8). Portions of the ditch are lined by stone walls but for the most part the ditch is retained by earthen berms. Pipes extending perpendicular from the ditch served as irrigation lines to the sugarcane fields. These pipes contain numerous small trapdoors (Figure 9), which would have controlled the amount of water released into the fields.

STATE SITE NUMBER 50-50-03-5950

FORM:	Seventeen (17) rock mounds
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	Varied
CONDITION:	Fair to good
SURFACE ARTIFACTS:	Metal cables; historic trash
EXCAVATION:	None

DESCRIPTION: This site consists of 17 rock mounds (Features 1 through 17) associated with sugarcane cultivation. Surface sediments are a silty clay. Visibility around the mounds is limited by a moderate amount of grass. Small *koa haole* trees are also present. The mounds are found throughout Lots 3 and 4 of the project area. They are constructed of very large boulders (greater than 3 tons) and are flat on top. They vary in length from 55.0 m to 100.0 m and in width from 22.0 to 68.0 m. Their long axes follow the gently sloped topography *mauka* to *makai*. They are situated end to end with the *mauka* side graded to ground surface and the *makai* side forming a terrace 15.0 to 20.0 m high (Figure 10). The series of mounds extend downslope east to west to the old railroad in a stair step fashion throughout Lots 3 and 4. The mounds are thought to have been used to transport sugarcane to the rail system below.

Feature 1 is 100.0 m long by 30.0 m wide and has an exterior height of 15.0 to 20.0 m. The top of the mound is composed mainly of cobbles and compact, dried silty clay fill. It is in good condition, however, portions of the south side may have been altered by bulldozers during construction of the road located to the south. A piece of twisted ferrous cable was observed on top of the mound, supporting the idea that the mounds formed some kind of transportation system.

Figure 8: Photo of Site 50-50-03-4787 Feature D Showing Lahaina Pump Ditch No. 1 Crossing Launiupoko Gulch.

Figure 9: Photo of Site 50-50-03-4787 Feature D Showing One of Many Trapdoors in Lahaina Pump Ditch No. 1.

Figure 10: Overview Photo of Site 50-50-03-5950 Feature 2 Rock Mound. Feature 1 is in the Background.

Feature 2 is 70.0 m long by 32.0 m wide. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition but may have been affected bulldozer activity.

Feature 3 is 58.0 m long by 47.0 m wide with an exterior height of 10.0 to 15.0 m on the *makai* end (Figure 11). The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. This mound is in good condition but may have been affected by bulldozer activity as well.

Feature 4 is 81.0 m long by 26.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. This mound is in good physical condition and has not been altered by bulldozer activity. Historic trash was observed in association with this mound.

Feature 5 is 65.0 m long by 37.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity. Historic trash was observed in association with this mound.

Figure 11: Photo of the South Side of Site 50-50-03-5950 Feature 3 Rock Mound. View is to the Northwest.

Feature 6 is 82.0 m long by 28.0 m wide with an exterior height of 10.0 to 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity. A metal cable was observed in association with this mound.

Feature 7 is 110.0 m long by 24.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity.

Feature 8 is 78.0 m long by 25.0 m wide with an exterior height of 30.0 m. The top of this mound unlike the previous mounds contains numerous boulders. The boulders are most likely the result of bulldozer activity. A metal cable was observed on the south side of the mound.

Feature 9 is 68.0 m long by 68.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. The *makai* side of the mound has been altered. A ring of large boulders is present around the *makai* edge of the mound forming a stepped area leading up to the mound. This step may be more recent in origin than the mound.

Feature 10 is 78.0 m long by 31.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. Piles of old sugarcane are present along the southern edge of the mound.

Feature 11 is 91.0 m long by 23.0 m wide with an exterior height ranging from 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 12 is 55.0 m long by 33.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 13 is 75.0 m long by 30.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 14 is 87.0 m long by 32.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. A metal cable was observed in association with the mound. The feature has been altered by bulldozer piles of old asphalt and gravel debris but the mound is in fair condition.

Feature 15 is 59.0 m long by 34.0 m wide with an exterior height of 10.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed. An unnamed gully is present northwest of the mound.

Feature 16 is 93.0 m long by 22.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. There is evidence for bulldozer activity at the *mauka* end of the mound. No cultural material was observed.

Feature 17 is 76.0 m long by 25.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition but has been altered by bulldozer activity.

STATE SITE NUMBER 50-50-03-5951

FORM: Irrigation ditch, pipes, reservoir, and flume
FUNCTION: Agricultural
AGE: Historic
DIMENSIONS: 6.0 m by 2.5 m (includes only reservoir and flume area)
CONDITION: Good
SURFACE ARTIFACTS: None
EXCAVATION: None

DESCRIPTION: The irrigation ditch, pipes, reservoir, and flume form part of the extensive irrigation system constructed by Pioneer Mill Company used for sugarcane cultivation. It is located on terrain that slopes gently to the west. The ground surface is a silty clay sediment. The rather dense vegetation coverage consists of grasses, shrubs, and trees, including *koa haole*, young java plum, and *`opiuma*. This portion of the irrigation system (Figure 12) consists of an underground water pipe that extends northwestward from a main irrigation pipe located 45.0 m to the south. The north end of the pipe terminates at a small concrete reservoir constructed of stones, concrete, and cinder blocks.

Figure 12: Overview Photo of Site 50-50-03-5951 Irrigation Ditch. View is to the Southwest.

A wooden trap door at the *makai* end of the reservoir opens to an irrigation pipe that at one time distributed water to the fields below. This pipe extends all the way down to the western boundary of the project area and eventually leads to a large concrete ditch below. Also extending from the *makai* side of the reservoir is a 3.0 m long aluminum flume that runs along the south side of the pipe. Overflow from the reservoir was probably diverted into the flume. Grooves on the concrete between the reservoir and the flume suggest a trapdoor was present at one time. Broken gourds are present in the ditch between the reservoir and the main pipe, however, they do not appear to be of great antiquity.

STATE SITE NUMBER 50-50-03-5952

FORM:	Terraces (15+)
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	248.0 m by 74.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	Stratigraphic Trenches (ST) 1 through 7; Test Units 1 and 2

DESCRIPTION: This site is located *mauka* of Site 5950 Feature 14 on a low gently sloping ridge between two unnamed gullies. The area is vegetated with dense grass and individual *kiawe* and *koa haole* trees. The site is a complex of terraces (Figure 13) associated with sugarcane cultivation. The complex is 248.0 m long from east to west and 74.0 m at its widest point. The terraces, oriented perpendicular to the slope, are constructed of small to medium sized basalt boulders mixed with dirt to form berms. Terraces range in height from 15 to 70 cm tall and are spaced approximately 1.0 m apart. Ditches running parallel to the slope, spaced 4.0 to 8.0 m apart, would have served to irrigate the terraces. The larger ditches (55 to 90 cm deep) have concrete water diversions. These terraces are very similar to those reported in Graves *et al.* (1998), PHRI (2000), and Haun *et a*l. (2001) who identified them as the remains of manually constructed terraces from the early 1900s that are found in areas not used for mechanized sugarcane cultivation. A complex of such terraces, located *mauka* of this site, is designated Site 2639 (Graves *et al.* 1998).

EXCAVATION: A total of seven stratigraphic trenches (see Figure 13) and two test units were excavated. Five of the stratigraphic trenches (ST-1 through ST-5) were excavated by hand, the remaining two (ST-6 and ST-7) were mechanically excavated with a backhoe. Stratigraphic trenches were excavated perpendicular to the terraces in order to examine their construction.

Stratigraphic Trench 1, measuring 1.0 m by 3.3 m, cross cuts two terraces and is located just south of one of the earthen water channels. Two stratigraphic layers were encountered (Figure 14). Layer I (0–24 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 20 percent pebbles. Grass roots are common in this layer. In profile this layer dips down lower in the center due to

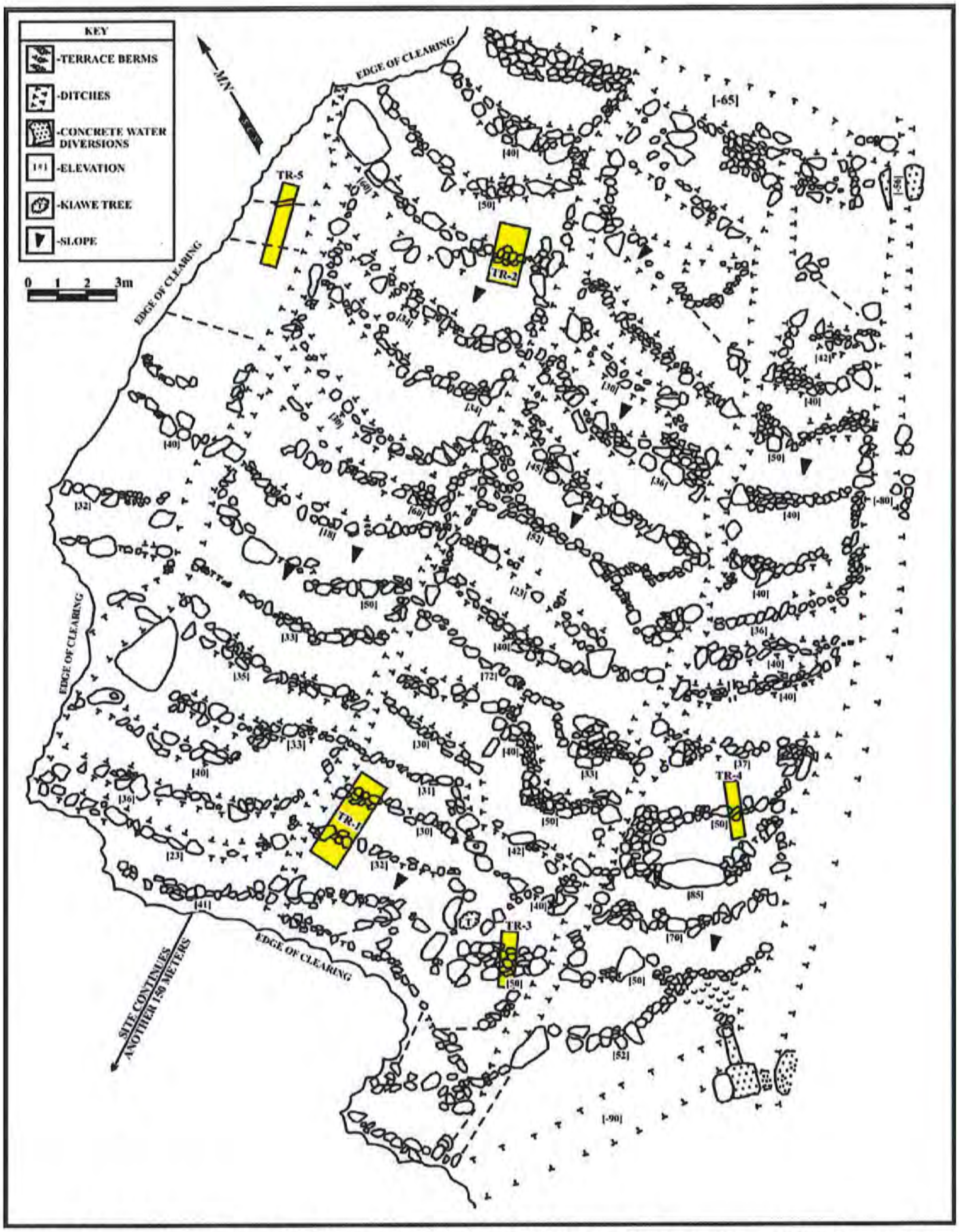

Figure 13: Map of a Portion of Site 50-50-03-5952 Showing the Locations of Stratigraphic Trenches 1 Through 5.

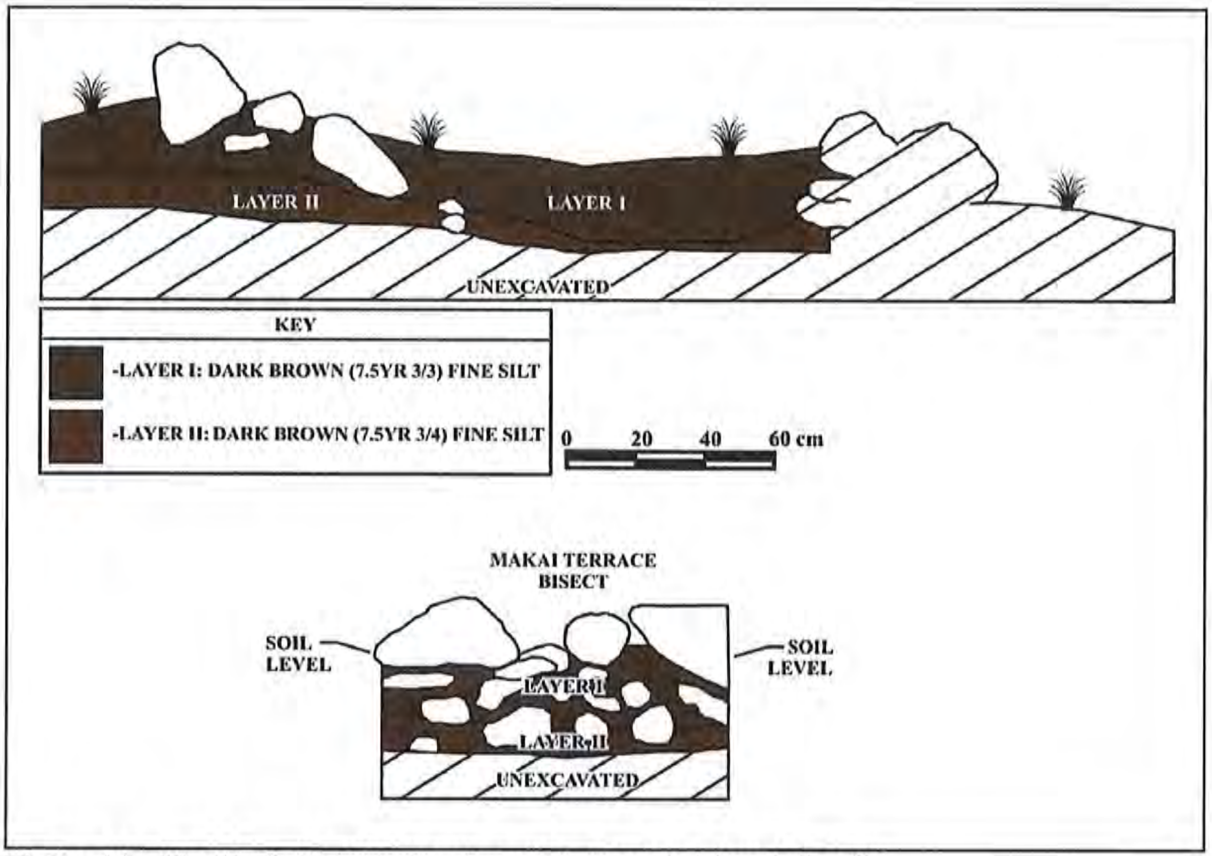

Figure 14: Site 50-50-03-5952 Stratigraphic Trench 1 South Profile.

running water in the channels. A modern nail, four small pieces of coral, and a very small charcoal sample were recovered from this layer. Layer II (24–30 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 35 percent pebbles and cobbles, and few roots. No cultural material was observed in Layer II.

Stratigraphic Trench 2, measuring 2.0 m by 1.0 m, cross cuts one rock terrace. Material collected from the surface includes slag and cement fragments. Layer I (0–10 cmbs) is a very dark brown (7.5 YR 2.5/3) humic layer containing dense grass roots. Layer II (10–25 cmbs) is a dark brown (7.5 YR 3/3) silty loam that is very rocky. No additional cultural material was observed in this trench.

Stratigraphic Trench 3, measuring 2.0 m by 0.5 m, cross cuts a terrace located next to a water channel. This terrace is wider and is constructed of larger rocks than other terraces in the area. Rocks vary in size from 20 to 60 cm in diameter and are stacked 1 to 3 courses high. Layer I (0–16 cmbs) is a very dark brown (7.5 YR 2.5/2) fine silty loam containing few roots. A charcoal sample (4 cmbs) was recovered from this layer. Layer II (16–18 cmbs) is a dark brown (7.5 YR 3.3) gravelly silty loam containing roots.

Stratigraphic Trench 4, measuring 2.0 m by 0.5m, cross cuts one rock terrace. Both sides of the terrace were excavated, however, the rock of the terrace was left in place. Layer I (0–18 cmbs) is a dark brown (7.5 YR 3/3) very fine silt containing 10 percent rocks and a fair amount of roots. Layer II (18–24 cmbs) is a dark brown (7.5 YR 3/4) fine silt containing 35 percent rocks and few roots. No cultural material was recovered.

Stratigraphic Trench 5, measuring 3.0 m by 0.6 m, cross cuts two rock terraces. The trench is parallel to a small water channel located to the southeast. Layer I (0–28 cmbs) is a dark reddish brown (10 YR 2.5/3) sandy silt very high in organic material. Layer II is a lens of possibly burnt sediment appearing in patches throughout the trench at approximately 20 cmbs. Charcoal samples, as well as, a bulk soil sample were taken from the lens. Fragments of historic glass were recovered below the Layer II lens.

Stratigraphic Trench 6 was mechanically excavated with a backhoe. The trench, measuring 10.0 m long by 1.0 m wide, cross cuts four terraces. The terraces range from 27 to 65 cm high. A water channel is present to the southwest of the trench and a concrete and rock faced channel is located to the southeast of the trench. Layer I (0–20 cmbs) is a very dark greyish brown (10 YR 3/2) very fine silt containing 1 to 2 percent cobbles and 70 percent grass roots. The peds are friable and the layer boundary appears wavy. No cultural material was observed in Layer I. Layer II (20–35 cmbs) is a dark brown (7.5 YR 3/3) silty clay containing more than 5 percent rootlets. Peds are moderately hard and slightly blocky in structure. Saprolite gravel is present along the bottom boundary which is wavy in nature. No cultural material was observed in Layer II. Layer III (35–80 cmbs) is a dark brown (7.5 YR 3/4) to yellowish brown (10 YR 5/4) silty clay. Peds are very dry and hard to very hard but friable when pressed. Saprolite rocks are present in this layer. No cultural material was observed. Two columns of soil samples were taken from Stratigraphic Trench 6.

Stratigraphic Trench 7 was mechanically excavated with a backhoe. The trench, measuring 14.5 m long by 1.0 m wide, cross cuts a number of terraces ranging in height from 40 to 50 cm and a number of alignments ranging from 15 to 30 cm high. A bulldozer pile is present at the northeast corner of the trench and a water channel crosses the southern end of the trench in an east-west direction. Layer I (0–16 cmbs) is a dark reddish brown (5 YR 3/2) sandy silt that is high in organic material. Layer II (16–38 cmbs) is a dark reddish brown (5 YR 3/3) sandy silt containing less organic material than the above layer. Layer III (38–53 cmbs) is a dark reddish brown (2.5 YR 3/4) sandy silt containing more than 10 percent gravel. Layer IV (53–76 cmbs) is a dark reddish brown (5 YR 3/3) sandy silt interspersed with rock. No cultural material was observed. Two columns of soil samples were taken from Stratigraphic Trench 7.

Two test units were excavated on a platform identified as Feature 1 (Figure 15 and 16). The platform is located to the northwest of the larger mapped area approximately 60.0 m away. The platform is irregular in shape and appears to have been altered by bulldozing activity. Cobbles on the eastern side of the platform display bulldozer scars. Facing is visible on the north and south sides of the platform. Two test units were placed next to one another on a level area atop the platform.

Test Unit 1 is 50 cm by 50 cm. Layer I (0–28 cmbs) is a dry, greyish brown very fine silt high in organic material. Charcoal and burnt *koa haole* seeds are present in this layer. Both materials were sampled. Layer II (28–42 cmbs) is a dry, reddish brown fine silt with 20 percent gravel and some fine roots. Rocks in this layer made it increasingly difficult to continue excavation.

Test Unit 2 is 50 cm by 50 cm. Layer I (0–26 cmbs) is a dry, greyish brown silt high in organic material. Slag fragments are abundant in this layer. Charcoal and burnt *koa haole* seeds are also present. Layer II (not visible in the north profile) is a dry, reddish brown fine silt with 20 percent gravel and some fine roots. Rocks in this layer made it increasingly difficult to continue excavation. No cultural material was observed in this layer.

STATE SITE NUMBER 50-50-03-5953

FORM:	Slag scatter
FUNCTION:	Work area
AGE:	Historic
DIMENSIONS:	50.0 m by 35.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	Worked slag
EXCAVATION:	Stratigraphic Trenches 1 and 2

DESCRIPTION: This site is a scatter of slag flakes and cores measuring 50.0 m long by 35.0 m wide. It is located in the northeastern portion of Lot 7. The ground surface is very gently sloping and the vegetation coverage consists of burnt grass and *koa haole*. The eastern edge of the site is within an old cane road and the western portion of the site contains earthen berms associated with sugarcane cultivation. The berms range in height from a few centimeters to 20

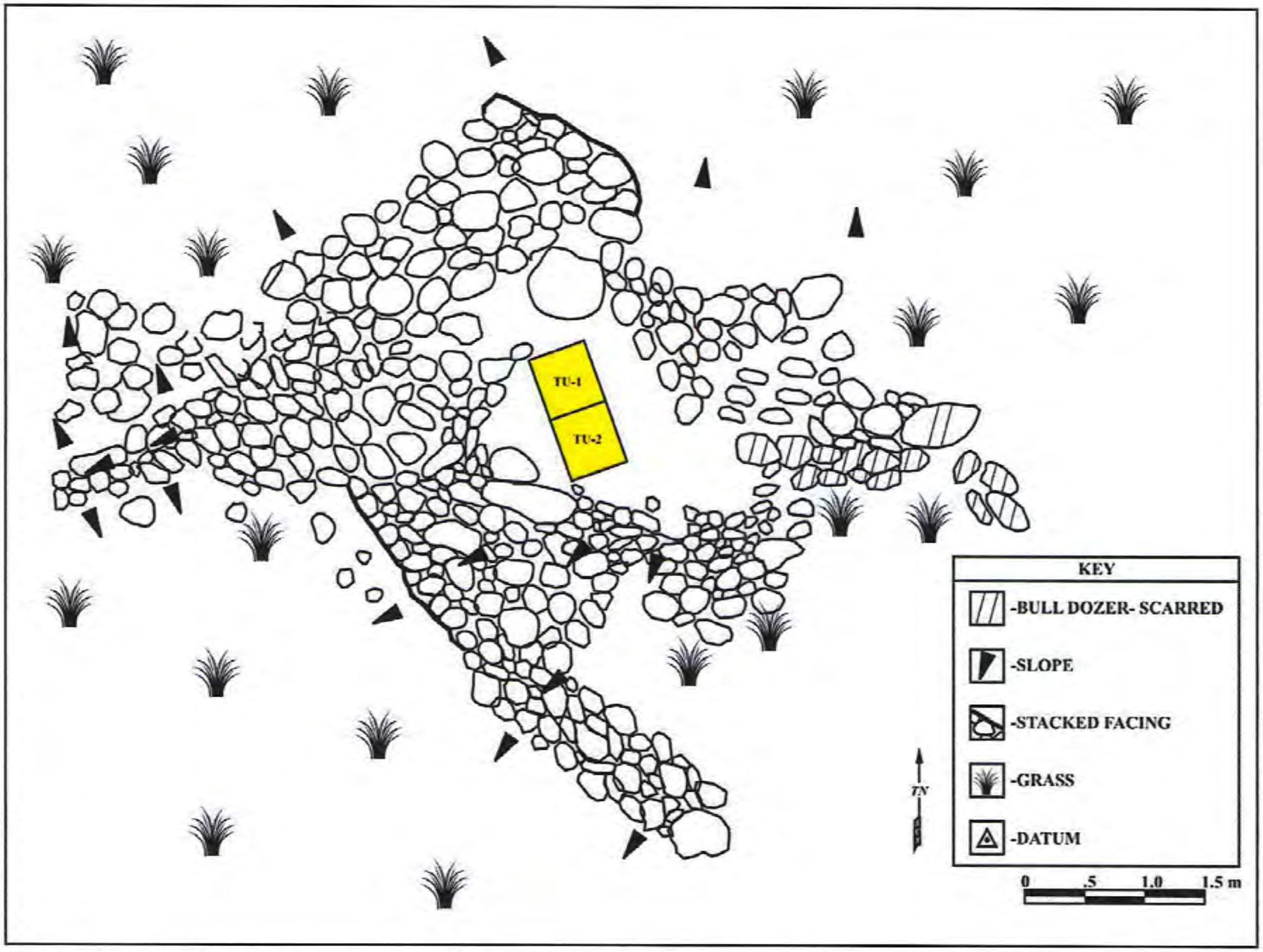

Figure 15: Plan View of Site 50-50-03-5952 Feature 1 Platform.

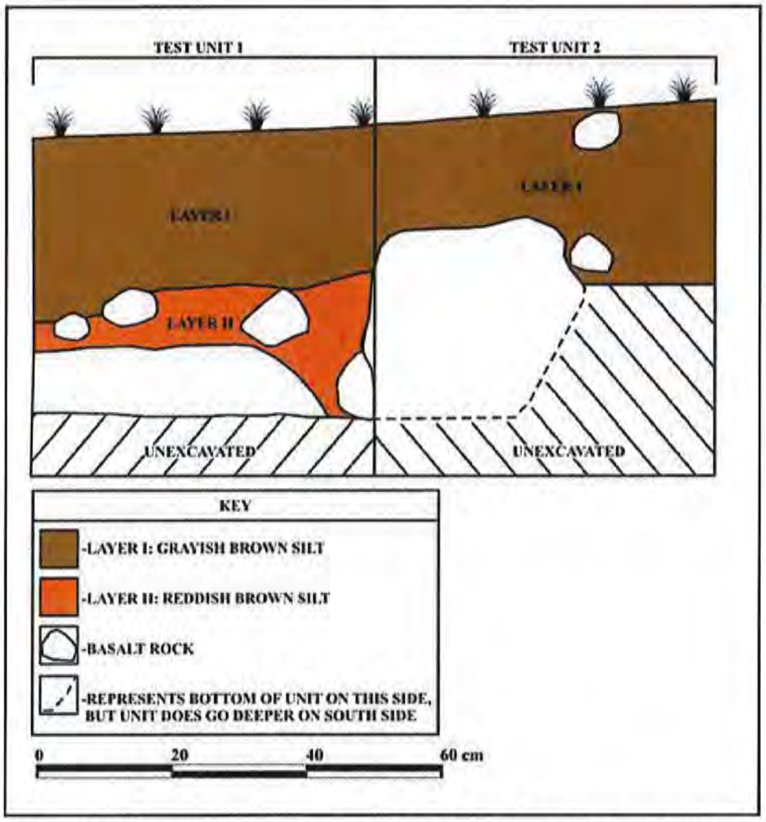

Figure 16: Site 50-50-03-5952 Feature 1 Test Unit 1 (left) and Test Unit 2 (right) North Profile.

centimeters high (Figure 17). The densest concentration of slag is found within the road (Figure 18). Larger pieces of slag are scattered in the area of the berms.

During the Inventory Survey the slag was thought to be volcanic glass. Twenty-one bags of samples were collected off the surface for further analysis. Representative samples were examined by Dr. John Sinton, Professor in the Department of Geology and Geophysics at The University of Hawai`i at Mānoa. Dr. Sinton identified the material as slag, a mill by-product. Like lava, slag is formed from melted rock. During the process of sugar production, rock and dirt is inadvertently melted at very high temperatures producing slag which can have a smooth glassy appearance very similar to volcanic glass (J. Sinton, pers. comm.). In fact, slag is often referred to as human-made "lava" rock. Originating from the same parent material and under similar conditions of extremely high heat, slag has similar flaking properties to volcanic glass. Its usefulness did not go unrecognized. The slag was produced at the Lahaina mill then transported to the site where it appeared to have been utilized. Additional research directly related to the slag is undergoing and will be published in several months in an academic paper.

Figure 17: Overview of Site 50-50-03-5953 Slag Scatter. View is to the West.

Figure 18: Site 50-50-03-5953 Slag Scatter in the Road.

EXCAVATION: Two stratigraphic trenches were mechanically excavated with a backhoe. Stratigraphic Trench 1 is 21.0 m long by 1.0 m wide. A 5.0 m representative profile was drawn of the trench (Figure 19). Layer I (0–20 cmbs) is a dark brown (7.5 YR 3/4) fine silt containing 5 percent rocks and organic material. Layer II (20–46 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 5 percent rocks and few roots. Layer III (46–60 cmbs) is a dark reddish brown (5 YR 3/3) silt containing 10 percent rocks. No cultural material was recovered during excavation.

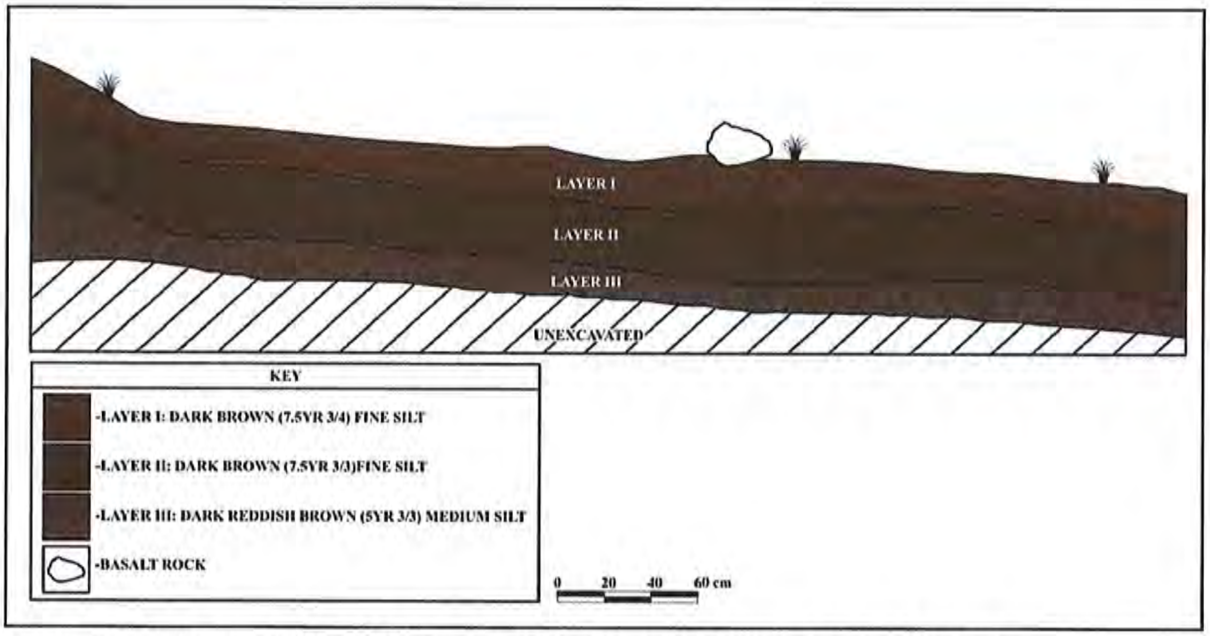

Figure 19: Site 50-50-03-5953 Stratigraphic Trench 1 South Profile (5 Meter Representation).

Stratigraphic Trench 2 is 20.0 m long by 1.0 m wide. A 5.0 m representative profile was drawn of the trench. Layer I (0–40 cmbs) is a dark brown (7.5 YR 3/3) sandy silt containing roots in the top 10 cm. Layer II (40–62 cmbs) is a dark yellowish brown (10 YR 4/4) saprolite. No cultural material was recovered during excavation.

STATE SITE NUMBER 50-50-03-5954

FORM:	Rock wall
FUNCTION:	Ranching
AGE:	Historic
DIMENSIONS:	169.5 m by 1.5 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: This rock wall (Figure 20), located near the south end of the project area in Lot 7, is a cattle wall from the ranching era. It extends downslope from near the eastern project boundary through dense grass, shrubbery, and trees, including *koa haole*. This core-filled wall is constructed of weathered, poor quality, subangular basalt. The wall exterior is composed of cobbles ranging in size from 40 to 90 cm in diameter. The wall stands 2 to 6 courses high and is faced. The cobble filling ranges in size from 10 to 30 cm in diameter. The top of the wall is fairly level. No cultural material was observed in association with this wall.

Figure 20: Mauka End of Site 50-50-03-5954 Rock Wall. View is to the Southwest.

STATE SITE NUMBER 50-50-03-5955

FORM:	Modified rock deposit
FUNCTION:	Indeterminate
AGE:	Indeterminate
DIMENSIONS:	20.0 m by 14.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	Coral fragments
EXCAVATION:	Test Units (TU) 1 and 2; Shovel Probes (SP) 1 through 10

DESCRIPTION: This site consists of several potentially "modified" rock concentrations occurring on a rocky slope (Figure 21). The site is located downslope from several other amorphous rock concentrations that are outside the project area. Linear mounds resulting from road construction are present to the south and a water channel occurs to the north. Grass, *'ilima*, and burnt *kiawe* provide moderate vegetation coverage. This tri-level rock concentration

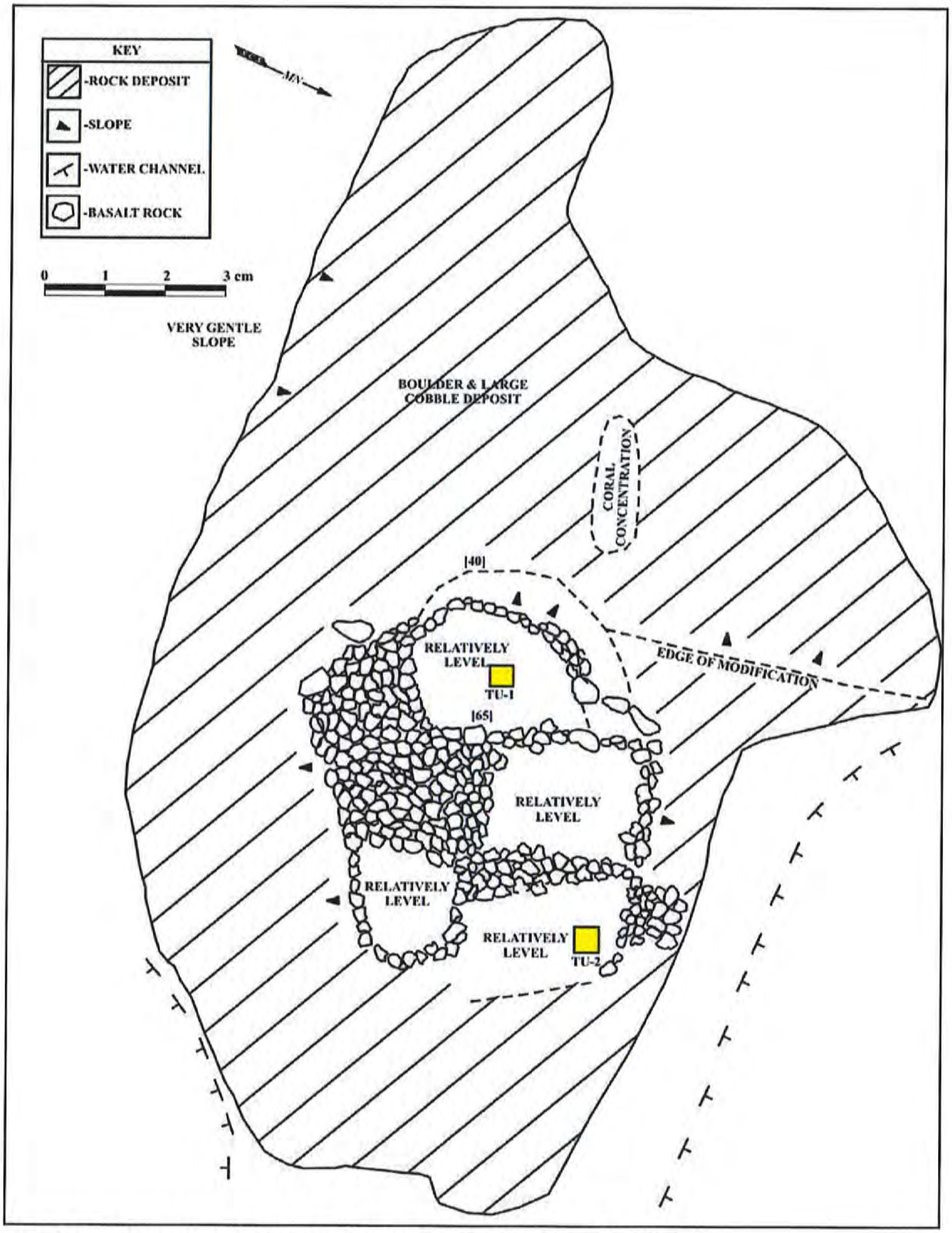

Figure 21: Plan View of Site 50-50-03-5955 Modified Rock Deposit.

contains two relatively level areas on its upper slopes. A larger rock deposit with no visible formal construction is located on the lower slopes of the feature where two additional relatively level areas are present. Several large pieces of branch coral and other coral fragments are present to the northwest, downslope of the modified portion of the feature. According to the field crew, the coral fragments appeared to have eroded (water erosion) to this location from the upper portions of the slope. The crew also noted that coral pieces were common in lower areas, this not surprising considering the proximity of this area to the coastline. The age and function of this feature are indeterminate and may simply be a modest activity area. As shown below, excavations did not show this feature to be more complex than documented from surface characteristics.

EXCAVATION: Two test units were excavated in two of the level areas on the rock deposit. Test Unit 1 is 50 cm by 50 cm. Layer I (0–35 cmbs) is a very dry, grey brown silt containing some sand and 25 percent pebbles and cobbles. The unit was terminated upon encountering large boulders. No cultural material was recovered from this unit.

Test Unit 2 is 50 cm by 50 cm. One layer was identified and excavated in two levels (Figure 22).

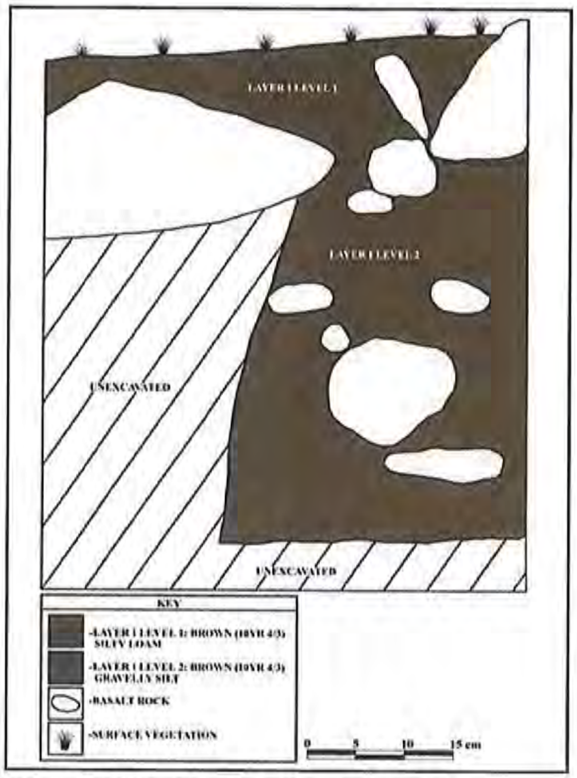

Figure 22: Site 50-50-03-5955 Test Unit 2 North Profile.

Layer I level 1 (0–12 cmbs) is a brown (10 YR 4/3) silty loam containing more than 50 percent rocks (cobble size and larger) and organic material. No cultural material was recovered from this level. Layer I level 2 (12–52 cmbs) is a brown (10 YR 4/3) very gravelly silt containing large cobbles and small boulders. The west end of the unit is dominated by very large rocks that were not removed. One coral fragment was recovered from this unit.

Ten shovel probes (Figure 23) (Table 2) were placed at regular intervals on a level area along the southwest edge of the modified feature. The shovel probes and their depths are presented below. No cultural material was recovered from any of the probes. Shovel Probes 5 and 8 were not excavated due to the lack of cultural material in the other probes.

Table 2: Shovel Probe Depths.

Shovel Probe	Depth (cmbs)
1	40
2	32
3	17
4	24
5	Not Excavated
6	24
7	20
8	Not Excavated
9	21
10	5

Shovel Probe 1 was the only probe that yielded any material. This probe was excavated to a maximum depth of 40 cmbs. Layer I (0–25 cmbs) is a very rocky, dark greyish brown (10 YR 4/2) silt. Four very small pieces of coral were collected from Layer I. Layer II (25–40 cmbs) is a very rocky, dark grey (10 YR 4/1) silt. This layer appears to represent either a stream or flood deposit based the presence of waterworn pebbles and gravel. No cultural material was recovered.

STATE SITE NUMBER 50-50-03-5956

FORM:	Shell midden and lithic scatter
FUNCTION:	Indeterminate
AGE:	Historic and possibly prehistoric
DIMENSIONS:	173 m by 141 m
CONDITION:	Fair
SURFACE ARTIFACTS:	Shell midden, lithics, metal and grass fragments
EXCAVATION:	Stratigraphic Trenches 1 and 2

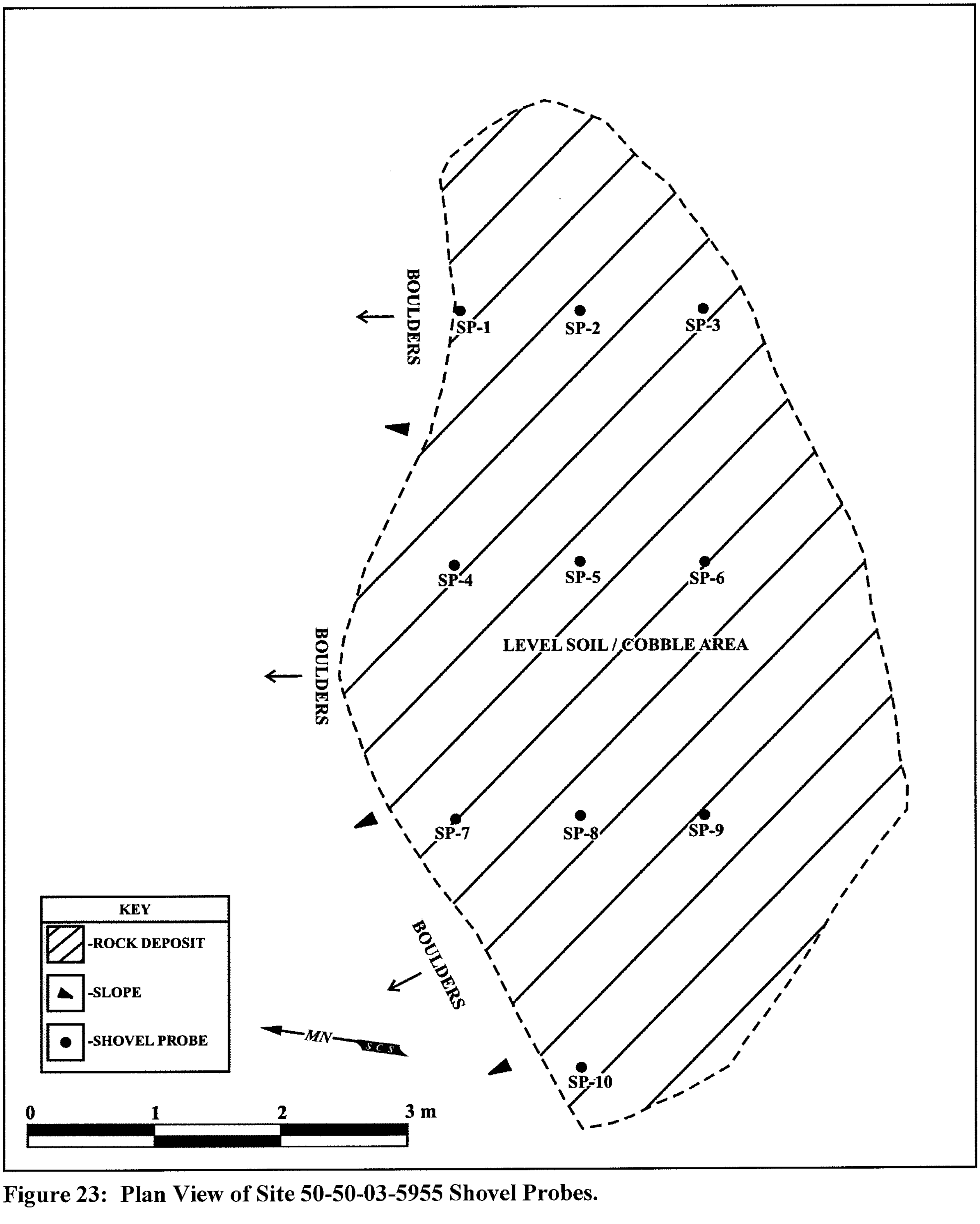

Figure 23: Plan View of Site 50-50-03-5955 Shovel Probes.

DESCRIPTION: This site is a large shell midden and lithic scatter with sparse historic debris, including glass and metal fragments. The area was heavily modified during the plantation era by the formation of earthen berms. The ground cover consists of sparse grass due to recent burning, therefore, visibility is good. Material appears to be more or less evenly distributed throughout the site.

Surface material was collected from two areas (Areas A and B). Different sampling strategies were used for each of the areas. Area A is approximately 170.0 m long by 85.0 m wide and covers approximately 14,450 sq m. Material collected consists of marine shells, coral, waterworn basalt, basalt flakes and cores, and historic debris, including metal railroad spikes and various colored glass fragments.

Area B is located northwest of Area A. Area B is irregular in shape and covers approximately 3,150 sq m. Only a portion of this area was sampled. A 20.0 m long by 10.0 m wide area was divided into eight 5.0 m by 5.0 m squares labeled Blocks A through H. The material collected from each block is summarized below (see also Appendix A).

Table 3: Material Collected from Blocks.

Block	**Material Collected**
A	marine shells, coral, basalt and slag flakes, glass fragments, metal
B	coral, basalt flake
C	marine shells, slag core, glass fragments, bisque potsherd
D	marine shells, coral, glass marble
E	marine shells, small mammal bone fragment, basalt and slag flakes, glass fragment
F	marine shells, coral, glass fragment
G	marine shells, basalt flakes, glass fragments, bisque potsherd
H	marine shell, coral, basalt and slag flakes, glass fragments, aluminum

The marine shells collected are very fragmentary and have suffered structural wear either from natural or human induced causes and therefore lack specific diagnostic features. Among the species identified are *Littorina* sp., *Conus* sp., *Cypraea* sp., and *Cellana* sp. (*`opihi*) which were extremely well liked as a food item and were reportedly the most commonly eaten shells in the Hawaiian Islands (Kay in Titcomb 1979). *`Opihi* shells were also good instruments for scooping, peeling, and scraping because of their sharp edges (Titcomb 1978). Other species identified include *Anachis miser*, which are common in shallow water and found on the fronds of certain kinds of algae, *Drupa ricina* and *Nerita picea, which* are found on rocky substrates, and *Nerita neglecta* (also called *Theodoxus neglecta*), *which* are found both in sea and brackish water.

Nerita picea and *Nerita neglecta*, called *pipipi* by the Hawaiians, were eaten as food and their shells used for lei (Kay 1979:63). *Cassis cornuta* which was eaten as food and whose shells were used as trumpets (Titcomb 1978) and *Purpura aperta* which was also eaten by the Hawaiians (Kay 1979) may also be present in the assemblage.

The basalt and slag flakes show an interesting adaptive behavior between different "lithic" materials being used for presumably similar purposes. The presence of the basalt flakes, while implying a prehistoric component, does not necessarily lead to the inference that they were deposited during prehistoric times. The slag flakes are undoubtedly historic in nature. The presence of both will be further assessed as part of a more in-depth study of the slag and slag flaking.

EXCAVATION: Two stratigraphic trenches were mechanically excavated with a backhoe. Stratigraphic Trench 1, 29.0 m long by 1.0 m wide, is located 18.5 m away from the northeast corner of the site. Layer I (0–30 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt that is high in roots and burnt organic material and contains more than 5 percent gravel. The charred material originates from burning that took place one year ago. Layer II (30–50 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt containing more than 10 percent gravel and cobbles. Layer III (50–80 cmbs) is a dark reddish brown (5 YR 3/4) and yellowish red (5 YR 4/6) sandy silt containing some gravel and saprolite. No cultural material was recovered during excavation.

Stratigraphic Trench 2 (Figure 24), 25.0 m long by 1.0 m wide, is located 28.5 m *makai* of Stratigraphic Trench 1. Layer I (0–30 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt containing more than 5 percent rock and a high amount of organic material. Layer II (30–50 cmbs) is a dark brown (7.5 YR 3/3) sandy silt containing more than 10 percent rock. This layer is not continuous throughout the whole trench. Layer III (50–80 cmbs) is a dark yellowish brown (10 YR 4/4) saprolite. No cultural material was recovered during excavation.

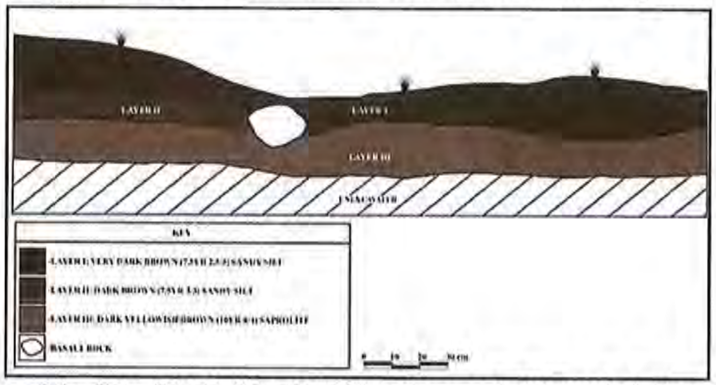

Figure 24: Site 50-50-03-5956 Stratigraphic Trench 2 South Profile.

STATE SITE NUMBER 50-50-03-5957

FORM:	Terrace
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	9.5 m by 4.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	Test Unit 1

DESCRIPTION: This site consists of a terrace on the edge of an unnamed gulch (Figure 25). The terraced area is 9.5 m long by 4.0 m wide and is relatively level. Two additional terraces may be present on top of the level area. The terraced area is bound by a pile of mechanically pushed boulders to the south, earthen berms to the east and west, and an unnamed gulch to the north. The terrace face is constructed of cobbles and boulders stacked up to 90 cm high in some areas. The terrace has been altered by bulldozing activity and one section of the terrace face has been disturbed by cattle.

EXCAVATION: Test Unit 1 (Figure 26) measures 1.0 m by 1.0 m and is located in the northwest portion of the terrace directly behind the terrace wall. Layer I (0–7 cmbs) is a very dark brown (7.5 YR 2.5/2) fine silt containing 25 percent rocks. Layer I is ashy and contains large burnt roots due to recent burning. Layer II (7–23 cmbs) is a dark reddish brown (5 YR 3/3) silt. This layer is coarse grained and contains 70 percent pebbles. Layer III (23–41 cmbs) is a dark brown (7.5 YR 3/3) silt containing 30 percent rocks. Layer IV (41–58 cmbs) is a dark brown (7.5 YR 3/3) silt that is more compact and less rocky than Layer III. Layer V (58–63 cmbs) is a dark brown (7.5 YR 3/2) silty sand that is slightly more compact that Layer IV and contains fewer rocks.

DISCUSSION AND CONCLUSIONS

A total of ten sites were identified during Inventory Survey of large land parcels near coastal Launiupoko. A majority of the sites are historic in age. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the ten sites is a scatter of slag fragments and cores interpreted to be a historic work/dumping area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites -5955 and -5956 are indeterminate but both can be viewed as activity areas likely related to historic times. Only negative results were obtained during subsurface testing.

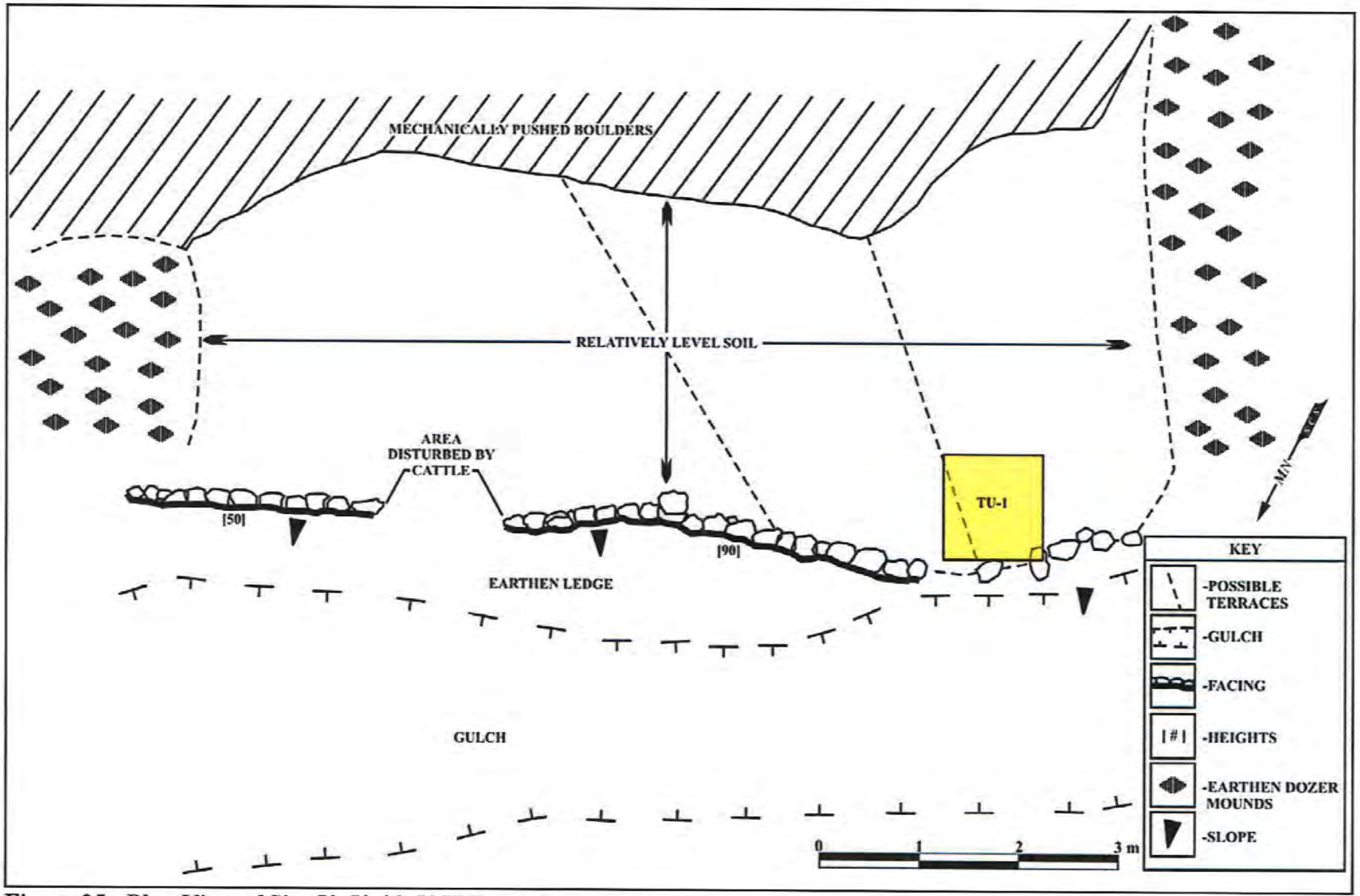

Figure 25: Plan View of Site 50-50-03-5957 Terrace.

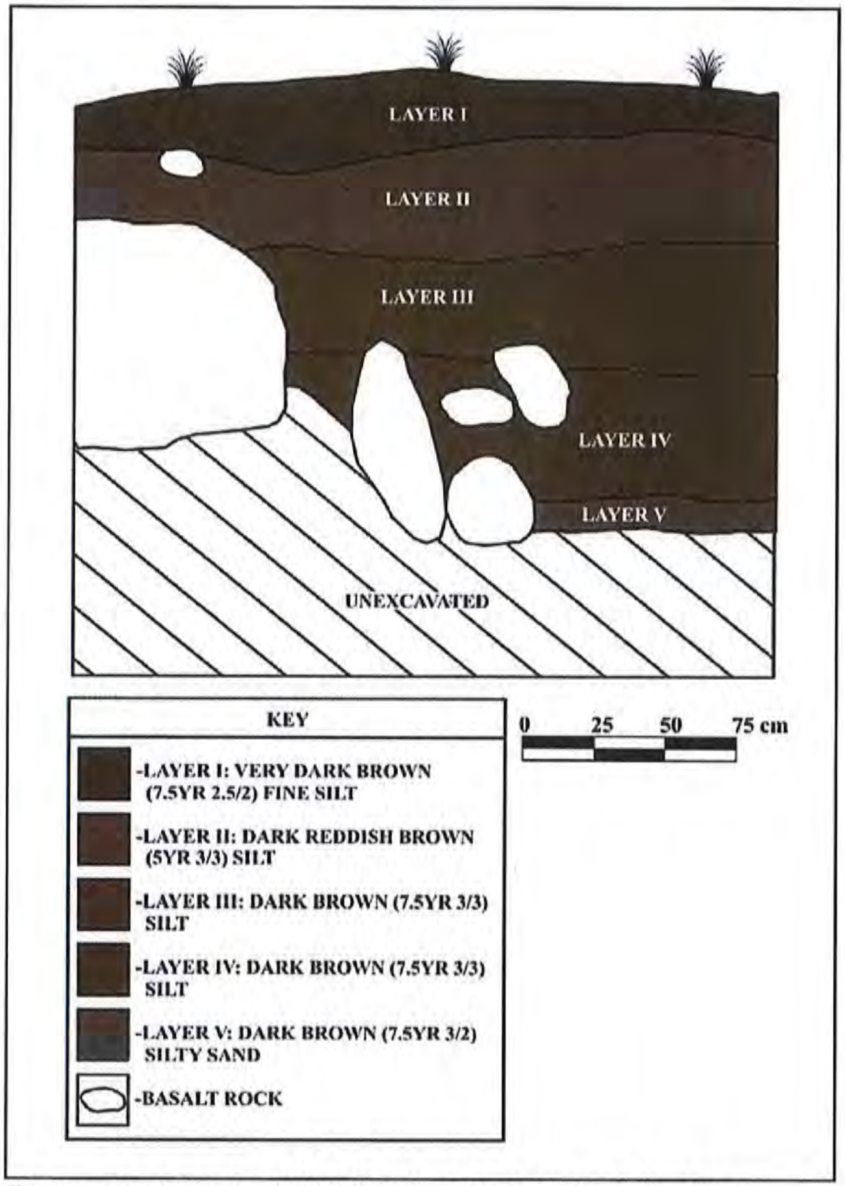

Figure 26: Site 50-50-03-5957 Test Unit 1 North Profile.

As expected, a majority of the sites identified during Inventory Survey are historic in age and are associated with either the plantation era or subsequent cattle ranching activities. These findings were "expected" based on the location of the project area: near modern infrastructure (highway, roadways) and on only moderately sloping lands (prime sugar cane cultivation land). The project area has been tremendously impacted by sugarcane cultivation practices through time. The large mounds composing Site -5950 indicate massive landscape clearance of rocks and boulders across this lower portion of the Launiupoko landscape. Even one flying near the project area in a commercial airplane is acutely aware of landscape alterations in Launiupoko.

However, only the lower portions of the landscape appear to have been most massively altered. Archaeological work occurring to the east (upslope) has revealed the presence of numerous prehistoric sites ranging from temporary work areas to habitation loci and ceremonial places dating from the c. A.D. 1200s (Graves *et al.* 1998; Haun and Henry 2001; Haun *et al.* 2001; Dega *et al.* 2006). The difference between the presence/absence of significant sites (or even prehistoric site presence) appears to primarily have been based on location. The lower areas were more amenable to sugar cane cultivation and were much drier. More *mauka* reaches contained undulating topography not necessarily as favorable to industrial-level sugar cane cultivation and also contained a different climate: wetter, a denser arboreal component, and deeper soils. Note that the difference between these two regions of Launiupoko is only 1-2 kilometers in distance. Overall, it appears as though occupants of the Launiupoko area, from the A.D. 1200s through historic times, had established a symbiotic relationship between their goals (farming, habitation, cultivation) and the micro-climates and micro-topography of the area. This appears one reason few sites were documented during this Inventory Survey in the lower reaches.

Finally, the current project occurs above the coast and below any real elevation gains along fairly modest undulating slopes. This area could be considered a relative "barren zone" compared to the other two resource areas. This is somewhat proven by the nature of sites in the coastal and slightly upland zones, when compared with this intermediate area. These intermediate were often the location of the most intensive historic use so may only be considered as "barren zones" for a short portion of history.

SITE SIGNIFICANCE ASSESSMENTS AND RECOMMENDATIONS

These sites have been evaluated for significance according to the criteria established for the Hawai`i State Register of Historic Places. The five criteria are presented below:

Criterion A:	Site is associated with events that have made a significant contribution to the broad patterns of our history
Criterion B:	Site is associated with the lives of persons significant to our past
Criterion C:	Site is an excellent site type; embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual construction

Criterion D: Site has yielded or has the potential to yield information important in prehistory or history

Criterion E: Site has cultural significance to an ethnic group; examples include religious structures, burials, major traditional trails, and traditional cultural places

Table 2: Sites Identified in the Launiupoko Large Lot Subdivision, Significance Assessments, and Recommendations

State # 50-50-03-	Temp. #	# of Features	Form (include shape)	Function; Site Significance and Recommendation
5950	T-1	16	Rock mounds (linear)	Agricultural (associated with sugarcane cultivation); Criterion D, Monitoring
5951	T-2	1	Irrigation ditch, water pipes, reservoir (irregular)	Agricultural (associated with sugarcane cultivation)); Criterion D, *NFW
5952	T-3	1	Terraces (irregular)	Agricultural (associated with sugarcane cultivation)); Criterion D, NFW
5953	T-4	1	Slag scatter (50 by 35 m)	Work area); Criterion D, NFW
5954	T-5	1	Rock wall (linear)	Ranching); Criterion D, NFW
5955	T-6	1	Modified rock deposit (irregular)	Indeterminate/Activity Area); Criterion D, NFW
5956	T-7	1	Midden and lithic scatter (173 by 141 m)	Activity Area); Criterion D, NFW
5957	T-8	1	Terrace (rectangular)	Agricultural (associated with sugarcane cultivation)); Criterion D, NFW
2665	T-9	1	2 rock wall segments (linear)	Ranching); Criterion D, NFW
4787 Feature D	T-10	1	Lahaina Pump Ditch No. 1	Agricultural (associated with sugarcane cultivation)); Criterion D, NFW

*NFW=No Further Work is Recommended

All of the sites identified during Inventory Survey are significant under Criterion D. At this juncture, all the sites have been thoroughly mapped and recorded. Archaeological Monitoring will be required at Site 50-50-03-5950 in the event that these mounds are dismantled in conjunction with the areas development. With the exception of Site 50-50-03-5950 no further work is recommended for the additional sites. As the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits appears very low. With the exception of Archaeological Monitoring at Site 5950 no further archaeological work is recommended in the project area.

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APPENDIX A: CULTURAL MATERIAL INVENTORY

APPENDIX A

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY

Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	1.1	Area B	Block A	Surface	-	-	Coral	-	0.2	2	
T-7	1.2	Area B	Block A	Surface	-	-	Coral	-	26.0	1	
T-7	1.3	Area B	Block A	Surface	-	-	Marine Shell	*Conus* sp.?	0.2	1	
T-7	1.4	Area B	Block A	Surface	-	-	Marine Shell	*Cellana* sp.	0.1	1	
T-7	1.5	Area B	Block A	Surface	-	-	Marine Shell	*Cypraea* sp.	0.2	1	
T-7	2.1	Area B	Block A	Surface	-	-	Flake	Basalt	-	4	
T-7	2.2	Area B	Block A	Surface	-	-	Flake	Slag	-	1	
T-7	3.1	Area B	Block A	Surface	-	-	Glass Sherd	Colorless	-	2	
T-7	3.2	Area B	Block A	Surface	-	-	Glass Sherd	Brown Transluscent	-	1	
T-7	3.3	Area B	Block A	Surface	-	-	Ferrous Metal	-	375.9	1	
T-7	4.1	Area B	Block B	Surface	-	-	Coral	-	4.9	4	
T-7	5.1	Area B	Block B	Surface	-	-	Flake	Basalt	-	1	
T-7	6.1	Area B	Block C	Surface	-	-	Marine Shell	*Conus* sp.	4.5	4	
T-7	6.2	Area B	Block C	Surface	-	-	Marine Shell	*Cypraea* sp.	3.0	6	
T-7	6.3	Area B	Block C	Surface	-	-	Marine Shell	*Conus* sp.?	0.1	1	
T-7	7.1	Area B	Block C	Surface	-	-	Core	Slag	-	1	
T-7	8.1	Area B	Block C	Surface	-	-	Glass Sherd	While Opaque	-	1	
T-7	8.2	Area B	Block C	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	Double Lipped
T-7	8.3	Area B	Block C	Surface	-	-	Pot Sherd	Bisque	-	1	Light Blue Decorat's
T-7	9.1	Area B	Block D	Surface	-	-	Marine Shell	Unidentifiable	0.3	1	
T-7	9.2	Area B	Block D	Surface	-	-	Marine Shell	*Cypraea* sp.?	0.3	1	
T-7	9.3	Area B	Block D	Surface	-	-	Marine Shell	*Cypraea* sp.	1.3	2	
T-7	9.4	Area B	Block D	Surface	-	-	Marine Shell	*Narita picea*	0.2	1	
T-7	9.5	Area B	Block D	Surface	-	-	Coral	-	5.2	2	
T-7	10.1	Area B	Block D	Surface	-	-	Historic	Glass Marble	-	1	
T-7	11.1	Area B	Block E	Surface	-	-	Marine Shell	*Cypraea* sp.	1.0	2	
T-7	11.2	Area B	Block E	Surface	-	-	Bone	Sm. Mammal	0.5	1	
T-7	12.1	Area B	Block E	Surface	-	-	Flake	Basalt	-	1	
T-7	12.2	Area B	Block E	Surface	-	-	Flake	Slag	-	1	

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY

Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	13.1	Area B	Block E	Surface	-	-	Glass Sherd	-	-	1	
T-7	14.1	Area B	Block F	Surface	-	-	Marine Shell	*Cypraea* sp.	1.4	2	
T-7	14.2	Area B	Block F	Surface	-	-	Marine Shell	Unidentifiable	1.9	1	
T-7	14.3	Area B	Block F	Surface	-	-	Coral	-	19.3	2	
T-7	15.1	Area B	Block F	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	
T-7	16.1	Area B	Block G	Surface	-	-	Marine Shell	Unidentifiable	1.5	2	
T-7	16.2	Area B	Block G	Surface	-	-	Marine Shell	*Cypraea* sp.	0.3	1	
T-7	16.3	Area B	Block G	Surface	-	-	Marine Shell	*Cypraea* sp.	3.7	3	
T-7	17.1	Area B	Block G	Surface	-	-	Flake	Basalt	-	6	
T-7	18.1	Area B	Block G	Surface	-	-	Glass Sherd	Colorless	-	2	
T-7	18.2	Area B	Block G	Surface	-	-	Pot Sherd	Bisque	-	1	While Glaze
T-7	19.1	Area B	Block H	Surface	-	-	Marine Shell	*Cypraea* sp.	1.3	1	
T-7	19.2	Area B	Block H	Surface	-	-	Marine Shell	Unidentifiable	2.7	4	
T-7	19.3	Area B	Block H	Surface	-	-	Marine Shell	*Cypraea* sp.	3.4	1	
T-7	19.4	Area B	Block H	Surface	-	-	Coral	-	43.0	3	
T-7	20.1	Area B	Block H	Surface	-	-	Flake	Basalt	-	6	
T-7	20.2	Area B	Block H	Surface	-	-	Flake	Slag	-	5	
T-7	21.1	Area B	Block H	Surface	-	-	Historic	Alluminum	1.4	1	
T-7	21.2	Area B	Block H	Surface	-	-	Glass Sherd	Pink Transluscent	-	1	
T-7	21.3	Area B	Block H	Surface	-	-	Glass Sherd	Green Transluscent	-	2	
T-7	22.1	Area A	-	Surface	-	-	Coral		555.7	111	
T-7	22.2	Area A	-	Surface	-	-					
T-7	22.3	Area A	-	Surface	-	-					
T-7	22.4	Area A	-	Surface	-	-					
T-7	22.5	Area A	-	Surface	-	-					
T-7	22.6	Area A	-	Surface	-	-					
T-7	23.1	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	233.6	14	
T-7	23.2	Area A	-	Surface	-	-	Marine Shell	*Cypraea* sp.	7.1	37	
T-7	23.3	Area A	-	Surface	-	-	Marine Shell	*Cassis cornuta*?	14.2	1	
T-7	23.4	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	39.8	13	
T-7	23.5	Area A	-	Surface	-	-	Marine Shell	Unidentifiable	77.0	100+	

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY

Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	23.6	Area A	-	Surface	-	-	Marine Shell	*Drupa ricina*	16.9	3	
T-7	23.7	Area A	-	Surface	-	-	Marine Shell	*Cypraea* sp.	9.9	2	
T-7	23.8	Area A	-	Surface	-	-	Operculum	-	0.4	1	
T-7	23.9	Area A	-	Surface	-	-	Marine Shell	*Nerita neglecta* & *Nerita picea*	2.5	15	
T-7	23.10	Area A	-	Surface	-	-	Marine Shell	*Littorina* sp.	1.0	6	
T-7	23.11	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	1.9	2	
T-7	23.12	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	2.8	1	
T-7	23.13	Area A	-	Surface	-	-	Marine Shell	*Anachis miser*	0.0	1	
T-7	23.14	Area A	-	Surface	-	-	Coral	-	2.9	11	
T-7	24.1	Area A	-	Surface	-	-	Historic	Ferrous	451.5	3	Railroad Spikes
T-7	25.1	Area A	-	Surface	-	-	Glass Sherd	Green Opaque	-	2	
T-7	25.2	Area A	-	Surface	-	-	Glass Sherd	Colorless	-	3	
T-7	25.3	Area A	-	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	
T-7	25.4	Area A	-	Surface	-	-	Glass Sherd	Amathyst	-	1	
T-4	19	-	-	Surface	-	-	Marine Shell	*Purpura aperta?*	41.0	1	
T-3	26.1	-	TU-1	I	-	0–28	Charcoal	-	-	-	
T-3	26.2	-	TU-1	I	-	0–28	Seeds	-	-	3	
T-3	26.3	-	TU-1	I	-	0–28	Seeds	Burned	-	6	
T-3	27.1	-	ST-1	I	-	0–24	Historic	Wire Nail	-	1	
T-3	27.2	-	ST-1	I	-	0–24	Coral	-	21.3	4	
T-3	27.3	-	ST-1	I	-	0–24	Charcoal	-	0.1	-	
T-3	27.4	-	ST-1	I	-	0–24		Slag	-	4	
T-3	28.1	-	ST-2	I	-	0–25	Land Snail	-	-	5	
T-3	28.2	-	ST-2	I	-	0–25	Historic	Cement	-	1	
T-3	28.3	-	ST-2	I	-	0–25		Slag	-	11	
T-3	29.1	-	ST-3	II	32	-	Charcoal	-	1.0	-	
T-3	30.1	-	ST-5	I	40–46	-	Glass Sherd	Irridescent/Colorless	-	3	
T-3	31.1	-	ST-5	II	41	-	Charcoal	-	0.0	-	
T-3	32.1	-	ST-5	II	45	-	Charcoal	-	0.0	-	

APPENDIX I-1.

State Historic Preservation Letter Accepting Paraso and Dega Archaeological Inventory Survey

LINDA LINGLE
GOVERNOR OF HAWAII

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

ROBERT K. MASUDA
DEPUTY DIRECTOR - LAND

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

(152)

November 13, 2006

Dr. Michael Dega
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 975
Honolulu, Hawaii 96813

LOG NO: 2006.3593
DOC NO: 0611MK07
Archaeology

Dear Dr. Dega:

SUBJECT: **Chapter 6E-42 Historic Preservation Review – Revised Archaeological Inventory Survey for 633 Acres in the Launiupoko Large Lot Subdivision Numbers 3, 4, and 7 Launiupoko and Polanui Ahupuaa, Lahaina District, Island**
TMK (2) 4-7-001: por. 2

Thank you for the opportunity to review this revised report which our staff received on August 24, 2006 (Paraso and Dega 2006, *An Archaeological Inventory Survey of 633 acres in the Launiupoko [Large Lot] Subdivision NOS 3, 4, and 7, Launiupoko and Polanui Ahupuaa, District of Lahaina [Formerly Kaanapali] Island of Maui, Hawaii [TMK (2) 4-7-01:2 por.]*...Scientific Consultant Services, Inc., ms). We previously provided comments and requested some revisions (LOG NO: 2006.2835/DOC NO: 0608MK27) including the insertion of permanent SIHP site numbers throughout the report. We indicated that the background section was acceptable.

The survey has adequately covered the project area documenting ten historic properties, two of which were previously identified during previous archaeological inventory survey. Previously identified SIHP 50-50-03-2665 consists of two historic ranching wall segments, and 50-50-03-4787 consists of an historic irrigation ditch. Newly identified sites 50-50-03-5950 through -5957 consist of plantation and ranching activity sites including rock mounds, irrigation systems, terraces, slag scatter, modified rock deposit, lithic/midden scatter, and wall segments. These sites represent historic plantation activities related to sugar production or ranching activities.

We agree with the significance assessments that all of the sites are significant under Criterion "D" for their information content. No further work is necessary for SIHP 50-50-03-5951 through 5957, -2665, and -4787.

We previously concurred with the preliminary mitigation recommendations for SIHP 50-50-03-5930, which consists of the large plantation era clearing mounds, and has been discussed within the community from a cultural perspective. Oral documentation by former plantation workers suggests that the mounds may be both constructed upon existing stone structures, and that cultural materials were periodically placed within the mounds during the field clearing process. We believe that archaeological monitoring during any deconstruction of these mounds is appropriate. We will await a monitoring plan detailing the proposed scope of monitoring.

We find this report to be acceptable. As always, if you disagree with our comments or have questions, please contact Dr. Melissa Kirkendall at (808) 243-5169 as soon as possible to resolve these concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

MK:kf

c: Bert Ratte, DPWEM, County of Maui, FAX 270-7972
Michael Foley, Director, Dept. of Planning, FAX 270-7634
Maui Cultural Resources Commission, Dept. of Planning, 250 S. High Street, Wailuku, HI 96793

APPENDIX I-2.

Archaeological Field Inspection Letter

SCIENTIFIC CONSULTANT SERVICES, Inc.

HAWAII

711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

August 9, 2007

Ms. Jenny Pickett
SHPD-Maui
130 Mahalani Street
Wailuku, HI 96793

Re: Field Inspection of Proposed Southerly/*Mauka* Extension of the Lahaina Bypass, Launiupoko and Polanui Ahupua`a, Lahaina District, Island of Maui, Hawai`i [TMK:(2) 4-7-01:por. various]

Dear Ms. Pickett:

At the request of Makila Land Company, LLC (Makila), Scientific Consultant Services, Inc. (SCS) conducted an Archaeological Field Inspection of the proposed Southerly/*Mauka* Extension of the Lahaina Bypass, Launiupoko and Polanui Ahupua`a, Lahaina District, Island of Maui, Hawai`i [TMK:(2) 4-7-01:por. various]. The Field Inspection was conducted by SCS staff on October 31 and November 1, 2006, mostly within abandoned agricultural fields. The area surveyed covered a 2.5 mile, 160 ft. wide corridor that extends toward Lahaina from the former Olowalu Landfill northwest to Puamana (Figures 1 and 2). The request for Field Inspection was made by Makila to satisfy historic preservation review requirements, as part of an Environmental Assessment. An Archaeological Cultural Impact Assessment (underway) is another component of that Environmental Assessment. Although this entire section of bypass corridor falls within lands already subjected to archaeological survey (see below), Makila and SCS agreed that a follow up field inspection would focus attention exclusively on the proposed corridor, and ensure that no undocumented archaeological sites would be impacted during bypass construction.

Previous Archaeology within Bypass Corridor

SCS conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District, Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.] (Paraso and Dega 2006). This project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing. Most importantly, Paraso and Dega's study covered 100 percent of the current project area (Figures 3). This former SCS work is particularly relevant to the current field inspection, as no new sites were found in the current project area. All archaeological sites within a 30 ft. radius of the proposed bypass were previously documented by Paraso and Dega (2006) (Figure 4). The following three paragraphs were taken directly from Paraso and Dega (2006):

> A total of ten sites were identified, the majority of which were assessed as historic. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the irrigation ditches was previously recorded by PHRI (2000) as State Site Number 50-50-03-4787 Feature D and is referred to as Lahaina Pump Ditch No. 1. Site 50-50-03-5950 is composed of 17 linear, large rock mounds scattered throughout the project area. Site 50-50-03-5951 consists of an irrigation ditch, water pipes, reservoir, and flume. Site 50-50-03-5952 is a terrace complex associated with the manual cultivation of sugarcane. Site 50-50-03-5957 is also a terrace associated with sugarcane cultivation.

> Two of the ten sites are rock walls associated with the cattle ranching era, one of which was previously recorded by Graves *et al.* (1998) and Haun *et al.* (2001) as State Site Number 50-50-03-2665. The other rock wall is designated Site 50-50-03-5954. One of the ten sites (Site 50-50-03-5953) is a scatter of slag fragments and cores interpreted to be a historic work area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites 50-50-03-5955 and 50-50-03-5956 are indeterminate but are simply referred to as activity areas. Site 50-50-03-5955 is a modestly modified rock deposit/bedrock area containing a small cache of coral fragments. This is site is simply interpreted as a modified area as disturbance, erosion, and lack of cohesiveness renders interpretations difficult. Site 50-50-03-5956 is a midden and lithic scatter that also contains historic material such as glass and metal fragments. Material was sampled during surface collection. No cultural materials were observed during subsurface testing.
>
> All of the sites identified during [Paraso and Dega's 2006] Inventory Survey are significant under Criterion D. All the sites have been thoroughly mapped and recorded. No further work is recommended for nine of these ten sites. SIHP 50-50-03-5950, the large plantation era clearing mounds, have been discussed within the community from a cultural perspective. Oral documentation by former plantation employees suggests that the mounds may have been constructed upon existing stone structures, and cultural materials were periodically placed within the mounds during field clearing (Kirkendall 2006), personal communication). If development of the area requires any deconstruction of these mounds (*i.e.*, the features of Site 5950) a qualified archaeologist should monitor these activities.

In general, the project area has been tremendously altered by sugarcane cultivation; Paraso and Dega's (2006) subsurface testing yielded negative results. The presence of any intact subsurface cultural deposits is very unlikely. Almost all views across this landscape portray the extent of historic and modern agricultural activity (Figure 5). A modern dirt road currently exists for roughly 80 percent of the length of the proposed bypass section subject to this field inspection (Figure 6).

Sites located within Bypass Corridor

Three sites documented by Paraso and Dega (2006) are contained within the proposed Lahaina bypass corridor: Sites 5954, 5955, and 5950. Sites 5954 (rock wall) and 5955 (activity area) have been documented fully and no further work has been recommended. However, five features of the clearing mound site (Site 5950) will be altered by the proposed bypass. Each of the 17 large mounds has been given an individual feature number, and numbers 3, 12, 13, 15, and 16 fall within the current project area (see Figure 4).

Conclusions

No new archaeological sites were documented during this Field Inspection of the proposed Lahaina bypass. Of the three previously recorded sites within the project area, two have been fully documented as Criterion D sites (Paraso and Dega 2006), and no further work has been recommended. This assessment was agreed with as the report was accepted by the SHPD (Log No.:2006.3593; Doc No.: 0611MK07). The monitoring required at Site 50-50-03-5950 (Features 3, 12, 13, 15, and/or 16) will be the responsibility of Makila or the developer first in need of deconstructing these features. If, by the time earth-moving procedures on the Lahaina bypass begin, several other mound features have been Monitored with negative results, SHPD may be consulted to determine the possibility of not Monitoring some or all of the mounds that fall within the Lahaina bypass corridor.

Although the Inventory Survey Report (Paraso and Dega 2006) alludes to oral histories pointing to possible site and/or artifacts within the historic plantation-era mounds, none have been empirically shown to contain sites and/or artifacts. The hypothesis of archeological material occurring within the Site 5950 mounds amounts to non-empirically substantiated notions. However, this is not one that should be readily dismissed. SCS archaeologists believe that if the large clearing mounds do contain items of archaeological interest, their value to the community and archaeological record would be significantly reduced due to their current provenience. Artifacts or sites found within the mounds today would have been pushed there, or been the base of literally tons of surrounding boulder deposit, and would therefore yield little intact objects or information. Questions remain as to whether significant sites occur under the larger mounds, whether the context of any finds would be secondary or even tertiary.

For this reason, Makila, SCS, and SHPD will communicate during mound deconstruction to determine an appropriate sample size for Archaeological Monitoring. SCS recommends that if the first four of 17 mounds Monitored within the Launiupoko lands produce entirely negative results, Site 5950 mound Monitoring may be discontinued for the duration of the development project.

Thank you again for reviewing this document and your advice on Monitoring during future ground altering activities in the Launiupoko area related to this project. Please call (597-1182) if you have any questions or concerns about this letter.

Best regards,

Jon Wilson, B.A.
Michael Dega, Ph.D.
Senior Archaeologists
Scientific Consultant Services, Inc.

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PHRI
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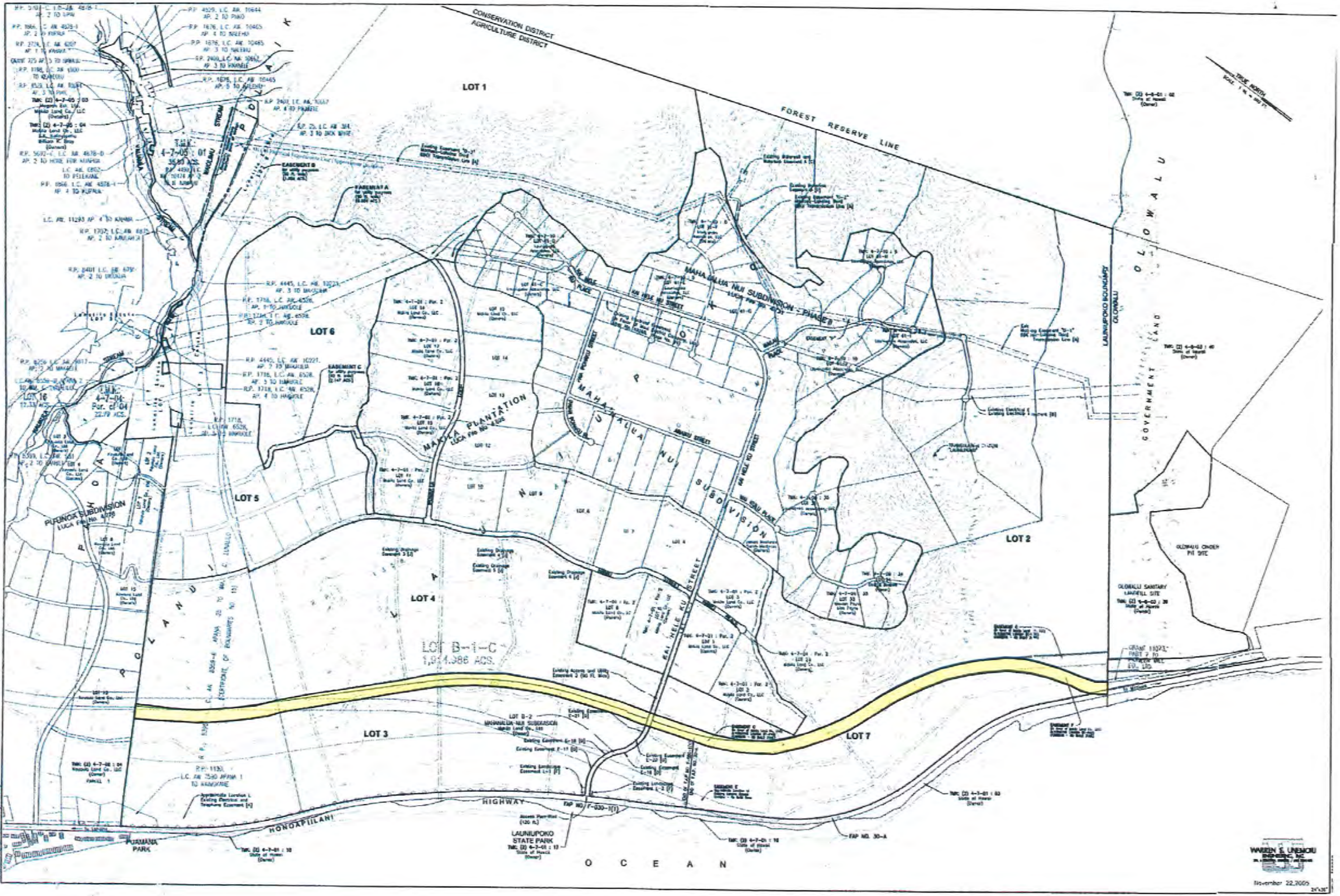


FIGURE 1: HIGHLIGHTED AREA SUBJECT TO FIELD INSPECTION (SURVEYOR'S MAP)

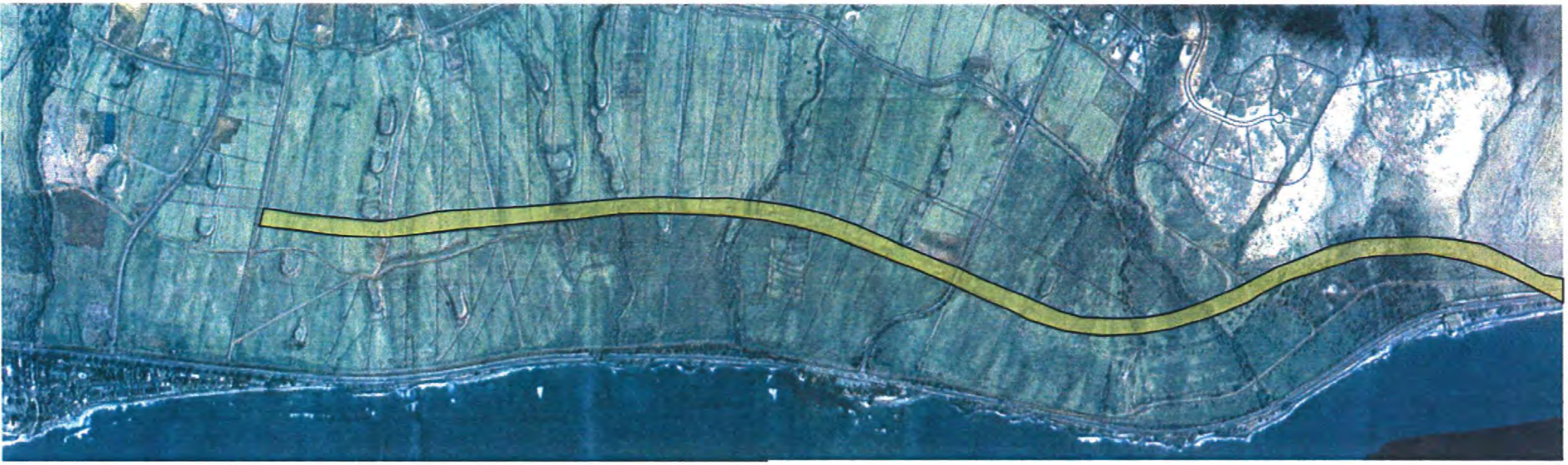


FIGURE 2: HIGHLIGHTED AREA OF FIELD INSPECTION (AERIAL PHOTOGRAPH)

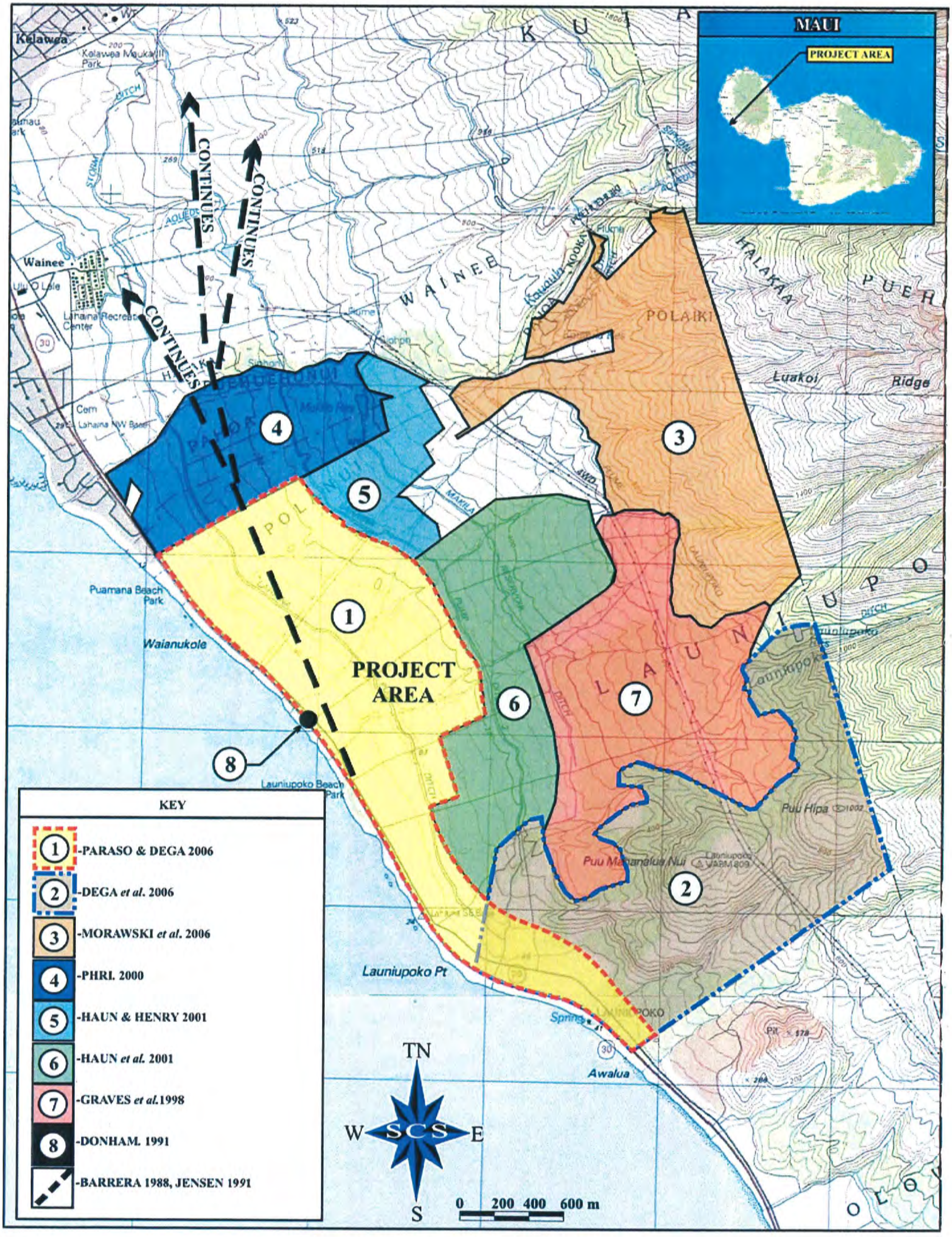
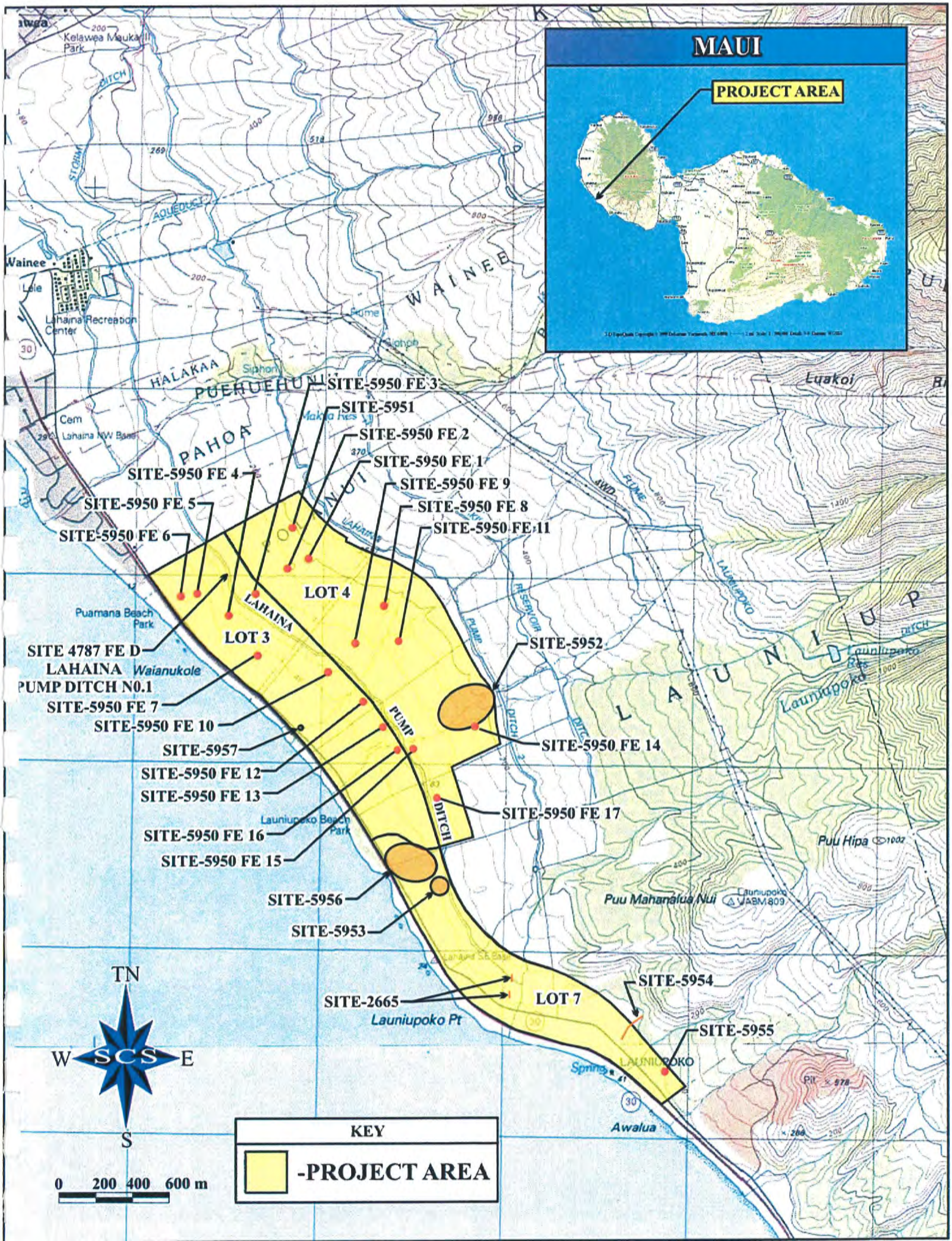


Figure 3: Previous archaeology near the project area.


MAUI
PROJECT AREA
SITE-5950 FE 3
SITE-5951
SITE-5950 FE 2
SITE-5950 FE 1
SITE-5950 FE 4
SITE-5950 FE 9
SITE-5950 FE 5
SITE-5950 FE 8
SITE-5950 FE 6
SITE-5950 FE 11
LOT 4
LOT 3
LAHAINA
SITE 4787 FE D
LAHAINA
PUMP DITCH N0.1
SITE-5952
SITE-5950 FE 7
SITE-5950 FE 10
SITE-5957
SITE-5950 FE 14
SITE-5950 FE 12
SITE-5950 FE 13
PUMP
DITCH
SITE-5950 FE 17
SITE-5950 FE 16
SITE-5950 FE 15
SITE-5956
SITE-5953
SITE-2665
LOT 7
SITE-5954
SITE-5955
TN
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KEY
-PROJECT AREA
Wainee
Lahaina Recreation Center
Kelawea Mauka II Park
HALAKAA
PUEHUEHUNUI
PAHOA
WAINEE
LAUNIUPOKO
Luakoi
Puamana Beach Park
Waianukole
Launiupoko Beach Park
Launiupoko Pt
Puu Hipa
Puu Mahanalua Nui
Awalua
Spring

URI ARF F P OS SOU ERL IAU EXT SIO F TI AH A B SS. W OU AS

FIGURE 6: AREA OF PROPOSED SOUTHERLY/MAUKA EXTENSION OF THE LAHAINA BYPASS. NOTE TWO MOUND FEATURES OF SITE 5950. VIEW TO NORTHWEST.

APPENDIX I-3.

Cultural Impact Assessment Report

SCS Project Number 763-DCIA-3

A CULTURAL IMPACT ASSESSMENT OF THE PROPOSED SOUTHERN/MAUKA EXTENSION OF THE LAHAINA BYPASS IN LAUNIUPOKO SUBDIVISION NOS 3, 4, AND 7
LAUNIUPOKO AND POLANUI AHUPUA`A
DISTRICT OF LAHAINA (FORMERLY KĀ`ANAPALI)
ISLAND OF MAUI, HAWAI`I
[TMK (2) 4-7-01:2 POR.]

Prepared by:
Leann McGerty, B.A.
And
Robert L. Spear, Ph.D.
Revised October 2012

Prepared for:
Makila Land Company, LLC
33 Lono Avenue, Suite 450
Kahului, HI 96732

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INTRODUCTION

Scientific Consultant Services, Inc. (SCS) has been contracted by the Makila Land Company, LLC, to conduct a Cultural Impact Assessment on a portion of Parcels 3, 4, and 7 of the Laniupoko Subdivision, Laniupoko and Polanui Ahupua`a (TMK:4-7-01:2 por). The area assessed is the proposed southern/mauka extension of the Lahaina Bypass (Figures 1and 2).

The Constitution of the State of Hawai`i clearly states the duty of the State and its agencies is to preserve, protect, and prevent interference with the traditional and customary rights of native Hawaiians. Article XII, Section 7 requires the State to "protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupua`a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778" (2000). In spite of the establishment of the foreign concept of private ownership and western-style government, Kamehameha III (Kauikeaouli) preserved the peoples traditional right to subsistence. As a result in 1850, the Hawaiian Government confirmed the traditional access rights to native Hawaiian *ahupua*`a tenants to gather specific natural resources for customary uses from undeveloped private property and waterways under the Hawaiian Revised Statutes (HRS) 7-1. In 1992, the State of Hawai`i Supreme Court, reaffirmed HRS 7-1 and expanded it to include, "native Hawaiian rights...may extend beyond the *ahupua`a* in which a native Hawaiian resides where such rights have been customarily and traditionally exercised in this manner" (Pele Defense Fund v. Paty, 73 Haw.578, 1992).

Act 50, enacted by the Legislature of the State of Hawai`i (2000) with House Bill 2895, relating to Environmental Impact Statements, proposes that:

> ...there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawaii's culture, and traditional and customary rights...[H.B. NO. 2895].

Act 50 requires state agencies and other developers to assess the effects of proposed land use or shore line developments on the "cultural practices of the community and State" as part of the HRS Chapter 343 environmental review process (2001). Its purpose has broadened, "to promote and protect cultural beliefs, practices and resources of native Hawaiians [and] other

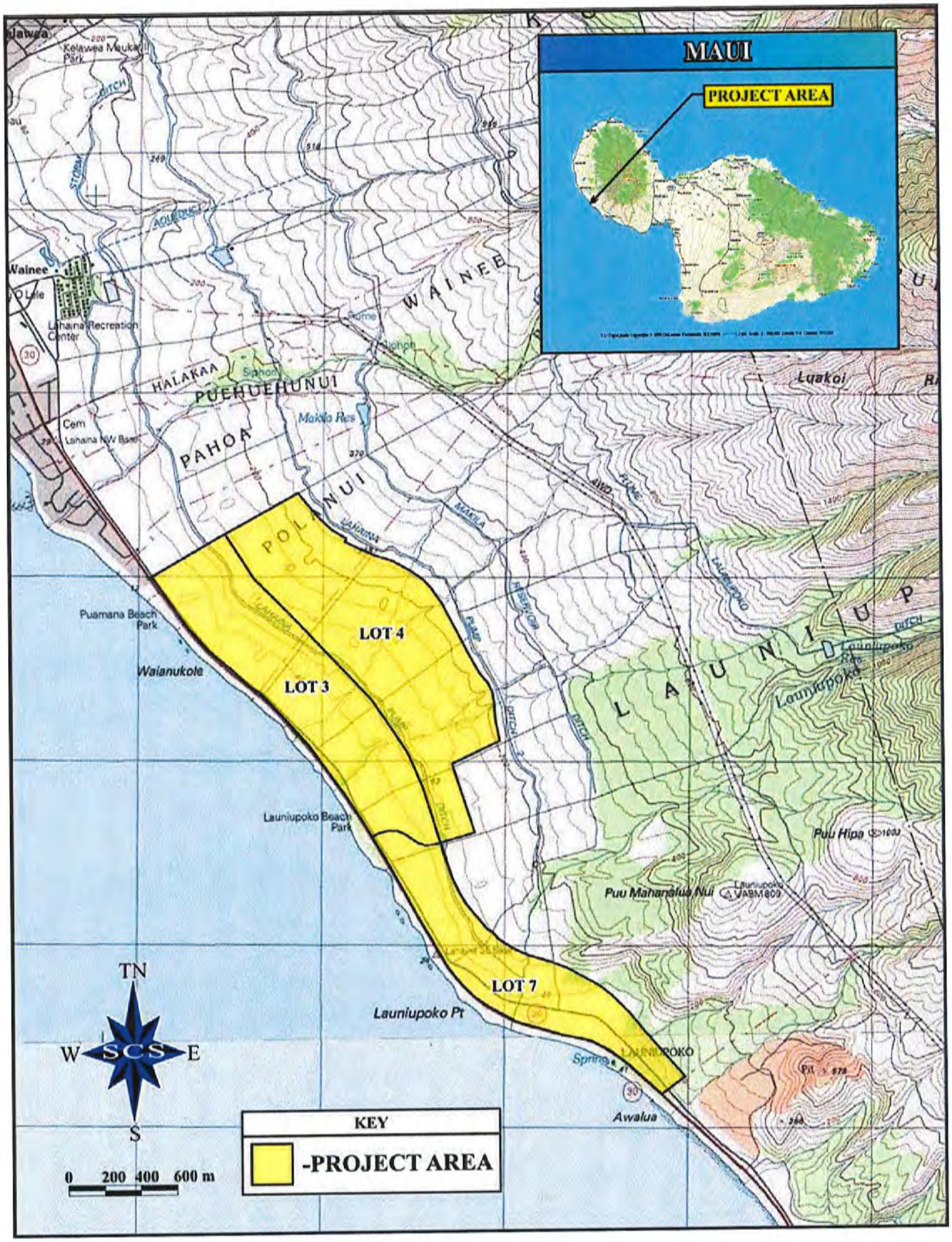

Figure 1: USGS Quadrangle Map Showing Project Area.

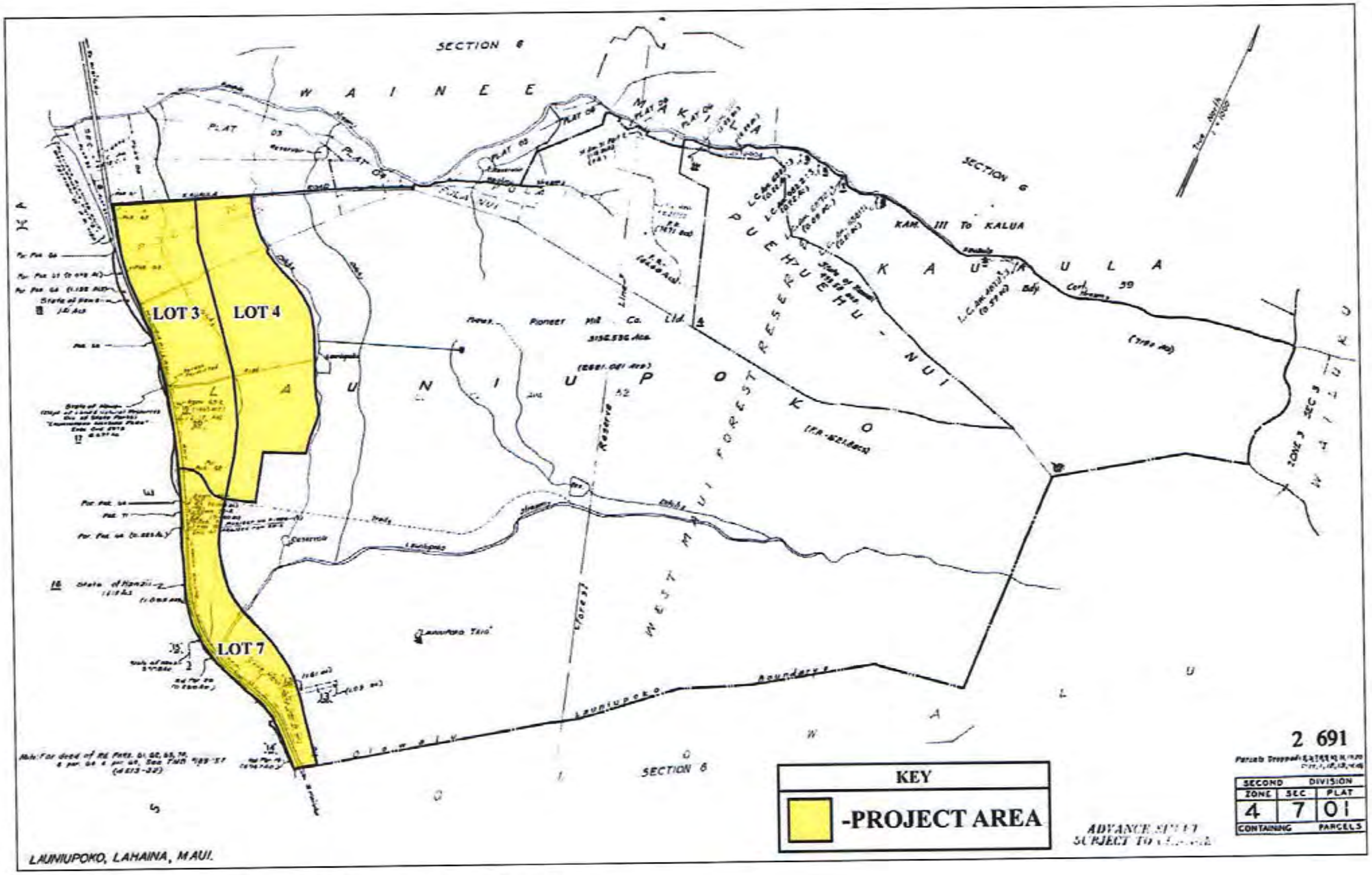

Figure 2: Tax Map Key [TMK] Showing Project Area.

ethnic groups. Cultural resources include a broad range of often overlapping categories, including places behaviors, values, beliefs, objects, records, stories, etc. (H.B. 2895, Act 40, 2000).

Act 50 also amended the definition of 'significant effect' to be re-defined as "the sum of effects on the quality of the environment including actions that are...contrary to the State's environmental policies...or adversely affect the economic welfare, social welfare, or cultural practices of the community and State" (H.B. 2895, Act 50, 2000). Thus, not only are native Hawaiian cultural resources evaluated, but those of other ethnic groups as well.

Act 50 requires that an assessment of cultural practices be included in the Environmental Assessments and the Environmental Impact Statements, and to be taken into consideration during the planning process. The concept of geographical expansion is recognized by using, as an example, "the broad geographical area, e.g. district or *ahupua`a*" (OEQC 1997). It was decided that the process should identify 'anthropological' cultural practices, rather than 'social' cultural practices. For example, *limu* (edible seaweed) gathering would be considered an anthropological cultural practice, while a modern-day marathon would be considered a social cultural practice.

According to the Guidelines for Assessing Cultural Impacts established by the Hawaii State Office of Environmental Quality Control (OEQC 1997):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religions and spiritual customs. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both manmade and natural which support such cultural beliefs.

This Cultural Impact Assessment involves evaluating the probability of impacts on identified cultural resources, including values, rights, beliefs, objects, properties, records, and stories occurring within the project area and its vicinity (H.B. 2895, Act 50, 2000).

METHODOLOGY

This Cultural Impact Assessment was prepared in accordance with the methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997). In outlining the "Cultural Impact Assessment Methodology", the OEQC states: that "...information may be obtained through scoping, community meetings, ethnographic interviews and oral histories…" (1997).

This report contains archival and documentary research, as well as communication with organizations having knowledge of the project area, its cultural resources, and its practices and beliefs. This Cultural Impact Assessment was prepared in accordance with the methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997). The assessment concerning cultural impacts should address, but not be limited to, the following matters:

(1) a discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints of limitations which might have affected the quality of the information obtained;
(2) a description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken;
(3) ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained;
(4) biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or being interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area;
(5) a discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken, as well as the particular perspective of the authors, if appropriate, any opposing views, and any other relevant constraints, limitations or biases;
(6) a discussion concerning the cultural resources, practices and beliefs identified, and for the resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site;
(7) a discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project;
(8) an explanation of confidential information that has been withheld from public disclosure in the assessment;
(9) a discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs;
(10) an analysis of the potential effect of any proposed physical alteration on cultural resources, practices, or beliefs; the potential of the proposed action to isolate cultural resources, practices, or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place, and;

(11) the inclusion of bibliography of references, and attached records of interviews which were allowed to be disclosed.

Based on the inclusion of the above information, assessments of the potential effects on cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

ARCHIVAL RESEARCH

Archival research focused on a historical documentary study involving both published and unpublished sources. These included legendary accounts of native and early foreign writers; early historical journals and narratives; historic maps and land records such as Land Commission Awards, Royal Patent Grants, and Boundary Commission records; historic accounts; and previous archaeological project reports.

INTERVIEW METHODOLOGY

Interviews are conducted in accordance with Federal and State laws and guidelines. Individuals and/or groups who have knowledge of traditional practices and beliefs associated with a project area or who know of historical properties within a project area are sought for consultation. Individuals who have particular knowledge of traditions passed down from preceding generations and a personal familiarity with the project area are invited to share their relevant information. Often people are recommended for their expertise, and indeed, organizations, such as Hawaiian Civic Clubs, the Island Branch of Office of Hawaiian Affairs, historical societies, Island Trail clubs, and Planning Commissions are depended upon for their recommendations of suitable informants. These groups are invited to contribute their input, and suggest further avenues of inquiry, as well as specific individuals to interview.

If knowledgeable individuals are identified, personal interviews are sometimes taped and then transcribed. These draft transcripts are returned to each of the participants for their review and comments. After corrections are made, each individual signs a release form, making the information available for this study. When telephone interviews occur, a summary of the information is often sent for correction and approval, or dictated by the informant and then incorporated into the document. Key topics discussed with the interviewees vary from project to project, but usually include: personal association to the *ahupua*`a; land use in the project's vicinity; knowledge of traditional trails, gathering areas, water sources, religious sites; place names and their meanings; stories that were handed down concerning special places or events in the project area; or any evidence of previous activities identified while in the project vicinity.

In this case, initial letters, briefly outlining the development plans along with maps of the project area, were sent to organizations whose jurisdiction should include knowledge of the area with an invitation for consultation. Consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui (Thelma Shimaoka); the Office of Hawaiian Affairs, O`ahu (Lance Foster); Planning Director for the Maui Planning Department (Michael Foley); the Lahaina Chapter of the Hawaiian Civic Club (Holuamoku Ralar); the Cultural Historian with the State Historic Preservation Division (SHPD, Hinano Rodrigues), Maui Office (SHPD); and Nā Kupuna O Maui (Patsy Nishiyama). If cultural resources are identified based on the information received from these organizations and additional informants, an assessment of the potential effects on the identified cultural resources in the project area and recommendations for mitigation of these effects can be conducted.

PROJECT AREA AND VICINITY

Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130). The project area consists of "undeveloped" land located on the western slopes of the West Maui range situated between coastal areas to the west and mountainous terrain to the east. The land is "undeveloped" per current housing but has been formerly developed through sugar cane cultivation. The majority of the project area falls within the bounds of Launiupoko Ahupua`a. The northern portion of the project area extends into the southern half of Polanui Ahupua`a.

Mostly within abandoned agricultural fields, the project area was a 2.5 mile, 160 ft. wide corridor that extended toward Lahaina from the former Olowalu Landfill northwest to Puamana (Figures 3 and 4). Although this entire section of bypass corridor falls within lands already subjected to an archaeological survey, Makila and SCS agreed that a follow-up field inspection (conducted in October 2006) would focus on the proposed corridor, and ensure that no undocumented archaeological sites would be present or impacted during bypass construction.

A previous Archaeological Inventory Survey was conducted by SCS on 633 acres of undeveloped Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, (Paraso and Dega 2006). This project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing. Most importantly, Paraso and Dega's study covered 100 percent of the current project area. This former SCS work is particularly relevant to the follow-up field inspection, as no new sites were found and all archaeological sites within a 30 ft. radius of the proposed bypass were previously documented by Paraso and Dega (2006).

Three archaeological sites documented by Paraso and Dega (2006) were contained within the proposed Lahaina bypass corridor: Sites 5954, 5955, and 5950. Sites 5954 (rock wall) and 5955 (activity area) have been documented fully and no further work has been recommended. Site 5950, clearing mounds, will be altered by the proposed bypass. Each of the 17 large mounds has been given an individual feature number, and numbers 3, 12, 13, 15, and 16 fall within the current project area. This assessment was agreed with as the report was accepted by the SHPD (Log No.:2006.3593; Doc No.: 0611MK07). The monitoring is required at Site 50-50-03-5950 (Features 1, 12, 13, 15, and/or 16).

Launiupoko is known to be rocky and dry, as rainfall is scarce. In *The Hawaiian Planter*, Handy states that:

> Although there is a sizable stream bed and a deep valley here, there is no visible evidence of wet taro cultivation, and the Hawaiian planters at Olowalu say that *lo`i* never existed in Launiupoko. It is possible that there may have been a few terraces on the level land at the base of the valley, but this is wholly arid land now and covered with dense brush [Handy 1940:103].

According to Handy and Handy (1972:272), the Lahaina District is "flanked by excellent fishing grounds." Although there appears to be few legends pertaining to the Launiupoko area, a search of the literature reveals several references indicating the importance of fishing in Launiupoko Ahupua`a. In *Sites of Maui,* Sterling (1998:27) quotes A.D. Kahaulelio from an article titled "Fishing Lore," *Ka Nupepa Kuokoa,* May 30, 1902, as saying "[t]he schools of *nehu* [*Stolephorus Purpureus,* an important bait fish used to catch tuna] were accustomed to coming in to Launiupoko and Keonepoko in the District of Lahaina, and sometimes at Mala." Kahaulelio also wrote the following about shark fishing in the area:

> Hoomoemoe Fishing for Sharks—It was much practiced by old timers of this ahupua`a of Makila, and also by the people of the upland of Kauaula since we were children…The kinds of sharks caught by the hoomoemoe method were lalakea and hammerheads…the place where hoomoemoe fishing was done was at Pahee, in Launiupoko, Lahaina. When you arrive at the little cape of Keahuiki and down the small incline, the first stretch you come to extending over to the rocky beach and adjoining with the sand on the left side, that is the place where the nets were laid [Sterling 1998:27].

CULTURAL AND HISTORICAL CONTEXT

The island of Maui ranks second in size of the eight main islands in the Hawaiian Archipelago. Pu`u Kukui, forming the west end of the island (1,215 m amsl), is composed of large, heavily eroded amphitheater valleys that contain well-developed, permanent stream systems that water fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal regions have been witness to many battles in ancient times and were coveted productive landscapes.

PAST POLITICAL BOUNDARIES

Traditionally, the division of Maui's lands into districts (*moku*) and sub-districts was performed by a *kahuna* (priest, expert) named Kalaiha`ōhia, during the time of the *ali`i* Kaka`alaneo (Beckwith 1940:383; Fornander places Kaka`alaneo at the end of the 15th century or the beginning of the 16th century [Fornander 1919-20, Vol. 6:248]). Land was considered the property of the king or *ali`i `ai moku* (the *ali`i* who eats the island/district), which he held in trust for the gods. The title of *ali`i `ai moku* ensured rights and responsibilities to the land, but did not confer absolute ownership. The king kept the parcels he wanted, his higher chiefs received large parcels from him and, in turn, distributed smaller parcels to lesser chiefs. The *maka`āinana* (commoners) worked the individual plots of land.

In general, several terms, such as *moku*, *ahupua`a*, *`ili* or *`ili`* ā*ina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua`a*) which customarily continued inland from the ocean and upland into the mountains. Extended household groups living within the *ahupua`a* were therefore, able to harvest from both the land and the sea. Ideally, this situation allowed each *ahupua`a* to be self-sufficient by supplying needed resources from different environmental zones (Lyons 1875:111). The *`ili `āina*, or *`ili*, were smaller land divisions and were next to importance to the *ahupua`a*. They were administered by the chief who controlled the *ahupua`a* in which it was located (*ibid*: 33; Lucas 1995:40). The *mo`o`āina* were narrow strips of land within an *`ili*. The land holding of a tenant or *hoa `āina* residing in an *ahupua`a* was called a *kuleana* (Lucas 1995:61). The project area is located in the *ahupua`a* ofLaunuipoko, meaning literally "short coconut leaf" (Pukui *et al.* 1974:130).

TRADITIONAL SETTLEMENT PATTERNS

Archaeological settlement pattern data indicates that initial colonization and occupation of the Hawaiian Islands first occurred on the windward shoreline areas of the main islands between the A.D. 4th and 11th centuries, with populations eventually settling in drier leeward areas during later periods (Kirch 1985). Although coastal settlement was dominant native Hawaiians began cultivating and living in the upland *kula* zones. Greater population expansion to inland areas began between A.D. 11th and 12th centuries and continued through the 16th century. Large scale or intensive agriculture was implemented in association with habitation, religious, and ceremonial activities.

The Hawaiian economy was based on agricultural production and marine exploitation, as well as raising livestock and collecting wild plants and birds. Extended household groups settled in various *ahupua`a*. During pre-Contact times, there were primarily two types of agriculture, wetland and dry land, both of which were dependent upon geography and physiography. River valleys provided ideal conditions for wetland *kalo* (*Colocasia esculenta*) agriculture that incorporated pond fields and irrigation canals. Other cultigens, such as *kō* (sugar cane, *Saccharum officinaruma*) and *mai`a* (banana, *Musa* sp.), were also grown and, where appropriate, such crops as *`uala* (sweet potato, *Ipomoea batatas*) were cultivated. This was the typical agricultural pattern seen during traditional times on all the Hawaiian Islands (Kirch and Sahlins 1992, Vol. 1:5, 119; Kirch 1985). Agricultural development on the leeward side of Maui was likely to have begun early in what is known as the Expansion Period (A.D. 1200-1400, Kirch 1985).

Most of the *ahupua`a* on the southern coast have been overshadowed by the famous roadstead and village of Lāhainā which served as the capitol of the Hawaiian Kingdom after the conquest of Kamehameha until 1855. The ethnographic and historic literature, often our only link to the past, reveals that the lands around Lāhainā were rich agricultural areas irrigated by aqueducts originating in well-watered valleys with permanent occupation predominately on the coast. A number of traditional activities took place in this district from fishing and cultivation by early Hawaiians to residential and recreational use by the *ali`i* (ruling) class. The district served as an important center both politically and socially during the late prehistoric and early historic period. It was the royal chiefly center for centuries (Thrum 1908, 1916, 1917; Walker 1981; Kirch 1985; Kamakau 1992; Sterling 1998) and played a key role in the intra-island warfare associated with island unification. By the late 1700s, Kamehameha I had firmly established his presence on Maui with the invasion of Lāhainā. By the early 1800s, Kamehameha I designated Lāhainā the capital of the Hawaiian Kingdom.

The District of Lāhainā extended from Honokohau Ahupua`a on the north to Ukumehame Ahupua`a on the south. Handy and Handy have stated the space cultivated by the natives of Lāhainā District at about "…three leagues [9 miles] in length, and one in its greatest breadth. Beyond this all is dry and barren; everything recalls the image of desolation" (1972:593). Crops cultivated included coconut, breadfruit, paper mulberry, banana, taro, sweet potato, sugar cane, and gourds.

Lāhainā served as the capital until 1845 when it was moved to Honolulu. In 1819, the first whaling ship Bellina arrived in what would later be known as Lāhainā Harbor. Lāhainā served as the center of commercial whaling in the Pacific until the mid-1800s. After the decline of the whaling industry, Lāhainā and surrounding areas became a base for sugarcane plantations. Most recently tourism is the main industry in Lāhainā.

THE GREAT MĀHELE

In the 1840s, traditional land tenure shifted drastically with the introduction of private land ownership based on western law. While it is a complex issue, many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kame`eleihiwa 1992:169-70, 176; Kelly 1983:45, 1998:4; Daws 1968:111; Kuykendall 1938 Vol. I: 145). The Great Māhele of 1848 divided Hawaiian lands between the king, the chiefs, the government, and began the process of private ownership of lands. The subsequently awarded parcels were called Land Commission Awards (LCAs). Once lands were made available and private ownership was instituted, the *maka`āinana*, if they had been made aware of the procedures, were able to claim the plots on which they had been cultivating and living. These claims did not include any previously cultivated but presently fallow land, *`okipū* (on O`ahu), stream fisheries, or many other resources necessary for traditional survival (Kelly 1983; Kame`eleihiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed LCA and issued a Royal Patent after which they could take possession of the property (Chinen 1961:16).

Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130).

The Waihona `Aina database (2006) compiles land ownership data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.), and Foreign Testimony (FT n.d.). The database lists only one claim for Launiupoko. The entire *ahupua`a* of Launiupoko consisting of 3,778 acres was awarded to Thomas Phillips (Royal Patent 1358 LCA 82); no *kuleana* lands were awarded within the *ahupua`a*. This LCA proved to be somewhat controversial as there was a stipulation that "this land shall not be conveyed to a haole and one who does not reside in Hawai`i." Testimonies concerning the boundaries reference a rock called Kohe Kili Pōhaku, which is described as "a place of one of the kohe (female genitalia) dropping diversions used by Pele's sister as she was fleeing the unwanted advances of Kamapua`a (Paraso and Dega 2006). The testimony also references two graveyards, one in Launiupoko and one in Polanui. Additional testimony over the boundary of Phillips's claim mentions the same rock, it states, "I have always heard the old people say that the parting here between the two lands runs down to Keahoiki, which is a point near a large rock called Kohe Kili pohaku. It is a place where the old Gods stood" (Waihona `Aina 2000).

Research of archival information from the Bureau of Conveyances document several mortgage transactions regarding the parcel. In 1853, Phillips mortgaged the property to Z. Kaauwai and then in 1856 to Antonio Sylvia (Paraso and Dega 2006).). In 1857 it was mortgaged and paid off to James R. Dow. On file with the Bureau of Conveyances is the deed of the sale at auction in 1857 of Phillips property to Charles Lake (Appendix A). There is also a reference to the property, "4 pcs" in Launiupoko, in the Grantor Index 1845-1869, which shows Grantor C. Coady by Atty to Grantee Charles Lake in 1864, the year Phillips died.

This same Grantor Index shows there was a record of a deed transaction between Grantor Benjamin Pittman by Atty to Grantee Campbell and Thurton concerning "various Pioneer Mill Plantation" lands in Lahaina (no date) (*ibid.*). Additional Circuit Court documents concerning Phillips's landholding in Launiupoko were located at the Hawai`i State Archives. These documents describe how Phillips's Hawaiian wife and heir, Kaho`omaeha, was denied rights to the property although she was named as heir in Phillips's two wills (*ibid.*).

With the exception of 66 acres of *kuleana* parcels, all 377 acres of Polanui (large Pola) Ahupua`a was awarded to William C. Lunalilo (Royal Patent 8395 LCA 8559-B, Apana 25). None of the awarded land was in the present project area.

Sugar was to be the economic future of Hawai`i and as early as 1828, two Chinese brothers, Ahung and Atai, of Honolulu's Hungtai Company arrived in Wailuku to explore the possibility of setting up one of its earliest sugar mills. Atai soon created a plant that processed sugar cane cultivated by Hawaiians, named the Hungtai Sugar Works (Dorrance and Morgan 2000:15–16). Ahung later joined Kamehameha III's sugar producing enterprise, although by 1844 both operations had ceased. The Wailuku Sugar Company was the next to follow, in 1862, and would expand sugar production over the next 126 years of its existence—4,450 acres by 1939. Land use in Launiupoko Ahupua`a in the mid 19th and early 20th century was largely devoted to the sugar industry. The Pioneer Mill Company was founded in 1860 by James Campbell, Henry Thurton, and James Dunbar. In 1864, Benjamin Pittman acquired lands in Launiupoko which he deeded to Campbell, Thurton, and Dunbar. In 1885, Thurton constructed a railroad system to transport sugarcane from the fields to the mill in Lahaina (Condé and Best 1973). One railroad line crosses through the northeast portion of Laniupoko and the other follows the coastline.

Between 1885 and 1895 the mill changed hands three times before finally falling under the control of Homer and Isenberg who incorporated the mill in 1895 (Goodwin and Leineweber 1997). Homer and Isenberg's agent was H. Hackfield Co. which later became Amfac, Inc. AMFAC, Inc., was incorporated in Hawaii in July 1918 as American Factors, Ltd., to take over the business of H. Hackfield & Company, Ltd., a company that was originally established in 1849. The name AMFAC was adopted in April 1966 (Harvard Business School, Baker Library, Historical Collections).

In 1900, when the Pioneer Mill Company was reorganized, the plantation controlled a total of 12,500 acres. Although the land was believed to be "…the rockiest of the irrigated plantations in Hawaii…" the Pioneer Mill Company developed an extensive and powerful irrigation and water collection system, consisting of tunnels, ditches, and flumes that extended into the valleys of the West Maui Mountains, including Launiupoko (Graves *et al.* 1998). The terrains rockiness required that the land be cultivated by hand (Gilmore 1936). The cleared rocks were used to construct walls that formed banks of the cane row and the areas between the walls were softened and planted. The soil beneath the rocks was very fertile and produced good yields. However, by 1930, the fields at Launiupoko were no longer used for sugarcane cultivation due to labor shortages and the difficulty associated with working such rocky fields (Graves *et al.* 1998). Thereafter, the fields were used for cattle grazing by the Pioneer Mill Company. A 1939 Pioneer Mill Company map of Launiupoko shows the old field designations, as well as, the ditches and reservoirs, including Lahaina Pump Ditch No. 1 which traverses the project area.

SUMMARY

The "level of effort undertaken" to identify potential effect by a project to cultural resources, places or beliefs (OEQC 1997) has not been officially defined and is left up to the investigator. A good faith effort can mean contacting agencies by letter, interviewing people who may be affected by the project or who know its history, research identifying sensitive areas and previous land use, holding meetings in which the public is invited to testify, notifying the community through the media, and other appropriate strategies based on the type of project being proposed and its impact potential. Sending inquiring letters to organizations concerning development of a piece of property that has already been totally impacted by previous activity and is located in an already developed industrial area may be a "good faith effort". However, when many factors need to be considered, such as in coastal or mountain development, a good faith effort would undoubtedly mean an entirely different level of research activity.

In the case of the present parcel, letters of inquiry were sent to organizations whose expertise would include the project area. Consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui (Thelma Shimaoka); the Office of Hawaiian Affairs, O`ahu (Lance Foster); Planning Director for the Maui Planning Department; the Lahaina Chapter of the Hawaiian Civic Club (Holuamoku Ralar); the Cultural Historian with the State Historic Preservation Division (Hinano Rodrigues), Maui Office (SHPD); and Nā Kupuna O Maui (Patsy Nishiyama). Additional individuals familiar with the Lahaina and Launiupoko region were recommended and then an attempt was made to contact them by phone for an informal interview concerning the possibility of cultural activities within the project area. An unsuccessful attempt was made to contact Ke`eaumoku and U`ilani Kapu with Kuleana

Ku`ikāhi, LLC. Clifford Nae`ole, Cultural Advisor for the Ritz Carlton Kapalua was contacted by phone.

Historical and cultural source materials were extensively used and can be found listed in the References Cited portion of the report. Such scholars as I`i, Kamakau, Beckwith, Chinen, Kame`eleihiwa, Fornander, Kuykendall, Kelly, Handy and Handy, Puku`i and Elbert, Thrum, Sterling, and Cordy have contributed, and continue to contribute to our knowledge and understanding of Hawai`i, past and present. The works of these and other authors were consulted and incorporated in the report where appropriate. Land use document research was supplied by the Waihona `Aina 2005 Data base.

CIA INQUIREY RESPONSE

As suggested in the "Guidelines for Accessing Cultural Impacts" (OEQC 1997), CIAs incorporating personal interviews should include ethnographic and oral history interview procedures, circumstances attending the interviews, as well as the results of the consultation. It is also permissible to include organizations with individuals familiar with cultural practices and features associated with the project area.

Analysis of the potential effect of the project on cultural resources, practices or beliefs, its potential to isolate cultural resources, practices or beliefs from their setting, and the potential of the project to introduce elements which may alter the setting in which cultural practices take place is a requirement of the OEQC (No. 10, 1997). It does not appear that the project area has been used for traditional cultural purposes within recent times.

As stated above, consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui; the Office of Hawaiian Affairs, O`ahu; Planning Director for the Maui Planning Department; the Lahaina Chapter of the Hawaiian Civic Club; the Cultural Historian with the State Historic Preservation Division, Maui Office (SHPD); and Nā Kupuna O Maui. Attempts were made to contact other individuals familiar with the Laniupoko region concerning the possibility of cultural activities within the project area. These individuals included, Ke`eaumoku and U`ilani Kapu with Kuleana Ku`ikāhi, LLC and Clifford Nae`ole, Cultural Advisor for the Ritz Carlton Kapalua.

From a total of nine contacts, five responses were received. These included the Office of Hawaiian Affairs, O`ahu Branch; SHPD Cultural Historian (both suggesting additional contacts); the Hawaiian Civic Club, Lahaina Chapter; Nā Kupuna O Maui and Cultural Advisor, Cifford Nae`ole.

Nā Kupuna O Maui and Cifford Nae`ole were not aware of any cultural activities associated with the proposed Southerly/Mauka Extension. Representatives from the Lahaina Hawaiian Civic Club met twice with Mr. Rory Frampton, Land Planner for Makila Land Co., LLC to discuss the proposed project and for a site inspection. As a result, the Lahaina Civic Club stated they were not aware of any sensitive cultural sites or activity areas . . . within the proposed corridor" (pers. Comm.. February 1, 2007). They stated:

> Overall we are supportive of the proposed extension since it could lead to an opening up or expansion of coastal areas. The shoreline between Launiupoko and Awalua contains many resources which are critical for the continuance of traditional and customary native Hawaiian practices (pole fishing, diving, collecting limu, camping, etc.).[*Ibid.*]

Howevever, they also felt that the proposed Bypass ". . . has the potential to inhibit opportunities for mauka/makai access. The Bypass should be designed to allow for safe mauka/makai access to the Valleys or upland areas" (*Ibid.*). The Lahaina Hawaiian Civic Club suggested incorporating pedestrian underpasses at major drainage crossings and streams since those areas would have been used as traditional *mauka/makai* access by native Hawaiians. They also noted the following concerns/recommendations pertaining to coastal use and access:

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

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

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

CULTURAL ASSESSMENT AND RECOMMENDATIONS

Based on historical research and those responses received from the Hawaiian Civic Club, Lahaina Chapter; Nā Kupuna O Maui; and Cultural Advisor, Cifford Nae`ole, it is reasonable to conclude that pursuant to Act 50, the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access, or other customary activities, will not be affected by development activities along the proposed southern/mauka bypass extension. . Because there were no specific cultural activities identified within the project area, there are no adverse effects

However, it is recommended that comments and suggestions offered by the Lahaina Chapter of the Hawaiian Civic Club be seriously considered and steps taken to mitigate their concerns for underpasses for *mauka* and *makai* access, preservation of visual plain and old coastal road, as well as legal assurance for public use in perpetuity.

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APPENDIX A: BUREAU OF CONVEYENCES DOCUMENT

September 29, 1857
Marshall of Hawaiian Islands; to Charles Lake
Deed - Kuleana Helu 82, Ahupuaa of Launiupoko to Thomas Phillips
Bureau of Conveyances, Liber 10, pages 43-44

…I William C. Parke, Marshall of the Hawaiian Islands; Whereas on the twenty ninth day of September A.D. 1857 by decree made in the Supreme Court of Law and Equity of the Hawaiian Islands, in a certain cause defending in said Court, where in James R. Davis is complainant & Thomas Phillips defendant, it was ordered that all the right, title & interest of the said defendant in & to all & singular the mortgage premises set forth & described in the mortgage of the complainant in this cause filed & therein described as follows, to wit. All that certain tract & parcel of land known & described as "Laeoniu Poka' [Launiupoko] situated outside the town of Lahaina, consisting of Four Thousand acres more or less, being the land granted to the said Thomas Phillips by his late Majesty Kamehameha III. And whereas I, William C. Parke as Marshall aforesaid was commanded in accordance with the said decree to sell the said mortgaged premises at Public Auction… I did afterwards sell the said property at Public Auction to Charles Lake who was the highest bidder… for the sum of one thousand, three hundred Dollars, $1300.00 which was the highest sum then & there bidden… [page 43]

APPENDIX J.

Section 106, 1966 National Historic Preservation Act Consultation Documentation

U.S. Department
of Transportation
**Federal Highway
Administration**

Hawaii Federal-Aid Division

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
Fax: (808) 541-2704

October 22, 2013

In Reply Refer To:
HDA-HI

Mr. William J. Aila, Jr.
Chairperson and State Historic Preservation Officer
Hawaii Department of Land and Natural Resources
601 Kamokila Boulevard, Suite 555
Kapolei, HI 96707

Subject: Proposed Relocation of the Lahaina Bypass Southern Terminus
Section 106 of the National Historic Preservation Act
Identification of Historic Properties and Notification of No Adverse Effect Determination
Launiupoko and Polanui Ahupuaa
District of Lahaina, Island of Maui
Federal-aid Project No. NH-030-1(051)

Dear Mr. Aila:

The State of Hawaii, Department of Transportation (HDOT), Highways Division is proposing to implement the subject project located in West Maui. The Federal Highway Administration (FHWA) is proposing to authorize construction of this undertaking.

This letter with enclosures is submitted to document consultation efforts conducted for this undertaking pursuant to Section 106 of the National Historic Preservation Act (NHPA) and the Advisory Council on Historic Preservation's regulations for Protection of Historic Properties (36 CFR, Part 800). We have identified historic properties in the subject project's area of potential effects (APE), applied the criteria of effect in 36 CFR §800 for the proposed undertaking, and have determined that it will have no adverse effect on historic properties.

In accordance with Section 106 of the NHPA, this letter requests that the State Historic Preservation Officer (SHPO) concur with the identification of historic properties and the no adverse effect determination regarding historic properties in the subject project's APE.

A detailed description of consultation efforts is included in the enclosed documentation. Section 106 consultation activities have been integrated with the State of Hawaii environmental review process that is currently being undertaken for the proposed project. The environmental review process was initiated in 2006 with early consultation with various agencies and organizations including the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), and the Department of Hawaiian Home Lands (DHHL) and have, thus far, included the pre-assessment, agency, and public consultation conducted during the preparation and publication of a State of Hawaii Draft Environmental Assessment (EA). A Cultural Impact Assessment (CIA) report was also completed for the proposed action in February 2007 by Scientific Consultant Services, Inc. (SCS), pursuant to Act 50 of the Hawaii State Legislature (2000), which requires that environmental review documents include an assessment of cultural practices. As part of the CIA preparation process, consultation was sought from various agencies, civic groups and individuals such as the Maui and Honolulu offices of the OHA, the SHPD, the Maui Planning Department, Na Kapuna O Maui, and Clifford Naeole (Cultural Advisor for the Ritz Carlton Kapalua).

The archaeological assessment documentation (including the November 2006 SHPD approval letter) and CIA report were included and discussed in the Chapter 343, Hawaii Revised Statute Draft EA for the project that was published in the Environmental Notice bulletin by the Office of Environmental Quality Control (OEQC) on May 8, 2012. To provide additional opportunity for public review and comment on the proposal to relocate the southern terminus of the Lahaina Bypass, a public meeting was held at the Lahaina Senior Center on June 12, 2012. While a number of comments were received from agencies, organizations, and individuals on the project, there were no substantive comments received on the findings of either the archaeological or cultural studies during the Draft EA review process. In addition, Section 106 consultation letters along with background materials were sent to the organizations and individuals listed in the enclosed documentation on April 9, 2013. No additional substantive comments were received.

Based upon consultations efforts and studies conducted, seven sites have been documented within the vicinity of the project's APE, none of which are either currently listed on the National Register of Historic Places or eligible for inclusion on the National Register of Historic Places. Seven sites documented in the Archaeological Inventory Survey (AIS) are contained within the vicinity of the proposed alignments. These seven sites include: Site 2665 (rock wall), Site 4787 D (Lahaina Pump Ditch), Site 5953 (slag scatter), Site 5954 (rock wall), Site 5955 (activity area), Site 5956 (activity area) and Site 5950 (rock mounds), which consists of pushpiles of large rocks that are the result of rock removal programs during former plantation use of the land. Site 5950 consists of a total of 17 rock clearing mounds, five or six of which may be affected by the proposed alignments.

These properties are identified in the *An Archaeological Inventory Survey of 633 Acres in the Launiupoko (Large Lot) Subdivision Nos 3, 4, and 7 Launiupoko and Polanui Ahupuaa District of Lahaina (Formerly Kaanapali) Island of Maui, Hawaii* and the *Field Inspection of Proposed Southerly/Mauka Extension of the Lahaina Bypass, Launiupoko and Polanui Ahupuaa, Lahaina District, Island of Maui, Hawaii* (enclosed) prepared for the project by SCS.

All seven sites identified are significant under Criterion D: Site has yielded or has the potential to yield information important in prehistory or history and have been thoroughly mapped and recorded. Archaeological monitoring will be required at Site 50-50-03-5950 in the event that these mounds are dismantled in conjunction with the project. With the exception of Site 50-50-03-5950, no further work is recommended for the additional sites. As the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits appears very low.

The FHWA has determined that this project will have no adverse effect on historic properties. As all seven sites are significant under Criterion D, and the information contained has been thoroughly documented, the project will have no adverse effect upon them as defined by 36 CFR §800.16(i). With the exception of archaeological monitoring at Site 50-50-03-5950, no further archaeological testing work is recommended in the project area.

We request your concurrence with the no adverse effect determination for this project. Enclosed for your review is documentation supporting this determination. This documentation was prepared based upon your department's guidelines for Section 106 submissions.

If the SHPD objects to the no adverse effect determination for the subject project, please inform us within 30 days of receipt of this letter. In the absence of a SHPD response by this date, the FHWA will assume the SHPD concurrence with this determination and will proceed with the undertaking. Please contact me at (808) 541-2326 or by email at wayne.kaneshiro@dot.gov if you have any questions.

Sincerely yours,

Wayne Kaneshiro

Wayne Kaneshiro
Highway Engineer

Enclosures

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

JESSE K. SOUKI
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

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

April 29, 2014

Meesa Otani, Environmental Engineer
United States Department of Transportation
Federal Highway Administration
300 Ala Moana Blvd., Rm 3-306
Box 50206
Honolulu, Hawaii 96850

LOG NO: 2013.6004
DOC NO: 1404MD41
Archaeology
History & Culture

Aloha Ms. Otani:

SUBJECT: **National Historic Preservation Act (NHPA) Section 106 Consultation – Proposed Relocation of Lahaina Bypass Southern Terminus Ref: HDA-HI Launiupoko and Pola Nui Ahupuaʻa, Lāhainā District, Island of Maui TMKs: (2) 4-7-001:026 and 030, 4-7-013:002, 005, 008, 010 and 011 (formerly portions of 4-7-001:027) (all, pors.)**

Thank you for the opportunity to review the proposed undertaking that we received on October 24, 2013. We apologize for the delay in our reply. This is Federal Aid Project No. NH-030-1(051). The Federal Highway Administration (FHWA) intends to authorize the construction of the aforementioned undertaking by the State of Hawaii, Department of Transportation, Highways Division (HDOT). The FHWA has authorized the State of Hawaii, Department of Transportation (HDOT) and its consultants, Munekiyo and Hiraga (M&H), Inc. and Scientific Consultant Services, Inc. (SCS) to advance the undertaking. Section 106 consultation letters have been sent to appropriate organizations and individuals.

The proposed undertaking will entail relocating the southern terminus of the Lahaina Bypass in West Maui from its current terminus point at Launiupoko to the vicinity of the Olowalu Landfill, a distance of approximately 4,800 lineal feet. The parcels of land affected by the proposed action are located in the identified subject tax map key numbers. The basic configuration of the Lahaina Bypass in terms of functional traffic flow will not change; the location of the southern terminus will simply be shifted further south towards Olowalu.

The Lahaina Bypass Southern Terminus Relocation Project will advance long-range regional transportation planning objectives for the West Maui region. The action is limited to a 10,300 lineal foot corridor that will be a minimum of 150 feet wide. As this project is being initiated by HDOT, the requirements of Chapter 343, Hawaii Revised Statutes are triggered. Furthermore, this HDOT-funded project includes funding support from the FHWA, thereby triggering the requirements of NEPA.

The majority of the project area is situated in Launiupoko Ahupuaʻa. The northern portion is located in the Pola Nui Ahupuaʻa, which is bordered to the north by Pahoa Ahupuaʻa; Olowalu Ahupua'a borders the project area to the south. An archaeological inventory survey (AIS) was included for a larger area (633 acres) including all three original alignment alternatives for this undertaking (Paraso and Dega August 2006). That survey, which was accepted by SHPD, identified seven sites within the original APE, features of one of which are present in the current APE (*Log No. 2006.3593, Doc No. 0311MK07*). At the time that SHPD accepted the AIS in 2006, we recommended archaeological monitoring for the removal of any large rock piles making up the features of SIHP 50-50-03-5950, large plantation era clearing mounds considered significant under criterion "d." The HDOT had originally proposed to monitor the five rock piles unless "if, by the time earth-moving procedures on the Lahaina bypass begin, several other mound features have been monitored with negative results, SHPD may be consulted to determine the possibility of not monitoring some or all of the mounds that fall within the Lahaina bypass corridor."

In reviewing this undertaking, SHPD staff have consulted records from earlier monitoring of rock piles in the western portion of the Lahaina Bypass, and conducted site visits to the features that are slated for removal should this alternative Southern Terminus be selected by FHWA. What we found is that during monitoring of seven rock-pile features of SIHP 5950 over the past few years, no historic properties were identified during monitoring (*Log No. 2012.2826, Doc No. 1310CG09*). After conducting site visits on April 15, 2014 at features within the current subject project's APE, SHPD staff concur that the available data from these rock-piles supports the assumption that they represent multiple field-clearing events by the Pioneer Mill Company to expand their sugar-cane production. In our opinion further archaeological monitoring of features of SIHP 5950, which has been fully documented, is unnecessary.

Therefore, **we concur** with the Federal Highway Administration's finding of **no adverse effect** pursuant to 36 CFR § 800. Should you have any questions regarding this letter please contact Morgan Davis on Maui at (808) 243-4641 or Morgan.E.Davis@hawaii.gov.

Aloha,

Theresa K. Donham
Deputy State Historic Preservation Officer
Historic Preservation Division

cc: Mr. Darrell Young (darrell.young@hawaii.gov)
Mr. Rory Frampton (rory@westmauiland.com)

APPENDIX K.

Section 4(f), 1966 U.S. Department of Transportation Act Consultation Documentation

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
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ACTING DEPUTY DIRECTOR - WATER

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

May 12, 2015

Meesa Otani, Environmental Engineer
United States Department of Transportation
Federal Highway Administration
300 Ala Moana Blvd., Rm 3-306
Box 50206
Honolulu, Hawaii 96850

LOG NO: 2015.01350
DOC NO: 1505MD18
Archaeology
History and Culture

Aloha Ms. Otani:

SUBJECT: **National Historic Preservation Act (NHPA) Section 106 Consultation – Final Determination of Applicability of Section 4(f) to Historic Sites – Proposed Relocation of Lahaina Bypass Southern Terminus, Ref: HDA-HI**
Launiupoko and Pola Nui Ahupuaʻa, Lāhainā District, Island of Maui
TMKs: (2) 4-7-001:026, 30; 4-7-013: portions of 002, 005, 008, 010 and 011 [formerly portions of 4-7-001:027]

Thank you for the opportunity to review the proposed project document we received on April 9, 2015. We apologize for the delay in our reply. This project is Federal Aid Project No. NH-030-1(051). The Federal Highway Administration (FHWA) intends to authorize the construction of the Lahaina Bypass Southern Terminus by the State of Hawaii, Department of Transportation, Highways Division (HDOT). In 2014, the State Historic Preservation Officer (SHPO) concurred that relocating the Lahaina Bypass Southern Terminus' location would have "*no adverse effect*" on historic properties (*Log No. 2013.6004, 1404MD41*). Section 4(f) of the US Department of Transportation Act of 1966 (49 USC 303/23 CFR 774.3(a) and (b)) mandates that special effort should be made to preserve the natural beauty of the countryside as public park and recreational lands, wildlife and waterfowl refuges, and historic sites. The FHWA has evaluated the subject project relative to the requirements of Section 4(f) and has determined that this project meets the exception in 23 CFR 774.13(b) and does not constitute a use under Section 4(f) for the reasons detailed below.

The proposed project involves relocating the southern terminus of the Lahaina Bypass in West Maui from its current terminus point at Launiupoko to the vicinity of the Olowalu Landfill, a distance of approximately 4,800 lineal feet. The parcels of land affected by the proposed action are located in the tax map keys identified above. The basic configuration of the Lahaina Bypass in terms of functional traffic flow will not change; the location of the southern terminus will be shifted further south towards Olowalu.

The archaeological inventory survey of the 633 acres associated with this project resulted in identification of seven sites. All of them are associated with former plantation use of the land, and were evaluated as eligible under Criterion D of the National Register of Historic Places (Paraso and Dega August 2006; *Log No. 2006.3593, Doc No. 0311MK07*). These sites consist of State Inventory of Historic Places (SIHP) 50-50-03-2665 (rock wall), SIHP 4787 Feature D (Lahaina Pump Ditch), SIHP 5953 (slag scatter), SIHP 5954 (rock wall), SIHP 5955 and 5956 (activity areas), and SIHP 5950 (17 rock clearing mounds); five to six of the SIHP 5950 mounds will be affected by the proposed alignment.

At the time that SHPD accepted the AIS in 2006, we recommended archaeological monitoring during removal of any of the SIHP 5950 clearing mounds. The HDOT proposed to monitor the five rock piles unless "if, by the time earth-moving procedures on the Lahaina bypass begin, several other mound features have been monitored with negative results, SHPD may be consulted to determine the possibility of not monitoring some or all of the mounds that fall within the Lahaina bypass corridor."

In reviewing this project, the SHPD staff consulted records from earlier monitoring of rock piles in the western portion of the Lahaina Bypass, and conducted site visits to the SIHP 5950 features slated for removal should the FHWA select this alternative Southern Terminus. The records findings indicate none of the seven SIHP 5950 rock pile features monitored in past years have resulted in identification of any subsurface historic properties (*Log No. 2012.2826, Doc. No. 1310CG09*). Based on the April 15, 2014, site visit to examine the features within the current subject project's APE, SHPD staff concur that the available data support interpretation of these rock piles as being associated with field-clearing events undertaken by the Pioneer Mill Company to expand their sugarcane fields and production. The SHPD believes SIHP 5950 has been sufficiently documented, and that further archaeological monitoring of SIHP 5950 is unnecessary.

The SHPO concurs with the FHWA's finding that this project meets the exception in 23 CFR 774.13(b) and does not constitute a use under Section 4(f) for SIHP 2665 (rock wall), SIHP 4787 Feature D (Lahaina Pump Ditch), SIHP 5953 (slag scatter), SIHP 5954 (a rock wall), SIHP 5955 and 5956 (activity areas), and SIHP 5950 (rock clearing mounds).

Should you have any questions regarding this letter, please contact Maui Lead Archaeologist Morgan Davis at (808) 243-4641 or at Morgan.E.Davis@hawaii.gov.

Aloha,

Alan S. Downer, PhD
Administrator, State Historic Preservation Division
Deputy State Historic Preservation Officer

cc: Mr. Darrell Young (darrell.t.young@hawaii.gov)
Mr. Rory Frampton (rory@westmauiland.com)

U.S. Department
of Transportation
**Federal Highway
Administration**

Hawaii Federal-Aid Division

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
Fax: (808) 541-2704

April 8, 2015

In Reply Refer To:
HDA-HI

Carty Chang, P.E.
Interim Chairperson and State Historic Preservation Officer
Hawaii Department of Land and Natural Resources
601 Kamokila Boulevard, Suite 555
Kapolei, HI 96707

Subject: Final Determination of Applicability of Section 4(f) to Historic Sites
Proposed Relocation of Lahaina Bypass Southern Terminus
Launiupoko and Polanui Ahupuaa, District of Lahaina, Island of Maui
Federal-aid Project No. NH-030-1(051)
Tax Map Keys: (2) 4-7-001:026 and 30 and (2) 4-7-013: 002, 005, 008, 010 and 011
(formerly portions of (2) 4-7-001: 027)

Dear Mr. Chang:

The Federal Highway Administration (FHWA) and the State of Hawaii Department of Transportation (HDOT) are planning the proposed relocation of the Lahaina Bypass Southern Terminus in West Maui from its current terminus point at Launiupoko to the vicinity of the former Olowalu landfill, a distance of approximately 4,800 lineal feet (See enclosed Figure 1 and Figure 2). The basic configuration of the Lahaina Bypass in terms of functional traffic flow will not change; the location of the southern terminus will simply be shifted further south towards Olowalu.

Section 4(f) of the U.S. Department of Transportation Act of 1966 (49 USC 303/23 CFR 774.3(a) and (b)) mandates that special effort should made to preserve the natural beauty of the countryside and public park and recreational lands, wildlife and waterfowl refuges, and historic sites. The FHWA has evaluated the subject project in relation to the requirements of Section 4(f).

To be afforded protection under Section 4(f) a historic property must be on or eligible for inclusion in the National Register of Historic Places (NRHP). The Archaeological Inventory Survey (AIS) completed for this project[1] and approved by the State Historic Preservation

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[1] *An Archaeological Inventory Survey of 633 Acres in the Launiupoko (Large Lot) Subdivision Nos 3, 4, and 7 Launiupoko and Polanui Ahupuaa District of Lahaina (Formerly Kaanapali) Island of Maui, Hawaii and the Field Inspection of Proposed Southerly/Mauka Extension of the*

Division (SHPD) on November 13, 2006[2], identified seven historic properties within the project area limits. All of these sites met the criteria for inclusion on the NRHP under Criterion D. The seven sites are identified as follows: Site 50-50-03-2665 (rock wall), Site 50-50-03-4787 D (Lahaina Pump Ditch), Site 50-50-03-5953 (slag scatter), Site 50-50-03-5954 (rock wall), Site 50-50-03-5955 (activity area), Site 50-50-03-5956 (activity area) and Site 50-50-03-5950 (rock mounds) which consists of push piles of large rocks that are the result of rock removal programs during former plantation use of the land. Site 50-50-03-5950 consists of a total of 17 rock clearing mounds, five (5) or six (6) of which may be affected by the proposed alignment. No further work is recommended for the additional sites. As the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits appears very low. (Please note that your agency previously concurred with the FHWA's finding of no adverse effect as part of the Section 106 Consultation under the National Historic Preservation Act, via letter dated April 29, 2014, DLNR Log No. 2013.6004, Doc No.: 1404MD41.)

Once a site has been identified as on or eligible for listing, the requirements for Section 4(f) apply, unless the FHWA determines that an exception under 23 CFR 774.13 applies. These exceptions include, but are not limited to archaeological sites when it is deemed important primarily for what can be learned by data recovery and the site has minimal value for preservation in place.

In applying any exception, a key requirement is that the official(s) with jurisdiction over the Section 4(f) resource must not object to the exception determination. In the case of the subject project's Section 4(f) archaeological resources, the State Historic Preservation Officer (SHPO) is the official with jurisdiction. Accordingly, the FHWA is consulting with you as the official with jurisdiction to ensure that you have no objections to our final determination that the seven sites are important, chiefly for what can be learned by data recovery from the sites and have minimal value for preservation in place and shall not be considered subject to Section 4(f) approval.

We ask for your concurrence that the proposed project meets the exception in 23 CFR 774.13(b) and does not constitute a use under Section 4(f) for Site 50-03-2665, Site 50-50-4787D, Site 50-50-03-5953, Site 50-50-03-5954, Site 50-50-03-5955, Site 50-50-03-5956, and Site 50-50-03-5950. We would greatly appreciate your assistance in reviewing the above information and providing us a response within 30 days of receipt of this letter.

Lahaina Bypass, Launiupoko and Polanui Ahupuaa, Lahaina District, Island of Maui, Hawaii, by Scientific Consultant Services, Inc.

[2] *Letter from SHPD to Scientific Consultant Services, Inc., November 13, 2006, DLNR Log No. 2006.3593, Doc No. 0611MK07.*

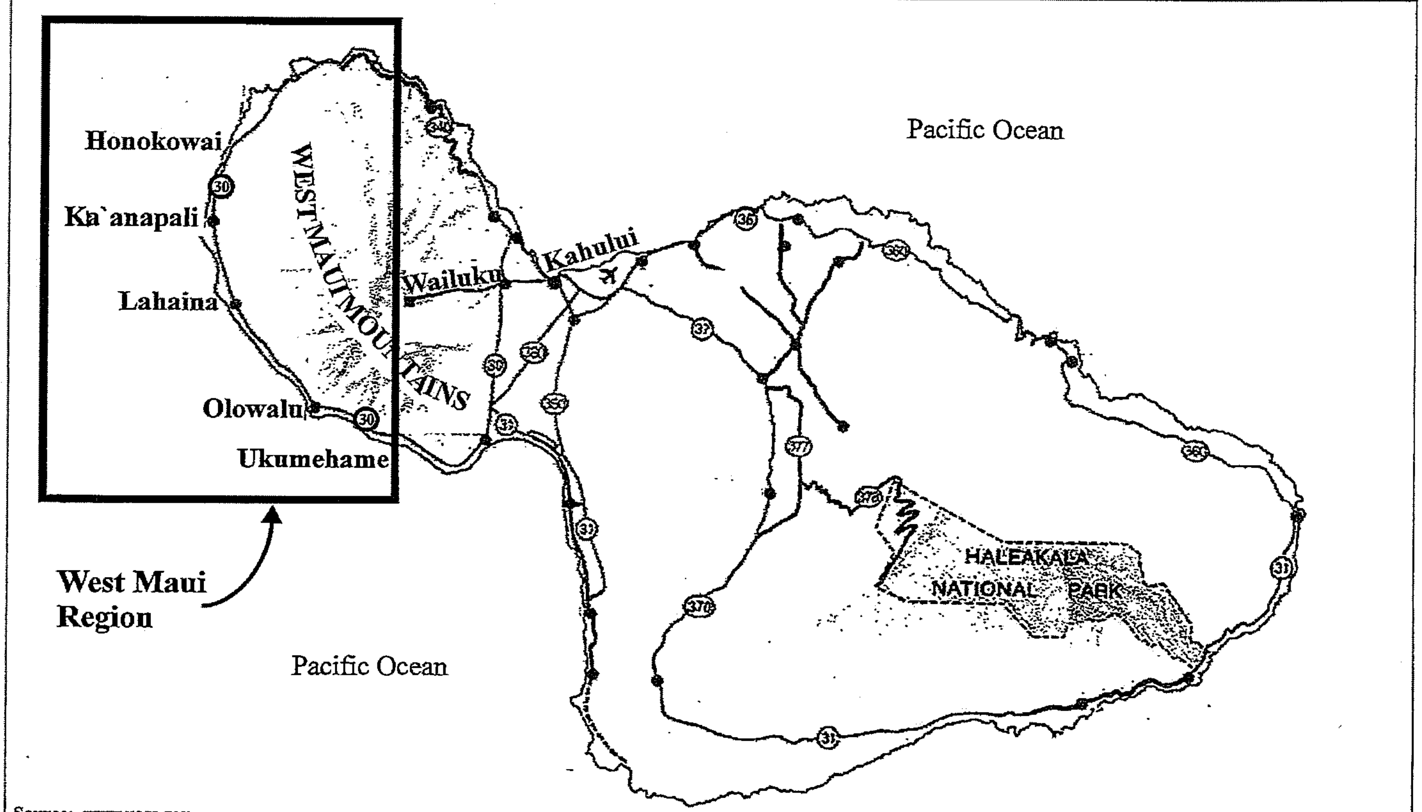
If you have any questions or if additional information is needed, please feel free to contact me by phone at (808) 541-2316 or by email at meesa.otani@dot.gov. Thank you for your assistance in this matter.

Sincerely yours,

Meesa Otani
Environmental Engineer

Enclosures

cc: Darell Young (HDOT), Morgan Davis (SHPD Maui), Mark Alexander Roy (Munekiyo & Hiraga, Inc.)



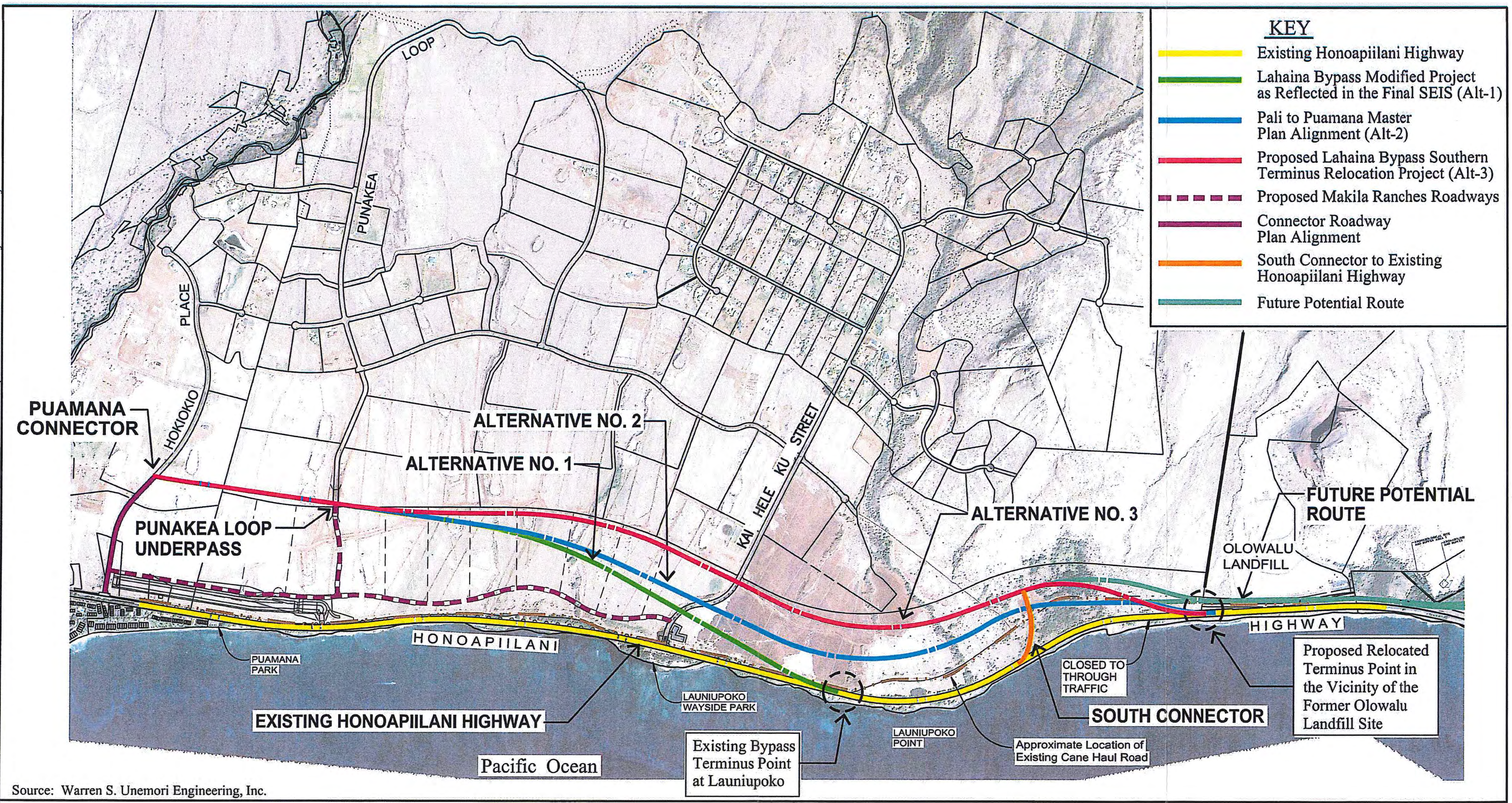
Source: www.usgs.gov

Figure 1 Proposed Lahaina Bypass Southern Terminus Relocation
West Maui Regional Location Map

MUNEKIYO & HIRAGA, INC.

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

MakilaLand\LahBypassExt\Draft EA\RegLoca



Source: Warren S. Unemori Engineering, Inc.

0 1200 2400 3600 4800

Scale: 1 in. = 1200 ft.

Proposed Lahaina Bypass Southern Terminus Relocation

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

FIGURE 2

Prepared For: State of Hawaii, Department of Transportation

V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Makila Section\exh-terminus location-fig23-00.dwg

APPENDIX L.

Essential Fish Habitat, 1966 Magnuson Stevens Fishery Conservation and Management Act Consultation Documentation

U.S. Department
of Transportation
**Federal Highway
Administration**

Hawaii Federal-Aid Division

300 Ala Moana Blvd, Rm 3-306
Box 50206
Honolulu, Hawaii 96850
Phone: (808) 541-2700
Fax: (808) 541-2704

October 8, 2013

In Reply Refer To:
HDA-HI

Mr. Michael Tosatto, Regional Administrator
National Oceanic and Atmospheric Administration, Pacific Islands Regional Office
National Marine Fisheries Service
1601 Kapiolani Blvd., Suite 1100
Honolulu, HI 96814

Dear Mr. Tosatto:

Subject: Essential Fish Habitat Consultation
Proposed Relocation of the Lahaina Bypass Southern Terminus
Launiupoko, Island of Maui
Federal-aid Project No. NH-030-1(051)

The Federal Highways Administration (FHWA) intends to fund the State of Hawaii Department of Transportation's (HDOT) relocation of the southern terminus of the Lahaina Bypass Highway in West Maui. We are continuing the consultation process with the National Oceanic and Atmospheric Administration (NOAA) pursuant to the Essential Fish Habitat (EFH), the Magnuson Stevens Fishery Conservation and Management Act of 1996, 16 U.S.C. et seq and associated federal regulations found at 50 CFR 600.

The proposed project involves the construction of the southern portion of the proposed Lahaina Bypass Highway near Launiupoko. It is located inland and does not involve construction activities within the marine involvement. However, given the proximity of the project to the shoreline, appropriate measures will take place to minimize impacts to water quality. Enclosed for your review is an analysis of potential impacts to the EFH prepared by the HDOT consultant.

We are seeking concurrence from your office that the proposed action will have minimal adverse impacts to the EFH. If you have any questions, or would like additional information please contact me at (808) 541-2326, or the designated non-federal representatives Darell Young of HDOT at (808) 587-1835 and the HDOTs Planning Consultant, Mark Roy at (808) 244-2015.

Sincerely yours,

FOR Wayne Kaneshiro
Transportation Engineer

Enclosures

cc: Mr. Darell Young/HWY-P, Mr. Mark Roy, Munekiyo and Hiraga, Inc.

Essential Fish Habitat Consultation
Proposed Relocation of the Lahaina Bypass Southern Terminus
Launiupoko, Island of Maui
Federal Aid Project No. NH-030-1(051)

Project Description

The Federal Highways Administration (FHWA) intends to fund the State of Hawaii Department of Transportation's (HDOT) relocation of the southern terminus of the Lahaina Bypass Highway in West Maui.

The project involves the southern extension of the Lahaina Bypass Highway which is to be constructed mauka (inland) and roughly parallel to the existing Honoapi`ilani Highway between Puamana and the former Olowalu Landfill in West Maui. Total length of new roadway corridor will be approximately 2 miles. The total width of the right of way or construction corridor will be approximately 150 ft. On average, the corridor route is roughly 1,000 feet inland from the existing Honoapi'ilani Highway. At the southern end of the project, a connection will be made to the existing Honoapi'ilani Highway. All construction activities will be land based, no work will occur seaward of the exiting Highway. Figures 1 and 2 shows the project location and vicinity as well as the proposed Highway alignments. Alternative 3 has been identified as the preferred alignment, see Exhibit C.

The project corridor traverses the moderately sloping alluvial fans of the Kaua`ula and Launiupoko streams and passes beneath Mahanaluanui Cinder Cone. The corridor is situated on elevated, sloping terrain where water runs off readily and does not accumulate. The project site is not located within a FEMA-designated floodplain, mass wastage areas, or braided stream bottom lands. The corridor crosses three un-named gulches and Launiupoko Stream, which directly discharge to the ocean. See Figure 3. The gulch and stream crossings are unavoidable given the route of this regional transportation corridor which runs inland and parallel to the coast. The three (3) unnamed gulches are classified as ephemeral (intermittent) with annual flow rates ranging from three (3) days to 10 days per year. These gulches are dry for most of the year but convey flow into the ocean only during large storm events.

Launiupoko Stream originates deep in the West Maui Mountains and is fed by both rainfall and artesian groundwaters. It has perennial flow in the upper valley, but only flows for about a mile before it is intercepted by a diversion that channels the stream down to an old plantation reservoir that dates from the early 1900's. According to the Hawaii Stream Assessment (HAS), Launiupoko Stream in its lower reaches (i.e. the locale of the project site) is not considered to be perennial as it runs dry for most of the year and flows only following large storm events.

While bridges were considered, given the flow characteristics within the three (3) unnamed gulches and Launiupoko Stream, culverts are being proposed as the best practicable alternative for the highway crossings in these areas. Overall, the length of the proposed culverts (approximately 150-200 ft) represents a small percentage of the overall length of these drainageways, which extend approximately 4 miles inland. Specifically, drainage ways Nos. 1, 2 and 4 extend inland approximately 20,461 ft, 18,382 ft. and 8,714 ft., respectively, while Launiupoko Stream, extends approximately 24,538 ft. inland. The remaining length of each drainageway will not be altered. Thus, only a small percentage of the drainage ways (less than 1% for drainage ways 1, 2 and Launiupoko Stream) will be hardened by the culverts.

The culverts will be designed to accommodate 100-year flood flows and will include side tapered and slope tapered transitional inlets as well as energy dissipaters as necessary to maintain the existing velocities in the drainageways. The construction schedule for this highway project will likely span several years, however, opportunities will be evaluated for the installation of the proposed drainage culverts to be scheduled, where feasible, during the summer months. In addition, site-specific Best Management Practices (BMP) will be installed during construction in these areas to mitigate the potential for sedimentation impacts during rainfall events.

The construction phase is expected to last approximately 18-24 months. Major grading and earthwork activities will occur in the early phases of the project. A comprehensive BMP program will be implemented during the construction of the project to mitigate the potential for sedimentation impacts to near shore waters and marine species.

Potential for adverse effects on EFH

As noted in your office's June 29, 2012 e-mail, the benthic habitat where Launiupoko Stream mouth and the unnamed gulches meet the Pacific Ocean is characterized as having geomorphological structures of coral covered aggregate reef, spur and groove structures, and uncolonized sand. The sea floor where these coral reef ecosystems occur qualify as EFH. The seafloor is also designated as EFH for bottom fish management unit species (MUS) group and the crustacean MUS. In addition, the water column has been designated as EFH for coral reef ecosystem MUS, bottomfish MUS, crustacean MUS and pelagic MUS.

Since all construction activities will occur on land, inland of coastal shoreline features and the marine environment, no direct impacts to marine species, habitats or coral reef ecosystems are anticipated. Indirect impacts may occur from increased sedimentation in coastal waters associated with upland construction activities. Coral reef cover can decline if sedimentation in the water increases from upland sources and coral becomes smothered in sediment. Increases in sediment have the potential of occurring during the construction phase or as a result of changes in water velocity. Long term changes in water flow and/or volume in gulches have the potential to alter freshwater input. Freshwater input can be impacted by the increase in impermeable surfaces from the new roadway or culverts. Upon full buildout of the project, the total amount of impervious surface will be approximately 32 acres.

In considering the relative significance of the impacts from the project, it is important to note that the watersheds upslope of the project area total approximately 4,500 acres as shown on Figure 3. The project will encompass an area approximately 70 acres in size and thus represents a relatively small percentage (1.1%) of land area contributing to stormwater flows within the area's watersheds. This minimizes the potential for having a significant effect on the quantity or quality of stormwater runoff generated by the watershed. Nevertheless, BMPs will be employed to minimize potential negative impacts to water quality in order to minimize the potential for contributing to cumulative impacts to coastal water quality.

Proposed Mitigation Measures

A comprehensive BMP program will be implemented during the construction of the project to mitigate the potential for sedimentation impacts to near shore waters and coral reef ecosystems. The contractor will be required to follow the Water Pollution and Erosion Control specifications outlined in Section 209 of the "Hawaii Standard Specifications for Road, Bridge and Public Works Construction" (Appendix 1). The Erosion Control notes which were established for Phase 1B-1 of the Lahaina Bypass project is attached as an example of the requirements which will be established for the subject project (Appendix 2). The contractor will also be required to follow Maui County's rules related to soil erosion and sedimentation control; a list of minimum BMPs required by Maui County's Soil Erosion and Sedimentation Control Ordinance, Chapter 20.08, Maui County Code (Appendix 3).

Long term measures will include establishment of retention basins to capture the additional runoff generated by the impermeable paved highway to maintain the current peak runoff during a 100-year storm, in accordance with Maui County's "Rules for the Design of Storm Drainage Facilities". In addition, Maui County has recently adopted "Rules for Storm Water Treatment Best Management Practices" which establish requirements for appropriate desilting and/or filtering mechanisms to minimize impacts from changes in storm water runoff quality. Lastly, as noted above, the culverts will be designed to accommodate 100-year flood flows and will include side tapered and slope tapered transitional inlets as well as energy dissipaters as necessary to maintain the existing velocities in the drainageways.

Specific measures to be implemented to prevent contamination of the marine environment from project-related construction activities include:

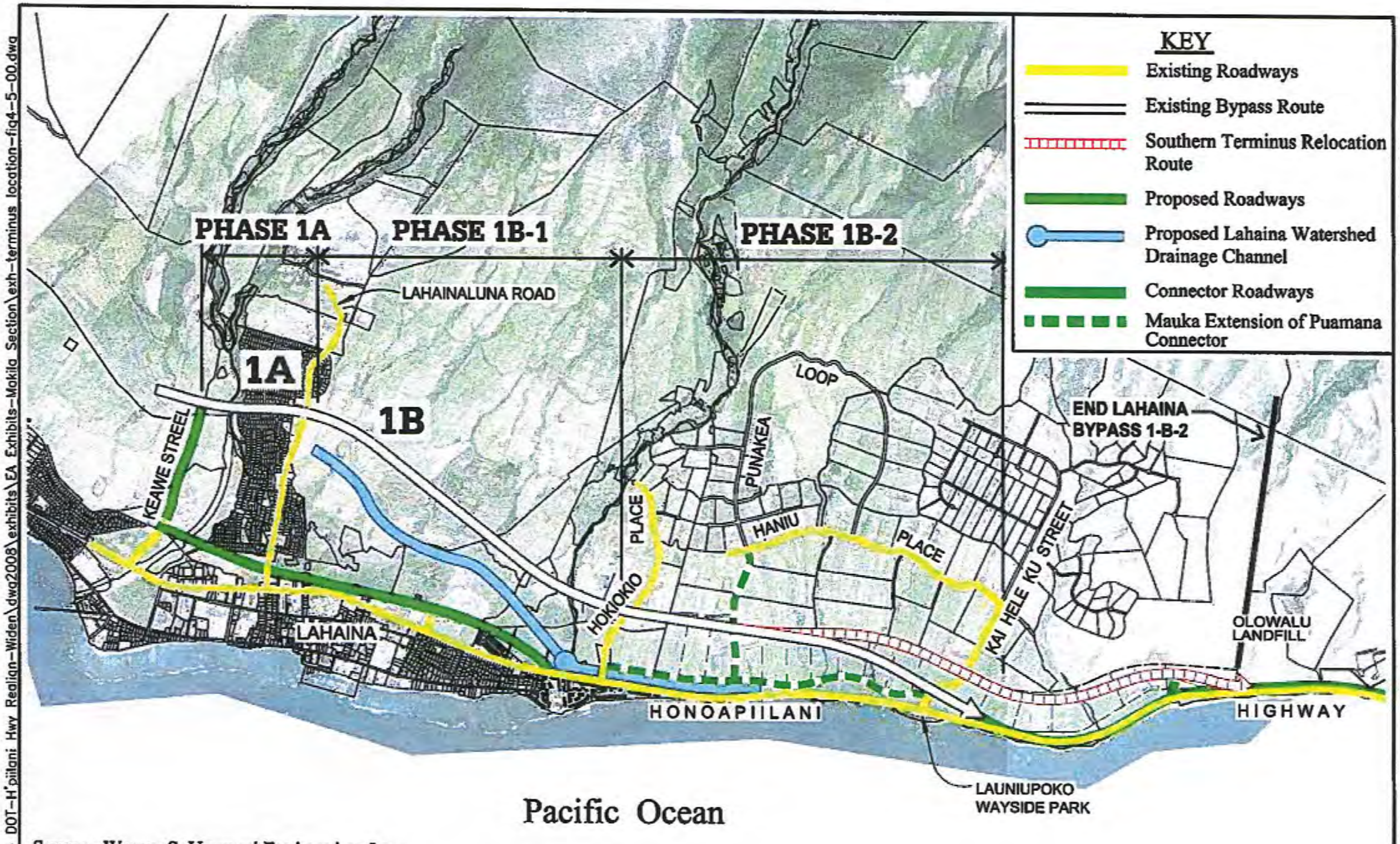
1. The project manager and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.

2. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.

3. The project's specifications will include requirements for the contractor to prevent debris and other wastes from entering or remaining in the marine environment during the project.

Conclusion

Based on the analysis above, it has been determined that the proposed action will have minimal adverse effect to EFHs including coral reef ecosystems in the project vicinity. This conclusion is based on the following considerations: (1) the project is land based and will not involve construction activities seaward of the existing highway, thus no direct impacts to EFH including coral reef ecosystems will occur; (2) incorporation of BMPs during the construction phase to mitigate potential impacts from sedimentation in storm water runoff; (3) installation of desilting and retention facilities to mitigate long term impacts from the increase in impermeable surfaces; and (4) the relative size of the footprint of the project in relation to the overall watershed.



Source: Warren S. Unemori Engineering, Inc.

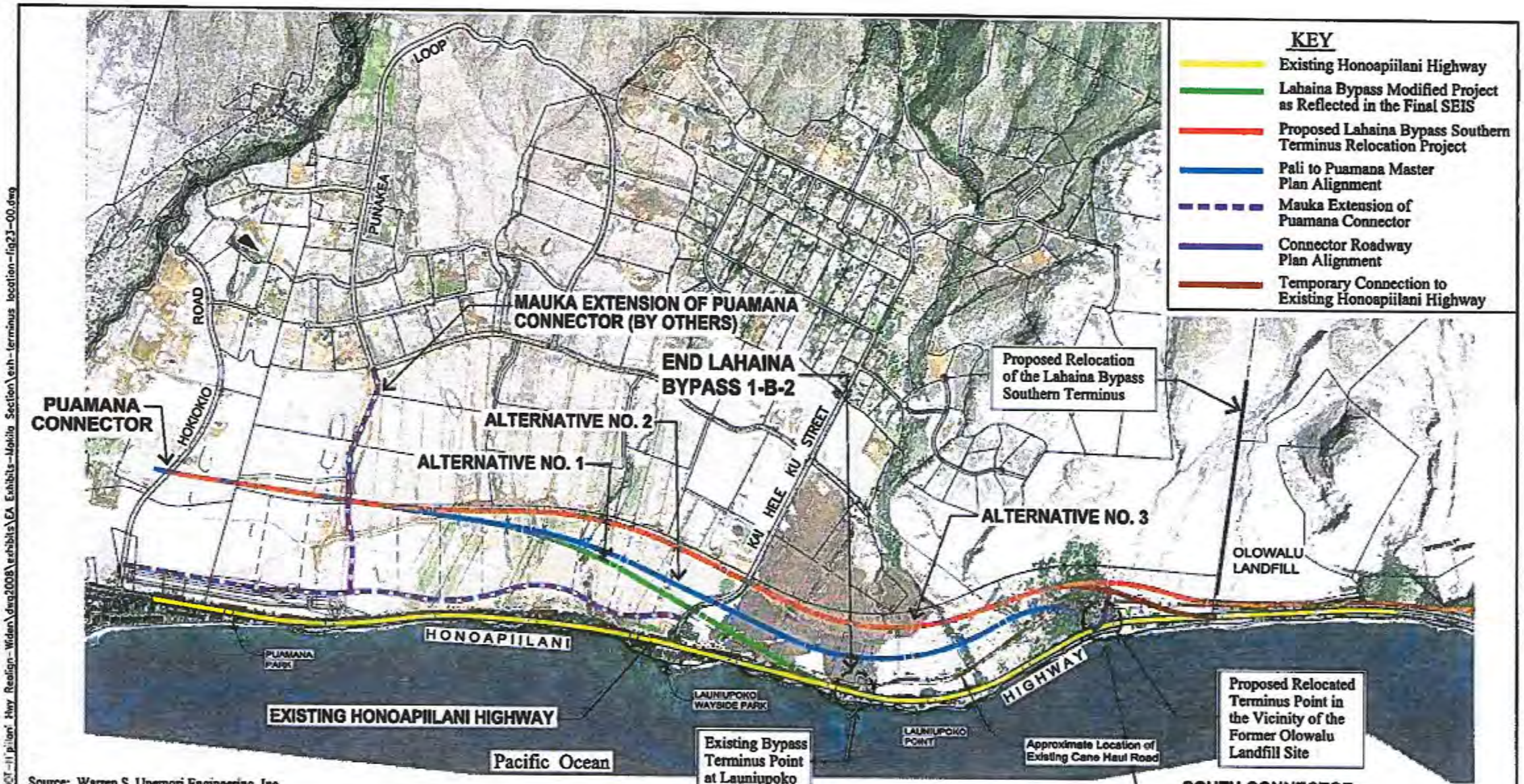
Proposed Lahaina Bypass Southern Terminus Relocation

Intial Construction Phases for the Lahaina Bypass

SCALE: 1 IN. = 3000 FT.
Prepared For: State of Hawaii, Department of Transportation

FIGURE 1

V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Mokila Section\exh-terminus location-fig4-5-00.dwg



Source: Warren S. Unemori Engineering, Inc.

Proposed Lahaina Bypass Southern Terminus Relocation
Alignment Comparison: Pali to Puamana Master Plan vs. Proposed Action

Scale: 1 in. = 1200 ft.

Prepared For: State of Hawaii, Department of Transportation

FIGURE 2

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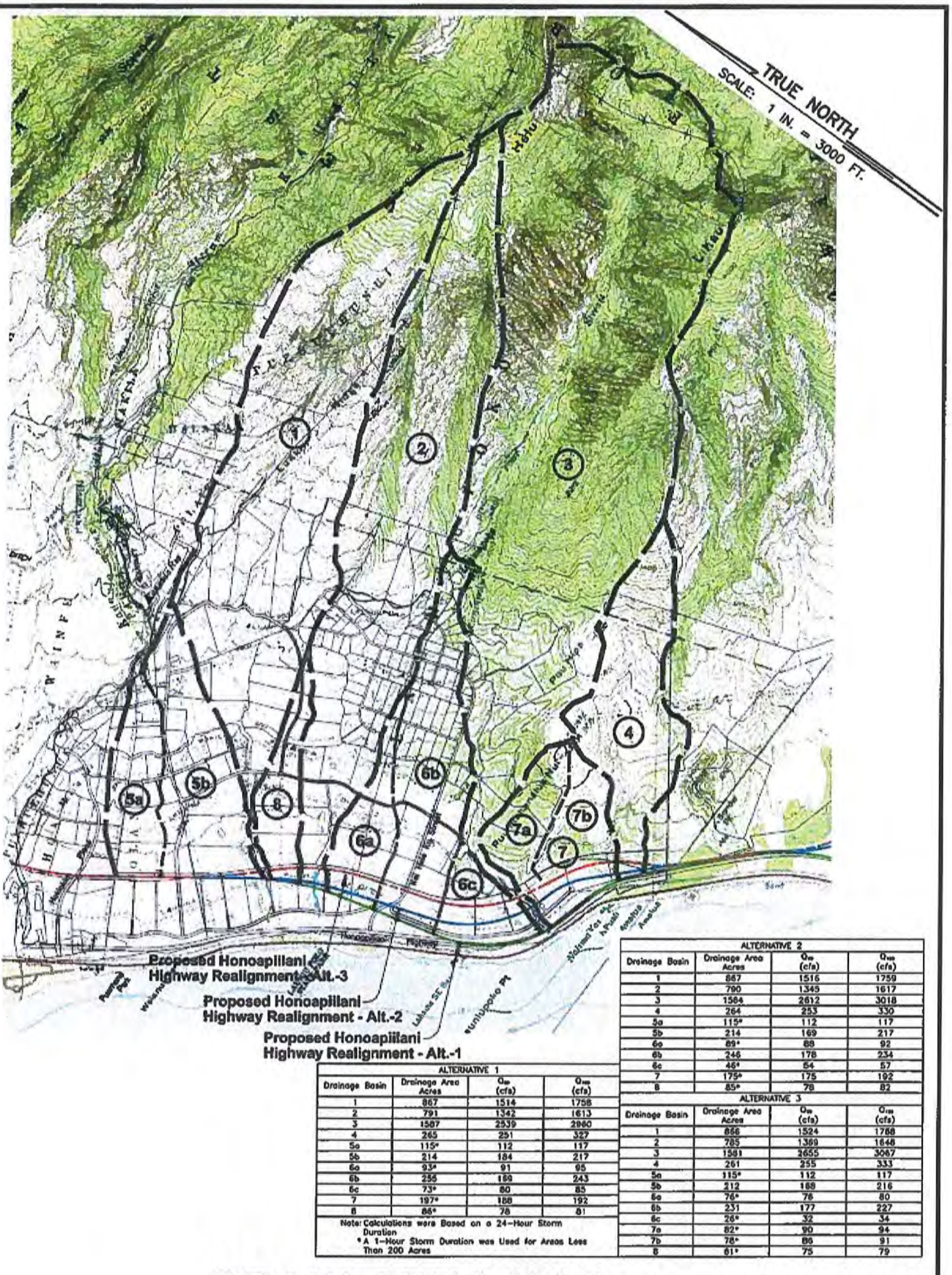
V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Makila Section\EXB-DRAINAGE-AREA-00.dwg



ALTERNATIVE 1			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	189	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

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

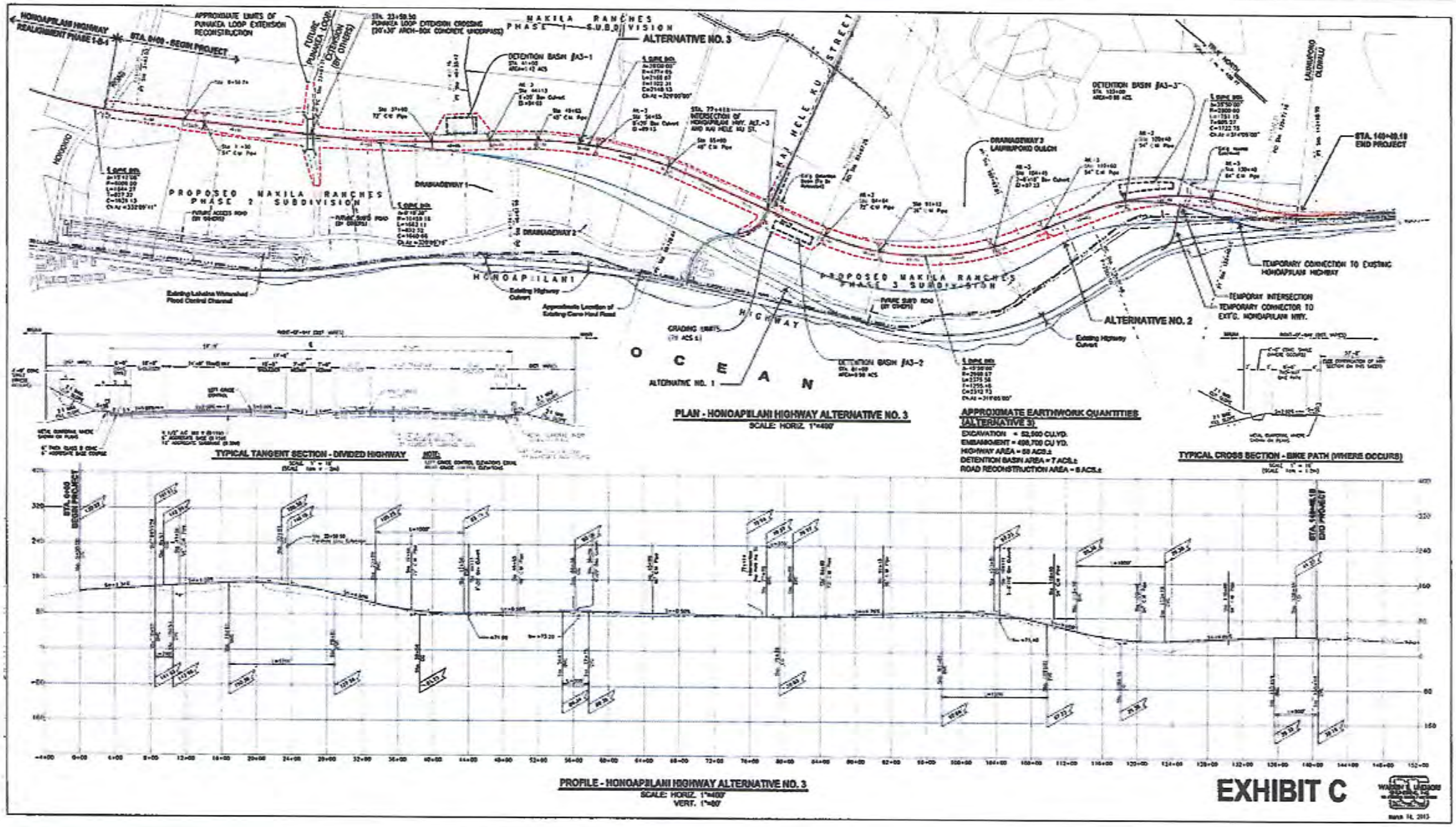
ALTERNATIVE 2			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	246	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

ALTERNATIVE 3			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	866	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	188	216
6a	76*	78	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	61*	75	79

DRAIN AREA MAP

FIGURE 3

April 10, 2008



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'

TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 3)

EXCAVATION = 52,500 CU.YD.
EMBANKMENT = 496,700 CU YD.
HIGHWAY AREA = 58 ACS.±
DETENTION BASIN AREA = 7 ACS.±
ROAD RECONSTRUCTION AREA = 6 ACS.±

PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'
VERT. 1"=80'

EXHIBIT C

SECTION 209 - TEMPORARY WATER POLLUTION, DUST, AND EROSION CONTROL

209.01 Description. This section describes the following:

(A) Including detailed plans, diagrams, and written site-specific best management practices (BMP); constructing, maintaining, and repairing temporary water pollution, dust, and erosion control measures at the project site, including local material sources, work areas and haul roads; removing and disposing hazardous wastes; control of fugitive dust (defined as uncontrolled emission of solid airborne particulate matter from any source other than combustion); and complying with applicable State and Federal permit conditions.

(B) Work associated with dewatering activities and complying with conditions of the National Pollutant Discharge Elimination System (NPDES) general permit coverage authorizing discharges associated with construction activity dewatering.

Requirements of this section also apply to borrow pit operations, haul roads and Contractor's storage sites located outside State Right-of-Way.

209.02 Materials. Materials shall conform to the following:

(A) Slope Drains. Slope drains may be constructed of pipe, fiber, mats, erosion control fabric, geotextiles, rubble, portland cement concrete, bituminous concrete, plastic sheets, or other materials acceptable to Engineer.

(B) Mulches. Mulches shall be recycled materials include bagasse, hay, straw, wood cellulose, bark, wood chips, or other materials acceptable to Engineer. Mulches shall be clean and free of noxious weeds and deleterious materials.

(C) Grass. Grass shall be a quick growing species such as rye grass, Italian rye grass, or cereal grasses. Grass shall be suitable to the area and provide a temporary cover that will not compete later with permanent cover. Alternative grasses are allowable if acceptable to Engineer.

(D) Fertilizer and Soil Conditioners. Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the Engineer. Fertilizer shall conform to Subsection 619.02(H)(1) - Commercial Fertilizer.

(E) Hydro-mulching. Hydro-mulching used as a BMP shall consist of materials in Subsections 209.02(B) - Mulches, 209.02(C) - Grass, and 209.02(D) –Fertilizer and Soil conditioners, with potable water meeting the requirements of Subsection 712.01 - Water. Installation and other requirements shall in accordance with portions of Section 641- Hydro-Mulch Seeding.

(F) Silt Fences. Silt fences shall be synthetic filter fabric mounted on posts and embedded in compacted ground in accordance with contract documents, and shall be in compliance with ASTM D6462, Standard Practice for Silt Fence Installation.

(G) Berms. Berms shall be gravel or sand wrapped with geotextile material. Alternate materials are allowable if acceptable to Engineer.

Alternative materials or methods to control, prevent, remove and dispose pollution are allowable if acceptable to Engineer.

209.03 Construction.

(A) Preconstruction Requirements.

(1) Water Pollution, Dust, and Erosion Control Meeting. Submit site specific BMP to Engineer. Schedule a water pollution, dust, and erosion control meeting with Engineer after site specific BMP is accepted in writing by Engineer. Meeting shall be scheduled 14 days before start of construction work. Discuss sequence of work, plans and proposals for water pollution, dust, and erosion control.

(2) Water Pollution, Dust, and Erosion Control Submittals. Submit the following:

(a) Written site-specific BMP describing activities to minimize water pollution and soil erosion into State waters, drainage or sewer systems. BMP shall include the following:

1. An identification of potential pollutants and their sources.

2. A list of all materials and heavy equipment to be used during construction.

3. Descriptions of the methods and devices used to minimize the discharge of pollutants into State waters, drainage or sewer systems.

4. Details of the procedures used for the maintenance and subsequent removal of any erosion or siltation control devices.

5. Methods of removing and disposing hazardous wastes encountered or generated during construction.

6. Methods of removing and disposing concrete and asphalt pavement cutting slurry, concrete curing water, and hydrodemolition water.

7. Spill control.

8. Fugitive dust control, including dust from grinding, sweeping, or brooming off operations or combination thereof.

9. Methods of storing and handling of oils, paints and other products used for the project.

10. Material storage and handling areas, and other staging areas.

11. Concrete truck washouts.

12. Concrete waste control.

13. Fueling and maintenance of vehicles and other equipment.

14. Tracking of sediment offsite from project entries and exits.

15. Litter management.

16. Toilet facilities.

17. Other factors that may cause water pollution, dust and erosion control.

(b) Provide plans indicating location of water pollution, dust and erosion control devices; provide plans and details of BMPs to be installed or utilized; show areas of soil disturbance in cut and fill, indicate areas used for storage of aggregate (indicate type of aggregate), asphalt cold mix, soil or waste, and show areas where vegetative practices are to be implemented. Indicate intended drainage pattern on plans. Include separate drawing for each phase of construction that alters drainage patterns. Indicate approximate date when device will be installed and removed.

(c) Construction schedule.

(d) Name(s) of specific individual(s) designated responsible for water pollution, dust, and erosion controls on the project site. Include home and business telephone numbers, fax numbers, and e-mail addresses.

(e) Description of fill material to be used.

Date and sign BMP. Keep accepted copy on site throughout duration of the project. Revisions to the BMP shall be included with original BMP. Modify contract documents to conform to revisions. Include actual date of installation and removal of BMP. Obtain written acceptance by Engineer before revising BMP.

Follow guidelines in the "Best Management Practices Manual for Construction Sites in Honolulu", in developing, installing, and maintaining BMPs for all projects. Follow Honolulu's City and County "Rules for Soil Erosion Standards and Guidelines" for all projects on Oahu. Use respective Soil Erosion Guidelines for Maui, Kauai and Hawaii projects.

(B) Construction Requirements. Do not begin work until submittals detailed in Subsection 209.03(A)(2) - Water Pollution, Dust, and Erosion Control Submittals are completed and accepted in writing by Engineer.

Install, maintain, monitor, repair and replace site-specific BMP measures, such as for water pollution, dust and erosion control; installation, monitoring, and operation of hydrotesting activities; removal and disposal of hazardous waste indicated on plans, concrete cutting slurry, concrete curing water; or hydrodemolition water.

Furnish, install rain gage in a secure location for projects that require NPDES permit from the Department of Health prior to field work including installation of site-specific BMP. Provide rain gage with a tolerance of at least 0.05 inches of rainfall, and an opening of at least 1-inch diameter. Install rain gage on project site in an area that will not deter rainfall from entering the gate opening. Maintain rain gage and replace rain gage that is stolen, does not function properly or accurately, is worn out, or needs to be relocated. Do not begin field work until rain gauge is installed and site specific BMPs are in place. Do not begin field work until rain gauge is installed and site specific BMPs are in place.

Address all comments received from Engineer.

Modify and resubmit plans and construction schedules to correct conditions that develop during construction which were unforeseen during the design and pre-construction stages.

Coordinate temporary control provisions with permanent control features throughout the construction and post-construction period.

Limit maximum surface area of earth material exposed at any time to 300,000 square feet. Do not expose or disturb surface area of earth material (including clearing and grubbing) until BMP measures are installed and accepted in writing by Engineer. Protect temporarily or permanently disturbed soil surface from rainfall impact, runoff and wind before end of workday.

Protect exposed or disturbed surface area with mulches, grass seeds or hydromulch. Spray mulches at a rate of 2,000 pounds per acre. Add tackifier to mix at a rate of 85 pounds per acre. Apply grass seeds at a rate of 125 pounds per acre. For hydromulch use the ingredients and rates required for mulches and grass seeds.

Apply fertilizer to mulches, grass seed or hydromulch at a rate of 450 pounds per acre. Apply an additional 250 pounds per acre every 90 calendar days.

Install velocity dissipation measures when exposing erodible surfaces greater than 15 feet in height.

BMP measures shall be in place and operational (such as shaping the earthwork to control and directing the runoff) at the end of workday. Shaping earthwork may include constructing earth berms along the top edges of embankments if acceptable to Engineer.

Install and maintain either or both stabilized construction entrances and wheel washes to minimize tracking of dirt and mud onto roadways. Restrict traffic to stabilized construction areas only. Clean dirt, mud, or other material tracked onto the road immediately. Modify stabilized construction entrances to prevent mud from being tracked onto road. Stabilize entire access roads if necessary.

Chemicals may be used as soil stabilizers for either or both erosion and dust control if acceptable to Engineer.

Provide temporary slope drains of rigid or flexible conduits to carry runoff from cuts and embankments. Provide portable flume at the entrance. Shorten or extend temporary slope drains to ensure proper function.

Protect ditches, channels, and other drainageways leading away from cuts and fills at all times by either:

(1) Hydro-mulching the lower region of embankments in the immediate area.

(2) Placing an 8- to 15-inch layer of excavated rock, if available on-site, without reducing the cross section of the drainageway. Rocks shall be less than four inches in diameter.

(3) Installing check dams and salutation control devices.

(4) Other methods acceptable to Engineer.

Provide for controlled discharge of waters impounded, directed, or controlled by project activities or erosion control measures.

Cover exposed surface of materials completely with tarpaulin or similar device when transporting aggregate, soil, excavated material or material that may be source of fugitive dust.

Cleanup and remove any pollutant that can be attributed to Contractor.

Install or modify BMP measures due to change in Contractor's means and methods, or for omitted condition that should have been allowed for in the accepted site specific BMP or a BMP that replaces an accepted site specific BMP that is not satisfactorily performing.

Properly maintain all BMP features. Inspect, prepare a written report, and make repairs to BMP measures at following intervals:

(1) Weekly during dry periods.

(2) Within 24 hours of any rainfall of 0.5 inch or greater which occurs in a 24-hour period.

(3) Daily during periods of prolonged rainfall.

(4) When existing erosion control measures are damaged or not operating properly as required by site specific BMP.

Remove, destroy, replace or relocate any BMP that must be removed, destroyed, replaced or relocated due to potential or actual flooding, or potential danger or damage to project or public.

Maintain records of inspections of BMP work. Keep continuous records for duration of the project. Submit weekly copy of records to Engineer.

In addition to weekly reports, submit to Engineer all amounts spent initializing and maintaining BMP during previous week. Amount spent includes, but is not limited to: purchases of erosion control material, construction of storage areas, and installation of water pollution, erosion and dust control measures. Submit report weekly along with site inspection report.

Protect finished and previously seeded areas from damage and from spillover materials placed in upper lifts of embankment.

The Contractor's designated representative specified in Subsection 209.03(A)(2)(d) shall address any BMP concerns brought up by Engineer within 24 hours of notification, including weekends and holidays. Failure to satisfactorily address these concerns, Engineer reserves the right to employ outside assistance or use Engineer's own labor forces to provide necessary corrective measures. Engineer will charge Contractor such incurred costs plus any associated project engineering costs. Engineer will make appropriate deductions from Contractor's monthly progress estimate. Failure to apply BMP measures shall result in either or both the establishment and increase in the amount of retainage due to unsatisfactory progress or withholding of monthly progress payment. Continued failure to apply BMP measures may result in one or more of the following: assessment of liquidated damages, suspension, or cancellation of Contract with Contractor being fully responsible for all additional costs incurred by State.

(C) Hydrotesting Activities. If work includes removing, relocation or installing waterlines, and Contractor elects to flush waterline or discharge hydrotesting effluent into State waters or drainage systems, obtain an NPDES Hydrotesting Waters Permit from Department of Health, Clean Water Branch (DOH-CWB).

Do not begin hydrotesting activities until the DOH-CWB has issued a Notice of General Permit Coverage (NGPC). Hydrotesting operations shall be in accordance with conditions in NGPC. Submit a copy of the NPDES Hydrotesting Waters Application and Permit to Engineer.

(D) Dewatering Activities. If excavation of backfilling operations require dewatering, and Contractor elects to discharge dewatering effluent into State waters or existing drainage systems, obtain NPDES General Permit Coverage authorizing discharges associated with construction activity dewatering from Department of Health, Clean Water Branch (DOH-CWB). If permit is required, prepare and submit permit application (CWB-NOI Form G) to DOH-CWB.

Do not begin dewatering activities until DOH-CWB has issued Notice of General Permit Coverage (NGPC). Conduct dewatering operations in accordance with conditions in NGPC. Submit copy of NPDES Hydrotesting Waters Application and Permit to Engineer.

209.04 Measurement.

(A) Installation, maintenance, monitoring, and removal of BMP will be paid on a lump sum basis. Measurement for payment will not apply.

(B) Engineer will only measure additional water pollution, dust and erosion control required and requested by Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

209.05 Payment. Engineer will pay for accepted pay items listed below at contract price per pay unit, as shown in the proposal schedule. Payment will be full compensation for work prescribed in this section and contract documents.

Engineer will pay for each of the following pay items when included in proposal schedule:

Pay Item	**Pay Unit**
Installation, Maintenance, Monitoring, and Removal of BMP	Lump Sum
Additional Water Pollution, Dust, and Erosion Control	Force Account

An estimated amount for force account is allocated in proposal schedule under 'Additional Water Pollution, Dust, and Erosion Control', but actual amount to be paid will be the sum shown on accepted force account records, whether this sum be more or less than estimated amount allocated in proposal schedule. Engineer will pay for BMP measures requested by Engineer that are beyond scope of accepted site specific BMP and for litter management due to rubbish created by the public on a force account basis.

No progress payment will be authorized until Engineer accepts in writing site-specific BMP or when Contractor fails to maintain project site in accordance with accepted BMP.

For all citations or fines received by the Department for non-compliance with Notice of General Permit Coverage (NGPC), the Contractor shall reimburse State within 30 days for full amount of outstanding cost State has incurred, or Engineer will deduct cost from progress payment.

Engineer will assess liquidated damages up to $27,500 per day for non-compliance of each BMP requirement and all other requirements in this section.

END OF SECTION 209

Appendix 2- Construction Plan Notes from Lahaina Bypass Phase 1-B-1

FED. ROAD DIST. NO	STATE	FED AID PROJ. NO	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW	NH-030-1(38)	2010	5	23

WATER POLLUTION AND EROSION CONTROL NOTES:

A. GENERAL:

1. See Section 209 - Water Pollution and Erosion Control, in the "Hawaii Standard Specifications for Road, Bridge and Public Works Construction". Section 209 describes but is not limited to: submittal requirements; scheduling of a water pollution and erosion control conference with the Engineer; construction requirements; method of measurement; and basis of payment.
2. The Contractor shall follow the guidelines in the "Construction Best Management Practices Field Manual", dated January 2008 in developing, installing and maintaining the Best Management Practices (BMP) for the project.
3. The Contractor shall follow the guidelines in the Honolulu's City & County "Rules Relating to Soil Erosion Standards and Guidelines" along with applicable Soil Erosion Guidelines for projects on Maui, Molokai, Kauai, and Hawaii.
4. The Engineer may assess liquidated damages of up to $27,500 for non-compliance of each BMP requirement and each requirement stated in Section 209, for every day of non-compliance. There is no maximum limit on the amount assessed per day.
5. The Engineer will deduct the cost from the progress payment for all citations received by the Department for non-compliance, or the Contractor shall reimburse the State for the full amount of the outstanding cost incurred by the State.
6. For projects that require an NPDES Permit from the Department of Health, install a rain gage prior to any field work including the installation of any site-specific best management practices. The rain gage shall have a tolerance of at least 0.05 inches of rainfall, and have an opening of at least one-inch in diameter. Install the rain gage on the project site in an area that will not deter rainfall from entering the gage opening. The rain gage installation shall be stable and plumbed. Do not begin field work until the rain gage is installed and site-specific best management practices are in-place.
7. The Contractor shall provide a stabilized construction entrance to reduce vehicle tracking of sediments. The stabilized construction entrance shall be included in the Water Pollution, Dust, and Erosion Control submittals. The minimum length shall be 50 feet. The minimum width shall be 30 feet. The minimum depth shall be 6 inches and underlain with geotextile fabric. The Contractor shall clean the paved street adjacent to the site entrance daily or as required to remove any excess mud, cold planed materials, dirt or rock tracked from the site. Dump trucks hauling material from the construction site shall be covered with a tarpaulin.
8. Designated Concrete Washout Area(s) shall be included in the Water Pollution, Dust, and Erosion Control submittals.
9. The Contractor shall submit the name of a specific individual designated responsible for inspections, maintenance and repair activities and filling out the inspection and maintenance report.
10. Personnel selected for the inspection and maintenance responsibilities shall receive training from the Contractor. They shall be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.
11. Contain, remove, and dispose slurry generated from saw cutting of pavement in accordance with approved BMP practices. Payment for confinement, removal, and disposal of slurry shall be considered incidental to the various contract items.

B. WASTE DISPOSAL:

1. Waste Materials
   All waste materials shall be collected and stored in a securely lidded metal dumpster. The dumpster shall meet all local and State solid waste management regulations. All trash and construction debris from the site shall be deposited in the dumpster. The dumpster shall be emptied a minimum of twice per week or as often as is deemed necessary. No construction waste materials shall be buried onsite. The Contractor's supervisory personnel shall be instructed regarding the correct procedure for waste disposal. Notices stating these practices shall be posted in the office trailer and the Contractor shall be responsible for seeing that these procedures are followed.
2. Hazardous Waste
   All hazardous waste materials shall be disposed of in the manner specified by local or State regulations or by the manufacturer. The Contractor's site personnel shall be instructed in these practices and shall be responsible for seeing that these practices are followed.
3. Sanitary Waste
   All sanitary waste shall be collected from the portable units a minimum of once per week, or as required.

C. EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE PRACTICES:

1. All control measures shall be inspected at least once each week and following any rainfall event of 0.5 inches or greater, within a 24 hour period.
2. All measures shall be maintained in good working order. If repair is necessary, it shall be initiated within 24 hours after the inspection.
3. Built-up sediment shall be removed from silt fence when it has reached one-third the height of the fence.
4. Silt screen or fence shall be inspected for depth of sediment, tears, to verify that the fabric is securely attached to the fence posts or concrete slab and to verify that the fence posts are firmly in the ground. Inspect and verify the bottom of the silt screen is buried a minimum of 6 inches below the existing ground.
5. Temporary and permanent seeding and planting shall be inspected for bare spots, washouts and healthy growth.
6. A maintenance inspection report shall be made promptly after each inspection by the Contractor. The Contractor shall submit a copy of of the maintenance inspection report to the Engineer no later than one week from the date of the inspection.

D. GOOD HOUSEKEEPING BEST MANAGEMENT PRACTICES:

1. Materials Pollution Prevention Plan
   a. Applicable materials or substances listed below are expected to be present onsite during construction. Other materials and substances not listed below shall be added to the inventory.

      Concrete
      Detergents
      Paints (enamel and latex)
      Metal Studs
      Tar
      Fertilizers
      Petroleum Based Products
      Cleaning Solvents
      Wood
      Masonry Block

   b. Material Management Practices shall be used to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff. An effort shall be made to store only enough product as is required to do the job.
   c. All materials stored onsite shall be stored in a neat, orderly manner in their appropriate containers and if possible under a roof or other enclosure.
   d. Products shall be kept in their original containers with the original manufacturer's label.
   e. Substances shall not be mixed with one another unless recommended by the manufacturer.
   f. Wherever possible, a product shall be used up completely before disposing of the container.
   g. Manufacturer's recommendations for proper use and disposal shall be followed.
   h. The Contractor shall conduct a daily inspection to ensure proper use and disposal of materials onsite.
2. Hazardous Material Pollution Prevention Plan
   a. Products shall be kept in original containers unless they are not resealable.
   b. Original labels and material safety data sheets (MSDS) shall be retained.
   c. Surplus products shall be disposed of according to manufacturers' instructions or local and State recommended methods.
3. Onsite and Offsite Product Specific Plan
   The following product specific practices shall be followed onsite:
   a. Petroleum Based Products:
      All onsite vehicles shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used onsite shall be applied according to the manufacturer's recommendation.
   b. Fertilizers:
      Fertilizers used shall be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer shall be worked into the soil to limit exposure to storm water. Storage shall be in a covered shed. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bin to avoid spills.
   c. Paints:
      All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the highway drainage system but shall be properly disposed of according to manufacturers' instructions or State and local regulations.
   d. Concrete Trucks:
      Wash Out or discharge concrete truck drum wash water only at a designated site. Do not discharged water in the highway drainage system or waters of the United States. The Contractor shall contact Drinking Water Branch, Department of Health at 586-4258 to receive permission to designate a disposal site. The Contractor shall clean disposal site as required or as requested by the Owner's representative.
4. Spill Control Plan
   a. A spill prevention plan shall be posted to include measures to prevent and clean up each spill.
   b. The Contractor shall be the spill prevention and cleanup coordinator. The Contractor shall designate at least three site personnel who shall receive spill prevention and cleanup training. These individuals shall each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel shall be posted in the material storage area and in the office trailer onsite.
   c. Manufacturers' recommended methods for spill cleanup shall be clearly posted and site personnel shall be made aware of the procedures and the location of the information and cleanup supplies.
   d. Materials and equipment necessary for spill cleanup shall be kept in the material storage area onsite.
   e. All spills shall be cleaned up immediately after discovery.
   f. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
   g. Spills of toxic hazardous material shall be reported to the appropriate State or local government agency, regardless of the size.

E. PERMIT REQUIREMENTS:

1. If a National Pollutant Discharge Elimination System (NPDES) Permit is required for Construction Activities of one acre or more, the Contractor shall submit to the Engineer six sets of the Water Pollution and Erosion Control Submittals as detailed in Subsection 209.03 of the Specifications.
2. If an NPDES Permit for Construction Dewatering is required, the Contractor shall be responsible to obtain the Permit from the Department of Health, Clean Water Branch.
3. The Contractor shall comply with all applicable State and Federal Permit conditions. Permits may include but are not limited to the following:
   a. NPDES Permit for Construction Activities
   b. NPDES Permit for Construction Dewatering
   c. NPDES Permit for Hydrotesting Waters
   d. Water Quality Certification
   e. Stream Channel Alteration Permit
   f. Section 404 Army Corps of Engineer Permit

TERRANCE E. ARASHIRO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATER POLLUTION AND
EROSION CONTROL NOTES

HONOAPIILANI HIGHWAY REALIGNMENT, PHASE 1B-1
Lahainaluna Rd. to Hokiokio Pl.
Federal Aid Project NO. NH-030-1(38)

Scale: None Date: November 23, 2009

SHEET No. 3 OF 5 SHEETS

REDUCED PLAN
(HALF SIZE)
0 1 2 3
INCHES ON ORIGINAL PLAN

Appendix 3 - Excerpts from Chapter 20.08, Maui County Code

20.08.010 Purpose.

The purpose of this chapter is to provide minimum standards to safeguard life and limb, protect property, and promote public welfare, and to preserve and enhance the natural environment, including but not limited to water quality, by regulating and controlling grubbing and grading operations within the County. The public health, safety and welfare requires that environmental considerations contribute to the determination of these standards insofar as they relate to protecting against erosion and sediment production.

(Ord. 2684 § 1, 1998; Ord. 816 § 1 (part), 1975; prior code § 24-1.1)

20.08.035 Minimum bmps.

Regardless of whether a permit is required pursuant to this chapter, all grading, grubbing and stockpiling activities shall provide bmps to the maximum extent practicable to prevent damage by sedimentation to streams, watercourses, natural areas and the property of others. It shall be the permittee's and the property owner's responsibility to ensure that the bmps are satisfactorily implemented.

A. Drainage. On-site drainage shall be handled in such a way to as to control erosion, prevent damage to downstream properties and to return waters to the natural drainage course in a manner which minimizes sedimentation or other pollution to the maximum extent practicable.

B. Dust control. All areas disturbed by construction activities shall control dust emissions to the maximum extent practicable through the application of bmps, that may include watering with trucks or sprinklers, erection of dust fences, limiting the area of disturbance, and timely grassing of finished areas.

C. Vegetation. Whenever feasible, natural vegetation, especially grasses, should be retained. If it is necessary to be removed, trees, timber, plants, shrubbery and other woody vegetation, after being uprooted, displaced or dislodged from the ground by excavation, clearing or grubbing, shall not be stored in or deposited along the banks of any stream, river or natural watercourse. The director may require the removal and disposal of such vegetation from the site within a reasonable time but not to exceed three months.

D. Erosion controls. All disturbed areas shall be stabilized with erosion control measures that may include: staging construction: clearing only areas essential for construction; locating potential nonpoint pollutant sources away from steep slopes, water bodies, and critical areas; routing construction traffic to avoid existing or newly planted vegetation; protecting natural vegetation with fencing, tree armoring, and retaining walls or tree wells; stockpiling topsoil, covering the stockpile to prevent dust, and reapplying the topsoil; covering or stabilizing all soil stockpiles; using wind erosion control; intercepting runoff above disturbed slopes and conveying it to a permanent channel or storm drain; constructing benches, terraces, or ditches at regular intervals to intercept runoff on long or steep disturbed or man-made slopes; providing linings or other method to prevent erosion of storm water conveyance channels; using check dams where needed to slow flow velocities; using seeding and fertilizing, mulching, sodding, matting, blankets, bonded fiber matrices, or other effective soil erosion control technique; and providing vehicle wheel wash facilities for vehicles before they leave the site.

E. Sediment control. In addition to the erosion control measures of this section, providing practices to capture sediment that is transported in runoff to minimize the sediment from leaving the site. Filtration and detention (gravitational settling) are the main processes used to remove sediment from construction site runoff. Sediment control measures include sediment basins; sediment traps; filter fabric silt fences; straw bale, sand bag, or gravel bag barriers; inlet protection; stabilized construction entrances, and other measures to minimize off site tracking of sediment by construction vehicles; and vegetated filter strips.

F. Material and waste management. Measures to insure the proper storage of toxic material and prevent the discharge of pollutants associated with construction materials and wastes shall be implemented.

G. Timing of control measure implementation. Timing of control measure implementation shall be in accordance with the approved erosion control plan if such plan is required. At a minimum disturbed areas of construction sites that will not be redisturbed for twenty-one days or more will be stabilized (grasses or graveled) by no later than the fourteenth day after last disturbance.

H. The use of soil as fill is prohibited within any shoreline area, as defined by chapter 205A-41, Hawaii Revised Statutes, except for sand as defined in section 20.08.020

I. Any grading of a coastal dune within the shoreline area or a frontal dune, is prohibited except that sand may be imported and placed on the area of the coastal dune mauka of the shoreline, with a grading permit required by section 20.08.040 for the purposes of rebuilding or enhancing the protective capacity and environmental quality of the coastal dune.

J. Upon prior approval of the director, sand that is blocking a drainage outlet may be removed to the minimum depth necessary to allow for the passage of flood waters. Any sand removed shall be placed on the adjacent shoreline.

(Ord. 3135 § 6, 2003: Ord. 2684 § 5, 1998)

20.08.060 Grading permit submittal requirements.

Each application for a grading permit shall also be accompanied by plans and specifications, including:

A. A plot plan and grading plan showing the location of the grading limits, property lines, best management practices to prevent erosion and sedimentation to the maximum extent practicable, neighboring public ways, sufficient dimensions and other data, for example photographs, to show the location of all work; details and location of existing and proposed land drainage patterns, drainage structures, drainage pipes, and retaining walls; and any other information as may be required by the director to carry out the purposes of this chapter.

B. Erosion control plan, and drainage plan and report. In the event the graded area is more than one acre or in the event a proposed cut or fill is greater than fifteen feet in height, an erosion control plan and a drainage plan and report shall be submitted with the plot plan. The erosion control plan and the drainage plan and report shall be prepared by an engineer.

   1. Erosion control plan. The erosion control plan shall employ best management practices to the maximum extent practicable to prevent or reduce pollutants from water bodies, including sediment and other contaminants, in discharges from a construction site. The erosion control plan shall include drawings with notes and details on the bmps to be implemented for the project, pursuant to section

20.08.035, minimum bmps. The erosion control plan shall address the following to the extent applicable:

a. Stabilization of denuded areas;
b. Protection/stabilization of soil stockpiles;
c. Permanent soil stabilization;
d. Establishment and maintenance of permanent vegetation;
e. Protection of adjacent properties and water bodies;
f. Sediment trapping measures;
g. Sediment basins;
h. Cut and fill slopes (terracing);
i. Stormwater management;
j. Sequence of construction operations, including phased and successive development projects;
k. Stabilization of waterways and outlets;
l. Storm sewer inlet protection;
m. Control of access and vehicular movement;
n. Vehicular control on residential lots during construction;
o. Working in or crossing watercourses;
p. Underground utility construction;
q. Timely installation of permanent erosion and sediment control;
r. Maintenance of erosion control facilities;
s. Protection of existing vegetation; and
t. Dust control.

2. Drainage plan and report. The drainage plan and report shall provide hydrologic and hydraulic calculations and information in accordance with title 15, "rules for the design of storm drainage facilities in the County of Maui," and revisions thereof, and other standards approved by the department of public works. The potential effects of the water runoff from the entire area covered by the permit on lower lying housing, businesses and other developments, and on water bodies, shall be included in the drainage plan and report.

C. Engineer's soils report. In the event a proposed cut or fill is greater than fifteen feet in height, or in the event any fill is in the water, including wetlands and streams, or in the event the fill material will be a highly plastic clay, the applicant shall submit an engineer's soils report, to include data regarding the nature, distribution, and engineering characteristics of existing soils, the subsurface conditions at the site or the presence of ground water when detected, and recommending the limits for the proposed grading, the fill material to be used and the manner of placing it, including the height and slopes of cut and fill sections. Terminology for describing soils in the engineer's soils report, insofar as practical, shall be based on the soil survey of islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, or its revisions, issued by the soil conservation service in connection with the university of Hawaii agriculture experiment station.

D. Engineering slope hazard report. If the proposed construction includes grading affecting an existing slope with a height greater than fifteen feet and with a grade steeper than thirty-five percent (10H:3.5V) where such grading is located above and may adversely impact residential or other developed areas as determined by the director, the applicant shall submit an engineering slope hazard report. The report shall, at a minimum, include an evaluation of hazards posed by potential surface and subsurface ground movement to the proposed development, and an evaluation of the hazard posed to adjacent properties or existing buildings by the proposed construction. The engineering slope hazard report and construction plans shall include mitigative measures to minimize the hazards posed by potential surface and subsurface ground movement and the threat that the development poses to properties adjacent to the proposed construction. The engineering slope hazard report shall also include a plan for re-vegetation of all disturbed and exposed slopes. The director may require additional mitigative measures as conditions of the permit.

E. Responsibility. The permittee and the property owner shall be responsible for construction, installation, and maintenance of structural and nonstructural bmps at construction sites in accordance with the approved erosion control and drainage plans. The adequacy of bmps employed, the implementation of corrective action, if needed, and the cost thereof, shall be the responsibility of the permittee and the property owner.

(Ord. No. 3895, § 3, 2011; Ord. 2684 § 8, 1998; Ord. 816 § 1 (part), 1975; prior code § 24-2.2(b))

From:	Danielle Jayewardene- NOAA Affiliate <danielle.jayewardene@noaa.gov>
Sent:	Tuesday, November 12, 2013 4:57 PM
To:	Wayne.KANESHIRO@dot.gov
Cc:	darell.young@hawaii.gov; Rory@westmauiland.com; Mark Roy; Gerry.Davis@noaa.gov
Subject:	NMFS final EFH comments re the Lahaina Bypass project on Maui

Hi Wayne,

I hope this e-mail finds you well. I have not yet been able to track down the hard-copy of the EFH consultation request package that you shared with me electronically as per below 10/10/13 e-mail. I have however, reviewed the electronic copy, which is sufficient in this case to provide our NMFS comments for the project pursuant to the Essential Fish Habitat (EFH) provision §305(b) of the Magnuson Stevens Fishery Conservation and Management Act (MSA;16 U.S.C. 1855(b)).

Based on a) the proposed project i.e. relocation of the Lahaina Bypass Southern Terminus on Maui being land-based with road construction occurring generally away from shoreline; b) EFH being present outside of and away from the direct project construction footprint; and c) the implementation of best management practices (BMP's) to avoid impact to EFH, we determine that the subject mentioned action *would not adversely affect EFH.*

To ensure that potential indirect and cumulative impact to coral reef resources and EFH is avoided/minimized, NMFS does recommend that the US Department of Transportation Federal Highway Administration and Hawaii State Department of Transportation reiterate to the contractor that they should ensure that each of the BMPs proposed in Appendix 1 and 3 in the 10/8/2013 EFH assessment are successfully implemented and monitored for effectiveness throughout the construction period. If BMPs are found to be ineffective, the contractor should halt construction and re-initiate construction only when effective BMPs have been implemented.

Thank you again for effectively working with us to complete your EFH consultation for this project. Don't hesitate to contact me should you have any further comments or questions.

Aloha,
Danielle

On 11/4/2013 10:22 AM, Danielle Jayewardene- NOAA Affiliate wrote:

> Hi Wayne,
>
> Thanks, and sorry for my slow response: yes was out then on annual leave so just got back to the office today. I have yet to sift through my many e-mails and mail but will keep a look out for the letter you attached and get back to you as soon as I can. If you don't hear from me and need to get a hold of me soon, please feel free to call me at 944 2162.
>
> Thanks,
> Danielle

From: Danielle Jayewardene - NOAA Affiliate [mailto:danielle.jayewardene@noaa.gov]
Sent: Wednesday, October 14, 2015 9:56 AM
To: Takara, Richelle (FHWA)
Subject: Re: Proposed Relocation of the Lahaina Bypass Southern Terminus - question

Hi Richelle,

Thanks for following up. Confirming as per my conversation with H-DOT that we have no objection to the change in design criteria given H-DOT's explanation that this will not change the determination re impacts to EFH.

Aloha,
Danielle

On Tue, Oct 13, 2015 at 1:40 PM, <Richelle.TAKARA@dot.gov> wrote:
Danielle:

Back in September/October 2013, FHWA and NOAA exchanged correspondence regarding the subject project. In the project description (page 3 of the pdf entitled Lahaina Bypass EFH to NMFS) we state "The culverts will be designed to accommodate 100-year flood flows…."

The Hawaii DOT standard design criteria for culverts is actually to accommodate a 50-year flood flow. The "100-year" was a typo.

We believe that this change in the project does not change our determination that the proposed action "would not adversely affect EFH."

We want to make sure you concur with our determination and to understand the process that needs to be followed to make this change.

Thank You!!!

Richelle M. Takara, P.E.
Transportation Engineer
FHWA Hawaii Division
300 Ala Moana Blvd. Rm 3-306 | BOX 50206 | Honolulu, HI 96850
(o)808.541.2311 | (c)808.223.4310

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Danielle Jayewardene Ph.D.
Coral Reef Ecologist
NOAA PIRO Habitat Conservation Division
1845 Wasp Blvd., Building 176
Honolulu, HI 96818
Ph 808-725 5088

APPENDIX M.

2009 Traffic Impact Analysis Report

TRAFFIC IMPACT ANALYSIS REPORT

for

The Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway

Prepared for:
Makila Land Company, LLC.

November 2009

Prepared By
SSFM INTERNATIONAL, INC.
Project Managers, Planners, & Engineers

501 Sumner Street, Suite 620
Honolulu, Hawai'i 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: contact_us@ssfm.com

TRAFFIC IMPACT ANALYSIS REPORT
FOR
THE PROPOSED RELOCATION OF THE SOUTHERN TERMINUS OF THE LAHAINA BYPASS HIGHWAY

LAHAINA, HAWAI'I

November 2009

PREPARED FOR:

Makila Land Company, LLC.

PREPARED BY:

SSFM International Inc.
501 Sumner Street, Suite 620
Honolulu, Hawai'i 96817

NO. 12356-C

This work was prepared by
me or under my supervision

Darin K. M. Leong
Licensed Professional Engineer
Certificate Number 12356-C
Expires: April 2010

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On Ramp Merger Worksheets

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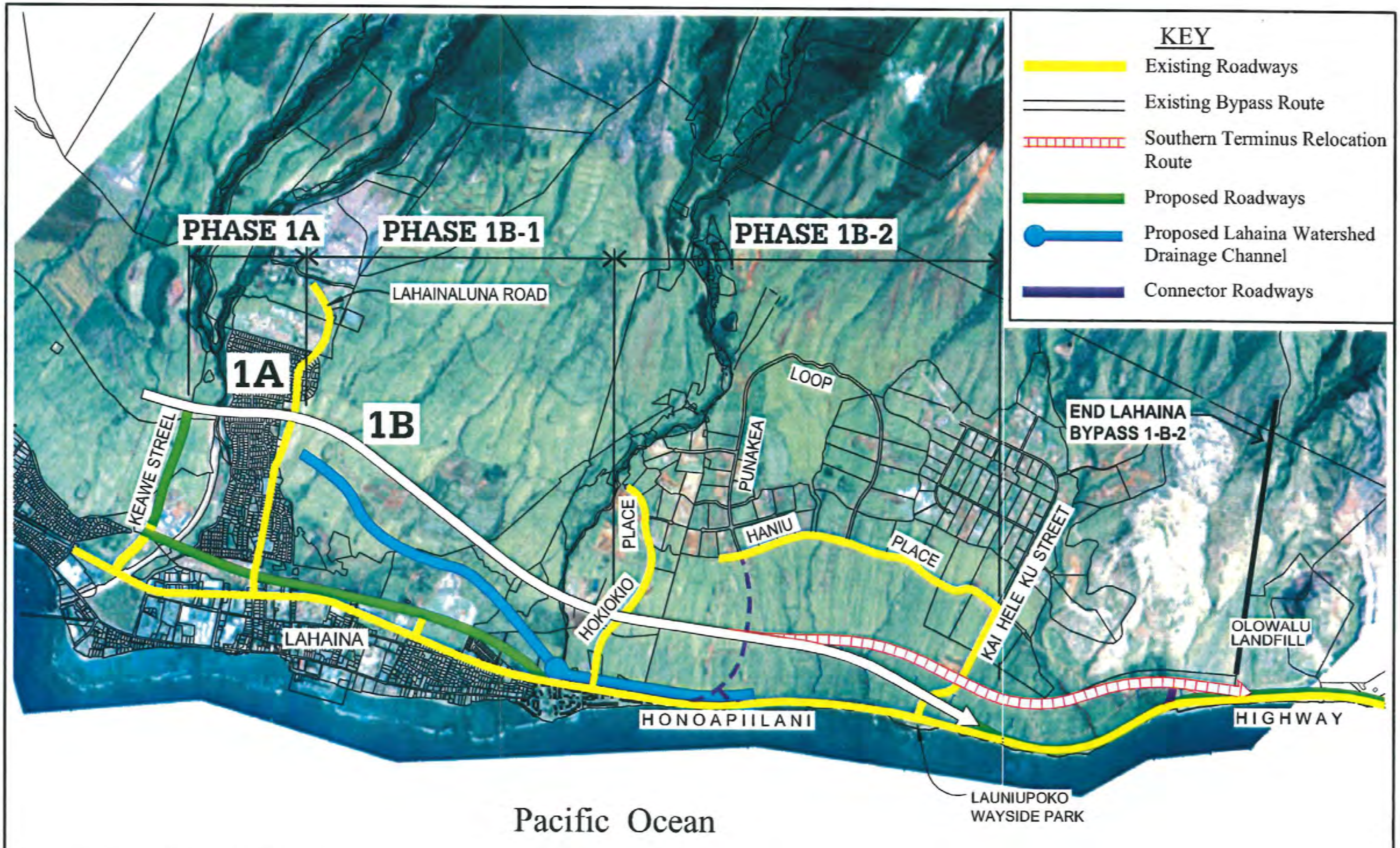
TRAFFIC IMPACT ANALYSIS REPORT
FOR THE PROPOSED RELOCATION OF THE SOUTHERN TERMINUS
OF THE LAHAINA BYPASS HIGHWAY

I. PURPOSE AND METHODOLOGY OF STUDY

The State of Hawaii Department of Transportation (HDOT), in coordination with the Federal Highway Administration (FHWA), is proposing the relocation of the southern terminus of the Lahaina Bypass from its currently approved location south of Launiupoko Beach Park to the vicinity of the former Olowalu Landfill site. The proposed terminus would be shifted to the south by approximately 4,800 feet as shown on Figure 1. The basic configuration of the Lahaina Bypass in terms of functional traffic flow would not change. Two alternative routes have been proposed whose routes would terminate at the same location, just north of the former Olowalu Landfill.

This study was conducted to analyze the traffic impacts of the proposed project in the planning years 2020 and 2035 and recommend conceptual designs for five intersections. Traffic forecasts were developed for both planning years and assigned to the study networks. A level of service analysis was conducted on the conceptual designs to identify traffic impacts and develop mitigating measures. The study area limits were the proposed Puamana Connector as the northern boundary and the southern terminus of the bypass highway with Honoapi'ilani Highway near Olowalu.



Source: Warren S. Unemori Engineering, Inc.

FIGURE 1

Proposed Lahaina Bypass Southern Terminus Relocation

Intial Construction Phases for the Lahaina Bypass

SCALE: 1 IN. = 3000 FT.
Prepared For: State of Hawaii, Department of Transportation

II. PROJECT BACKGROUND

The HDOT has been planning and implementing a wide range of transportation projects to mitigate the current and forecast traffic congestion on West Maui. They have used the recommendations of the Maui Long-Range Land Transportation Plan (February 1997) as a guide in implementing improvements. Two key components of the plan include the widening of Honoapli'ilani Highway and the implementation of the Lahaina Bypass Highway. The HDOT has completed the widening of Honoapli'ilani Highway from Kaanapali Parkway to Honokowai Stream and the modernization and synchronization of nine traffic signals from Leiali'i Parkway to Shaw Street. They have completed the final design for widening the highway from Dickenson Street to Aholo Road and construction was initiated in October, 2009

The HDOT initially proposed a Lahaina Bypass route between Puamana and Kaanapali. The widening of Honoapli'ilani Highway from Kaanapali to Honokowai was part of this action. The Record of Decision (ROD) for the Environmental Impact Statement (EIS) of this initial project was approved by the FHWA in June, 1991.

The HDOT subsequently modified the project to extend the northern terminus for the bypass route from Kaanapali to Honokowai and to extend the southern terminus from Puamana to Launiupoko. The amended project included several connector and access roadways, and was referred to as the Lahaina Bypass Modified Project in the Supplemental EIS. The ROD for the Final Supplemental EIS was approved by the FHWA in October 2003. The HDOT is now implementing the Lahaina Bypass Highway in phases. The design-build contract for Phase 1A from Keawe Street Extension to Lahainaluna Road was awarded in January 2007 and the two year construction phase began in January 2009. The design contract for Phase 1B-1 from Lahainaluna Road to Hokiokio Place is estimated for completion in late 2009, with the three year construction phase expected to begin in mid 2010. Design and construction of later phases will follow.

A long range goal of HDOT is to provide additional corridor capacity in West Maui to meet the region's rapid population growth. The Lahaina Bypass Highway is a key project to reaching this goal. Since completion of the ROD in 2003, the HDOT in coordination with the FHWA, is proposing the relocation of the southern terminus of the Lahaina Bypass from Launiupoko to the vicinity of the Olowalu Landfill about 4,800 feet to the south. The proposed action complements the HDOT's ongoing Honoapi'ilani Highway Widening/ Realignment, Maalaea to Launiupoko project, which is studying options for providing needed highway capacity between these two points. The project objectives could be achieved either via widening or realignment of the highway, including a new inland alignment between the Pali and Launiupoko. The proposed relocation of the southern terminus advances the objectives of the current study by establishing a viable point of connection for the next phase of work.

III. PROPOSED ALTERNATIVES

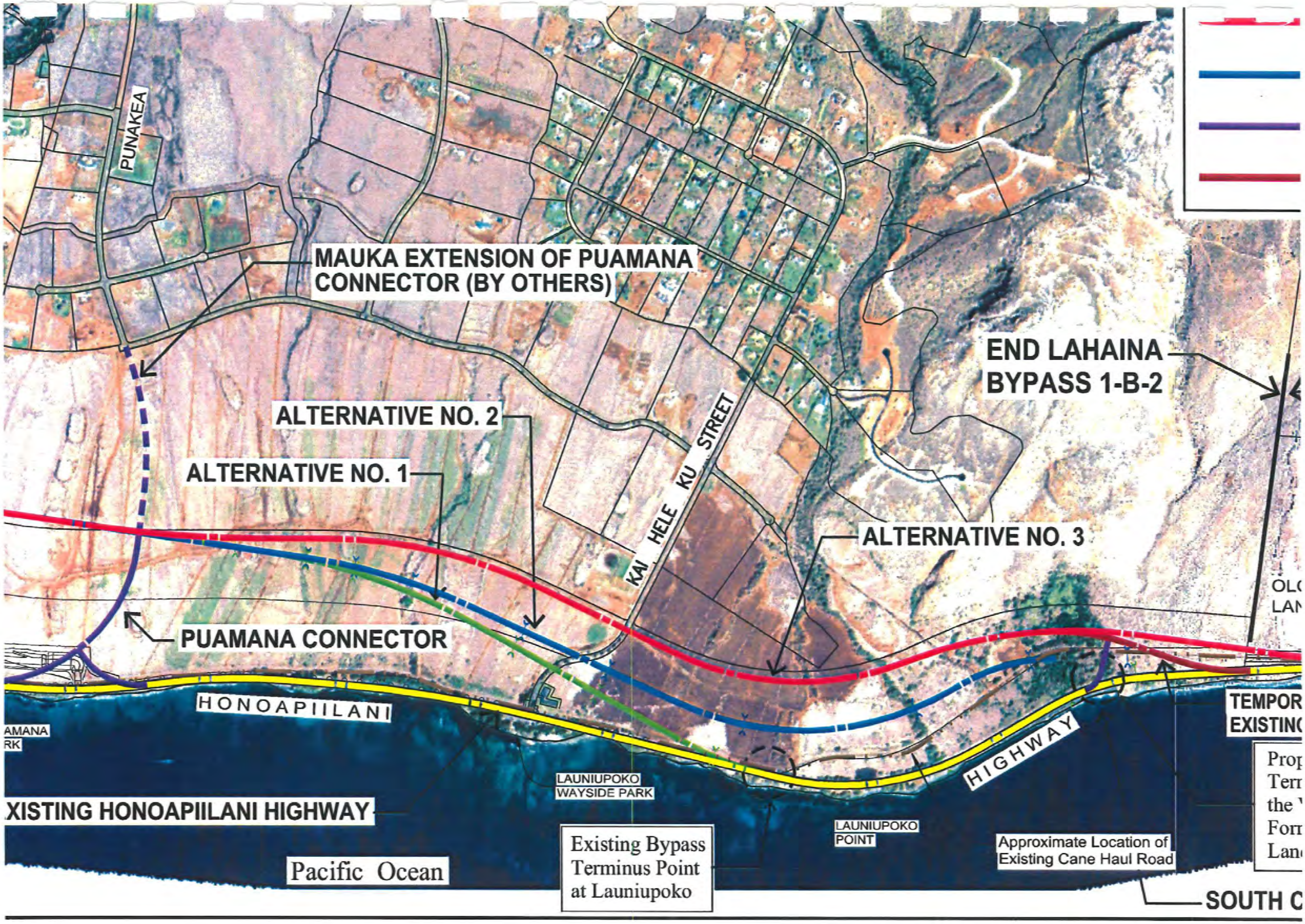
Three alternative alignments for the southern terminus of the Lahaina Bypass Highway have been proposed:

1. The approved alignment intersects Honoapi'ilani Highway south of the Launiupoko Wayside Park.

2. The County proposed Pali to Puamana (P2P) alignment is approximately midway between the mauka alignment and existing highway and continues south on a mauka alignment to Ma'alaea. For the purposes of this study, it would intersect Honoapi'ilani Highway north of the former Olowalu landfill.

3. The preferred mauka alignment intersects Honoapi'ilani Highway in the vicinity of the former Olowalu Landfill in the same location as alternative number 2.

The three alternative alignments are shown on Figure 2. Alternative numbers 2 and 3 would require relocating the southern terminus of the Lahaina Bypass Highway from its currently approved location by Launiupoko Beach Park to about 4,800 feet south. This relocation would result in a more inland alignment for the southerly segment of roadway. There would be no additional intersections or connector roads with the proposed relocation, and no changes in terms of functional traffic flow. The mauka alignment of alternative number 3 would intersect with Kai Hele Ku Street at a location that provides better design features with Kai Hele Ku Street compared to the first two alternative alignments.



Proposed Lahaina Bypass Southern Terminus Relocation

IV. HIGHWAY NETWORK DESCRIPTION

The entire Lahaina Bypass Highway would be completed as a two-lane highway from its northern terminus in Honokowai to its southern terminus by year 2020. The bypass highway would be widened to four lanes by year 2035. It should be noted that the 2003 ROD stated, "A four (4) lane wide Lahaina Bypass Road between Launiupoko and Honokowai, will be required to accommodate the Year 2020 Traffic Projections with the planned roadway projects and the known developments." The ideal (maximum) capacity of a two-lane highway is about 1700 vehicles per lane each way and 3200 vehicles per hour for both lanes, per the Highway Capacity Manual (2000) published by Transportation Research Board. These highway lane capacities were assumed for the 2020 study network.

This study indicated the need for four highway lanes in the study area in 2020. Two assumptions were made in order to provide four lanes of highway capacity in 2020. First, it was assumed that the existing section of Honoapiilani Highway between the Puamana Connector and the southern terminus would remain in operation. Also, it was assumed that the section of Honoapi'ilani Highway south of the southern terminus would have four lanes. These assumptions are discussed in further detail below.

The HDOT and County of Maui had planned to convert the current section of Honoapi'ilani Highway between the Puamana Connector and the south terminus of the bypass highway into a local recreational roadway when the bypass highway is completed and not allow through traffic. This was to enhance coastal recreational opportunities and to mitigate coastal erosion problems. For the purposes of this study, this section of highway was assumed to remain in operation until the bypass highway was expanded to four lanes in 2035 to provide four highway lanes in the study area.

The section of Honoapi'ilani Highway south of the bypass highway southern terminus is planned as having two lanes in 2020. This study assumed that a portion of the current highway immediately south of bypass highway intersection would be widened to four lanes by 2020 to accommodate the traffic volumes forecast for this study. If the highway were not widened, there would be long periods of congested traffic flows through the day. The volume of northbound traffic reaching the bypass highway would be constrained by the capacity of the two lane highway and would be lower than the volumes shown in these forecasts. Similarly, southbound traffic would back up from the two lane section into the bypass highway and create lower traffic volumes than forecast.

The current Honoapi'ilani Highway Widening/ Realignment, Maalaea to Launiupoko project, is indicating the need for six highway lanes passing through mountainous terrain within their study area in 2035. This capacity could be provided with one six-lane facility or two or more separate facilities. This finding also implies that the two-lane section of Honoapi'ilani Highway between the Puamana Connector and the southern terminus would need to remain open. This study found that the four lane bypass highway passing through rolling terrain would provide sufficient capacity within this study area. Two alternative highway networks were developed for 2035 to account for this difference of findings. The baseline network assumed four highway lanes in the study area while the alternative provided six lanes of highway north of the southern terminus, which assumed that Honoapi'ilani Highway would remain open between the Puamana Connector and the southern terminus. It was assumed that the section of the Lahaina Bypass Highway between the Puamana Connector and southern terminus would have a 55 mile per hour (mph) design speed, the same as for Phase 1B-1 of the bypass.

The Puamana Connector would be a new mauka-makai roadway providing access between the bypass highway and the portion of Honoapi'ilani Highway entering Lahaina town from the south. The general location of the makai intersection of this new roadway would be in the vicinity of the Puamana Beach Park. The Puamana Connector would be extended mauka of the bypass highway to provide access to existing and proposed mauka development. The 2003 ROD indicated that this roadway "would be constructed by others." It was assumed that the section of the Puamana Connector below the bypass and the section of Honoapi'ilani Highway north to Lahaina would also have a 55 mph design speed.

The two alternative routes which are being considered for the Puamana Connector are identified on Figure 2. The north alternative would align with Hokiokio Place that serves a mauka community of about 25 parcels. Punakea Loop would have to be extended makai to connect with Honoapi'ilani Highway to provide access for new residential units planned for that mauka area. From Honoapiilani Highway vehicles from Punakea Loop could access the Puamana Connector at Hokiokio Place. Punakea Loop would pass beneath the bypass highway and not intersect with it. The second alternative would align the connector road with Punakea Loop and serve most of the new proposed housing in the mauka area. A connector roadway would have to be built between Hokiokio Place and Punakea Loop mauka of the bypass highway so that the residents in the former subdivision could reach the connector roadway. Only one of the alternatives can intersect the access-controlled bypass highway due to their proximity to each other.

This study prepared network-wide traffic forecasts assuming the Punakea Loop alignment for the Puamana Connector since it is forecast to handle the higher volume of traffic. A supplemental analysis included only the two intersections of the Pumana Connector with the Hokiokio Place alignment. Although both alternative networks would have different volumes at each intersection, the differences would be greatest at these two intersections. The supplemental analysis limited its scope to the year 2020 forecast and year 2035 forecast with 33% diversion for comparison purposes.

Kai Hele Ku Street currently intersects Honoapi'ilani Highway as a signalized intersection. The mauka segment of this private roadway serves several mauka communities while the segment makai of Honoapi'ilani Highway serves the Launiupoko Wayside Park. The proposed bypass highway would create a new intersection on the mauka segment of Kai Hele Ku Street for all 2020 and 2035 alternatives. The mauka alignment (Alternative 3) of the bypass roadway would intersect with Kai Hele Ku Street at a location that provides for better design features with Kai Hele Ku Street compared to the approved (Alternative 1) or the P2P (Alternative 2) alignments.

The five study intersections of the preferred mauka alternative are identified on Figure 2:

1. Lahaina Bypass Highway and Honoapi'ilani Highway (south)
2. Lahaina Bypass Highway and Kai Hele Ku Road
3. Lahaina Bypass Highway and Puamana Connector
4. Honoapi'ilani Highway (north) and Puamana Connector
5. Honoapi'ilani Highway and Kai Hele Ku Street

V. TRAFFIC FORECASTING METHODOLOGY

Traffic forecasts were prepared for the preferred mauka alignment for the morning and afternoon peak hours of the years 2020 and 2035. The first study year is the expected completion of the entire bypass highway as a two-lane highway and the second year is its completion as a four-lane highway. A single set of traffic assignment forecasts was made for the preferred mauka alternative. A subsequent analysis indicated that all three alternatives would have very similar traffic forecasts and that one set of forecasts was sufficient.

Austin, Tsutsumi and Associates, Inc. (ATA), who prepared the traffic forecasts for the bypass highway in the ROD, prepared baseline AM and PM peak hour forecasts at the Lahaina Bypass Highway/Puamana Connector intersection for the 2035 forecast year. These traffic forecasts are for the baseline bypass highway alignment without the existing Honoapi'ilani Highway alignment between the Puamana Connector and southern terminus intersections. The year 2035 traffic assignment forecasts were based on the "Honoapiilani Highway Widening/Realignment Maalaea to Launiupoko" Draft Traffic Technical Memorandum (April 28, 2008) by CH2MHill. These AM and PM peak hour traffic forecasts assumed there were no capacity restraints on the highway system. More than half of the forecast traffic volumes would utilize the Puamana Connector to access the makai route to Lahaina town.

The year 2035 traffic forecasts were converted to year 2030 forecasts as an intermediate step to obtaining the year 2020 traffic forecasts. The year 2035 forecasts were reduced by the 5.5% to 6% factors CH2MHill had used to convert the original 2030 forecasts prepared by ATA to obtain the 2035 forecasts for their study. The year 2030 traffic forecasts were based on the 2030 population forecasts and distributions from the "Draft Maui Island Plan" (March 2008). The 2030 peak hour forecasts were then converted to year 2020 forecasts by the ratio of 2020 to 2030 West Maui population forecasts from the draft plan.

The rate of population/traffic growth in West Maui per the draft island plan is summarized below:

YEAR	WEST MAUI POPULATION	GROWTH RATIO FROM PREVIOUS YEARS
2035	--------	1.055 to 1.06
2030	28,903	1.15
2020	25,096	1.40
2000	17,967	-----

The draft island plan does not include population forecasts for 2035. CH2MHill derived the 5.5% to 6% growth rates for 2030 to 2035 based on the growth rate from 2020 to 2030. Most of the traffic growth in the West Maui area is forecast to occur by 2020. Only a relatively slight increase in traffic would occur between 2020 and 2035 as most of the available lands would be developed by 2020.

Two additions were made to the ATA baseline forecasts for this study. First, the future traffic from proposed residential units in the Makila area was included. An additional 400 units could be located in the area of Makila mauka of the bypass highway. An additional 36 units could be located in the makai area bounded by the Puamana Connector and preferred mauka bypass highway alignment. Then the highway volumes were adjusted for capacity restraints.

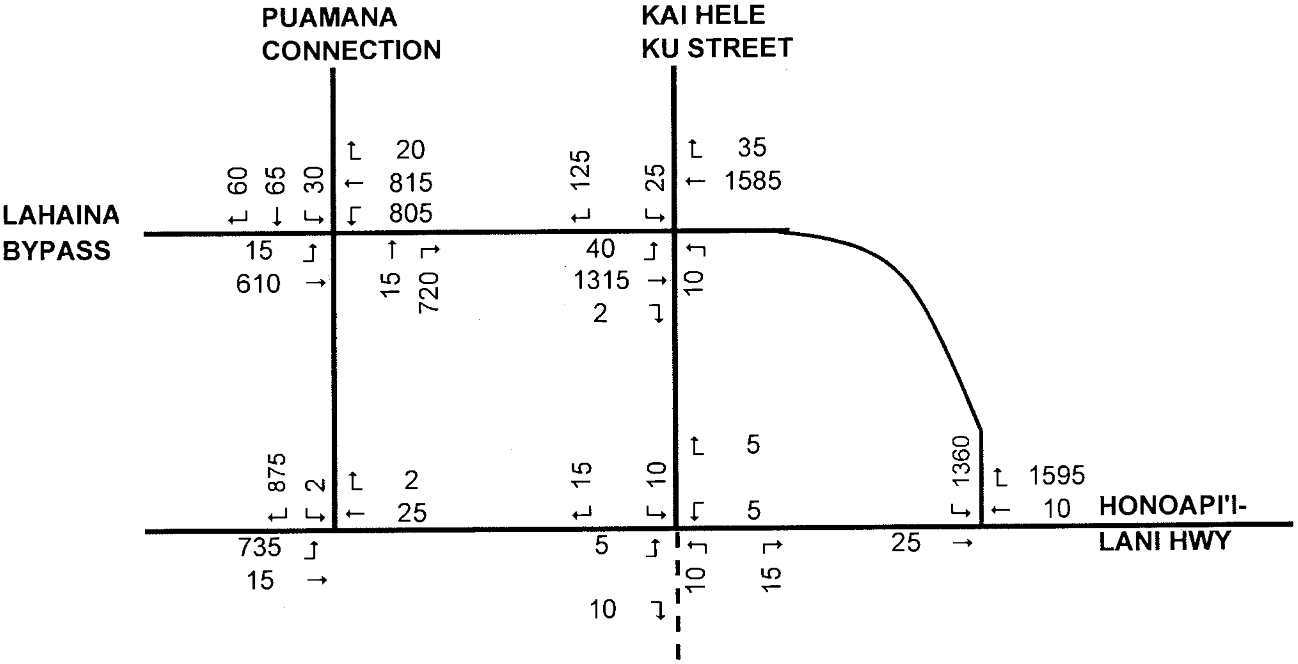
The additional trips generated by these 436 new homes were forecast using the trip generation equations for single family dwelling units from the Institute of Transportation Engineers Trip Generation Report (7th Edition, 2003). Trip distribution factors were derived from the Kai Hele Ku Street intersection turning volumes and the 2035 forecasts. It was assumed that 70% of the new mauka trips would enter the roadway system via the Puamana Connector, while the remaining 30% of trips would use Kai Hele Ku Street. These additional units were assumed to be in place by 2020 and would not increase by 2035.

Figures 3 to 7 are not-to-scale schematic maps of the proposed highway network intended to show the traffic forecast volumes. The turning movements shown at each intersection are not indicative of the proposed design of the intersection, but are used to show the hourly traffic demand volumes at each intersection. The final intersection designs would be based on the volumes of these through and turning movements.

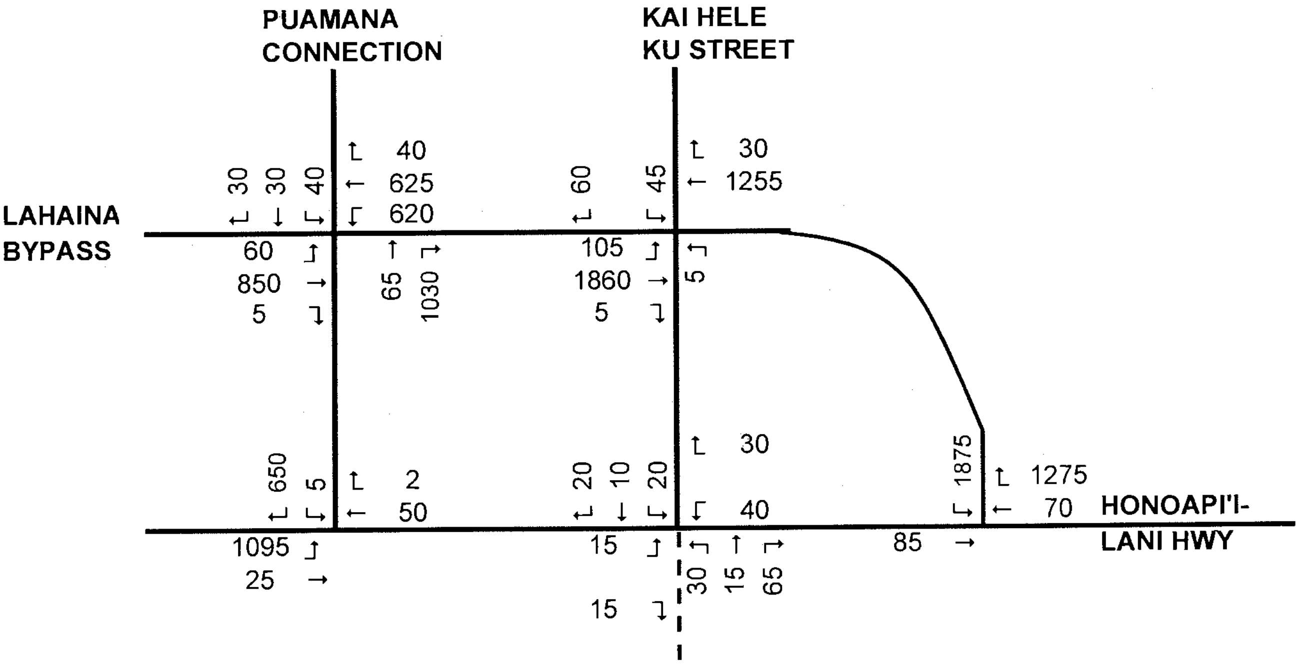
The modified baseline traffic assignments with the Makila development and without the existing highway between the Puamana Connector and southern terminus are shown on Figures 3 and 4 for years 2020 and 2035, respectively.

These modified 2020 forecasts at the Lahaina Bypass Highway and Puamana Connector intersection are compared to the peak hour volumes in the ROD as shown below:

	AM PEAK HOUR		PM PEAK HOUR	
MOVEMENT	ROD	NEW	ROD	NEW
Northbound through	1105	815	945	625
Northbound left turn	830	805	525	620
Southbound through	485	610	900	850
Eastbound right turn	855	720	1330	1030



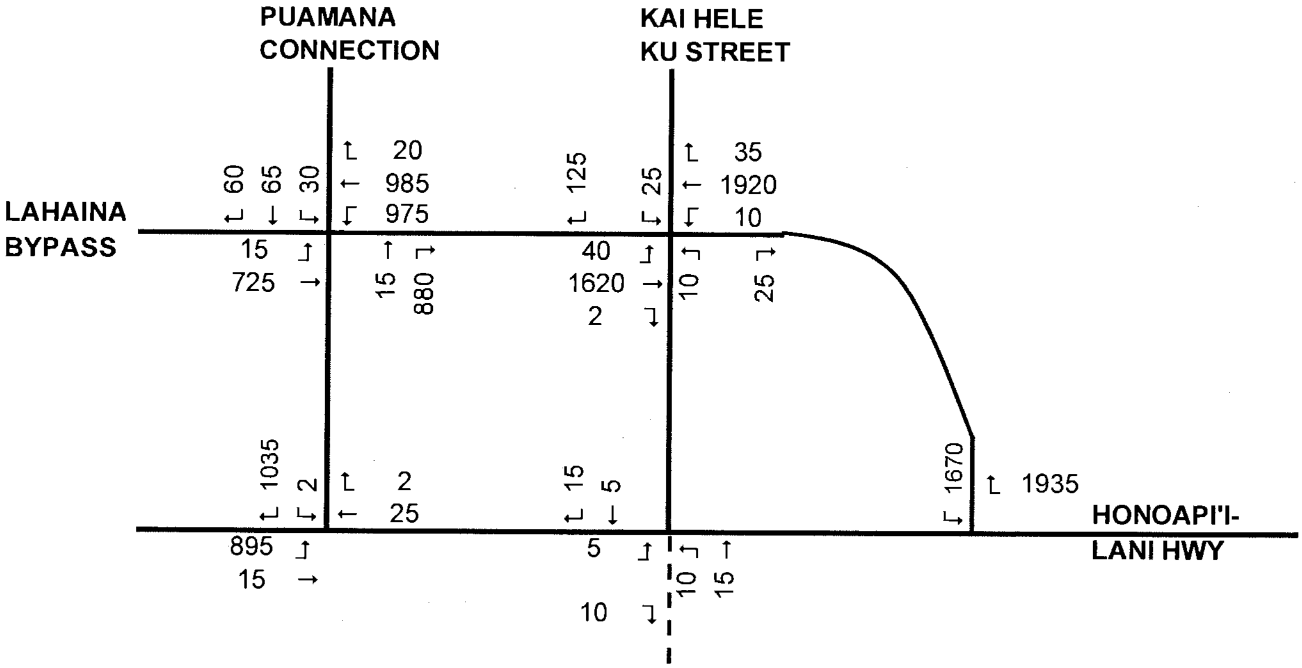
AM PEAK HOUR



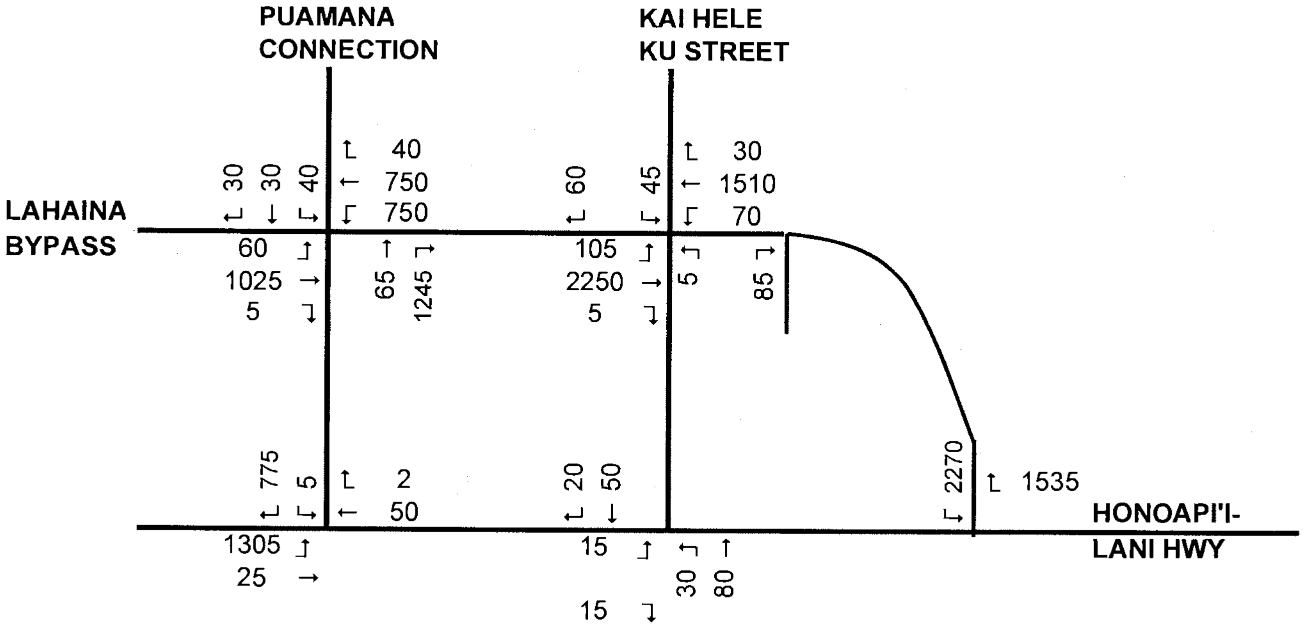
PM PEAK HOUR

NOT TO SCALE

2020 BASELINE TRAFFIC FORECAST W/ MAKILA DEVELOPMENT
FIGURE 3



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

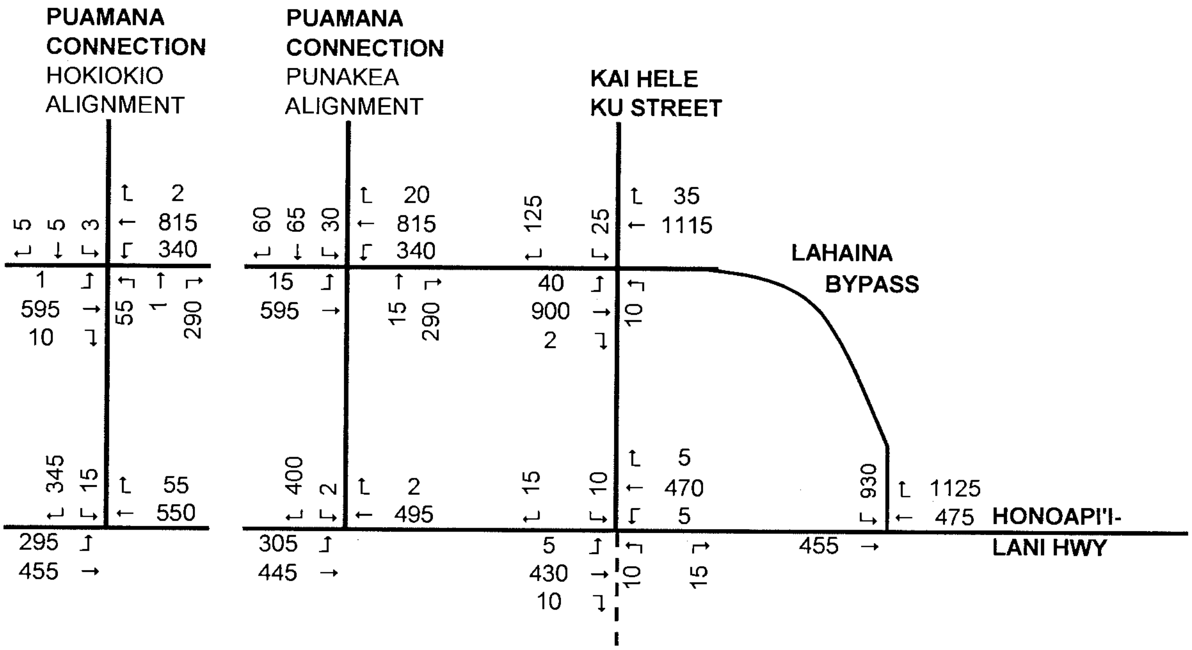
2035 BASELINE TRAFFIC FORECAST W/ MAKILA DEVELOPMENT
FIGURE 4

The new AM peak hour northbound volumes are lower than the equivalent ROD volumes, while the southbound/eastbound volumes are about equal. Both the new northbound and south/eastbound volumes in the PM peak hour are also lower than their equivalent ROD volumes.

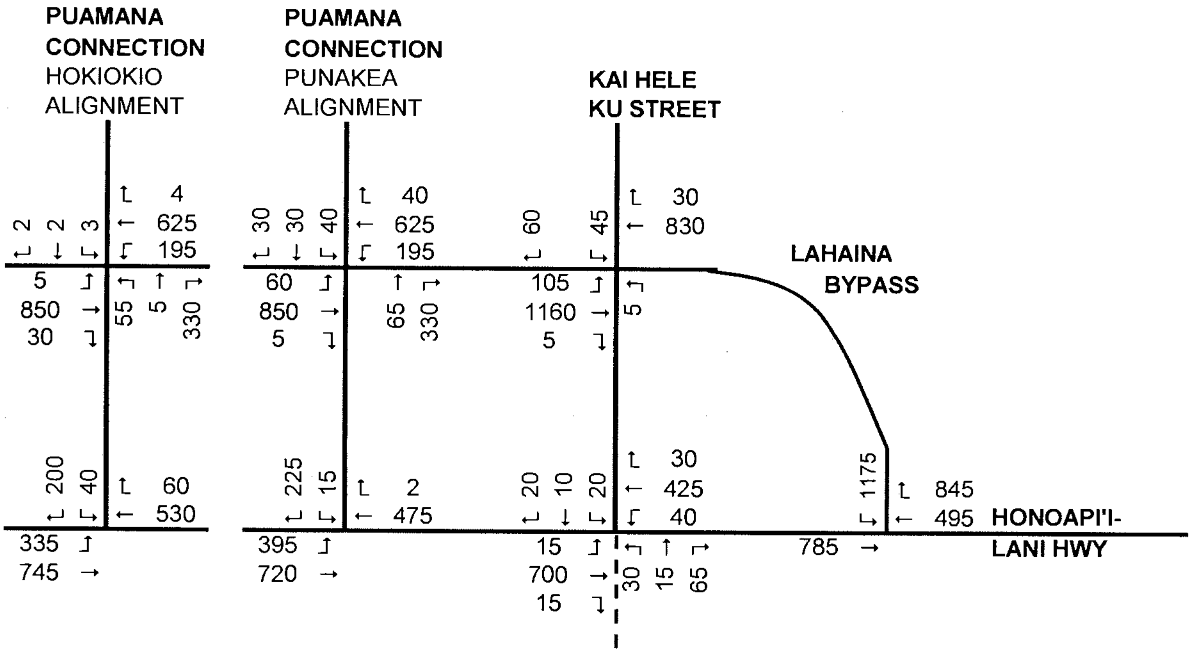
The 2020 baseline traffic forecasts exceed the two-lane bypass highway capacity between the Puamana Connector and southern terminus. Therefore, it was assumed that most of those trips that utilize the Puamana Connector (presumedly Lahaina-oriented trips) would divert to the existing Honoapi'ilani Highway alignment between these two points. It is estimated that 60 percent of these morning peak hour trips and 70 percent of the afternoon peak hour trips would need to divert to maintain similar levels of traffic operations on both the bypass highway and Honoapi'ilani Highway. The year 2020 traffic assignment forecasts constrained by highway capacity are shown on Figure 5.

The traffic forecast for the Puamana Connector along the Hokiokio Place alignment is also shown on Figure 5 to the left of the network-wide forecasts. Comparing the two sets of forecasts, the major volumes at the bypass intersection do not change while those volumes entering and leaving the mauka roadway are much smaller with the Hokiokio Place alignment. At the Honoapi'ilani Highway intersection, the traffic volumes entering and leaving the south highway leg are slightly higher with the Hokiokio Place alignment while the through (traveling between Honoapi'ilani Highway and Puamana Connector) volumes are slightly lower.

Two highway network scenarios were assumed for the year 2035. The first scenario assumed the baseline network with the section of Honoapi'ilani Highway between the Puamana Connector and southern terminus restricted to local recreational traffic. The traffic volumes for this scenario would be as shown on Figure 4, the baseline 2035 traffic forecast. The second scenario assumed that the existing section of Honoapi'ilani Highway between the Puamana Connector and the southern terminus would continue to be in service to maintain six lanes of highway capacity through this study area. Two levels of diversion, upper and lower bounds, were estimated regarding the percentage of trips that would use the makai route . It was estimated that 20 percent and 33 percent of the peak hour trips would divert to the Honoapi'ilani Highway. These low levels of diversion assume that the highway network would be designed to encourage most of the trips to utilize the bypass highway route. The year 2035 traffic assignment forecasts with 20% diversion are shown on Figure 6. The year 2035 traffic assignment forecasts with 33% diversion are shown on Figure 7. As with the year 2020 forecasts, the traffic forecast for the Puamana Connector aligned with the Hokiokio Place are also shown on Figure 7 to the left of network-wide forecasts.



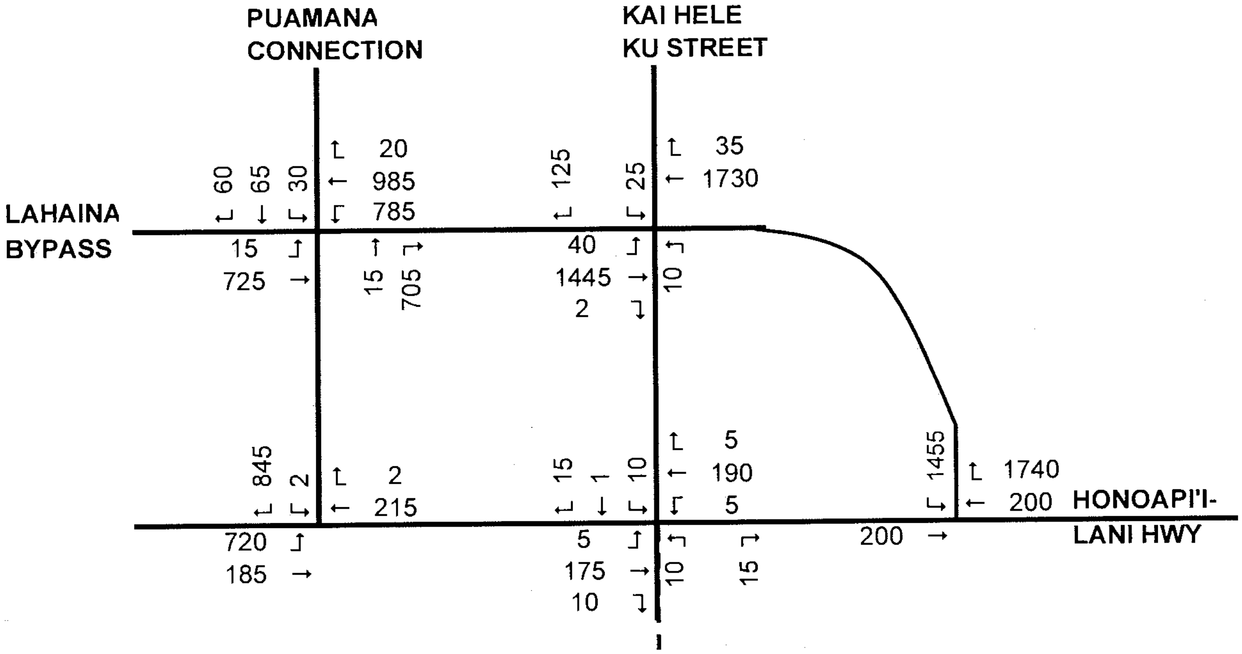
AM PEAK HOUR



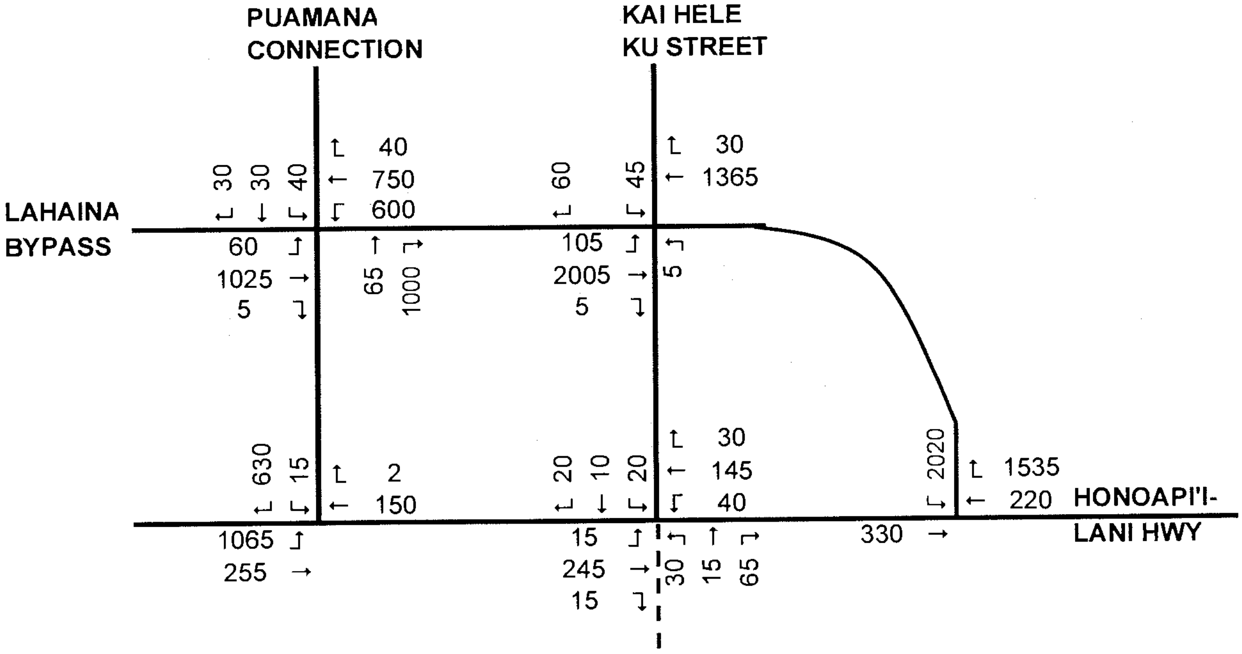
PM PEAK HOUR

NOT TO SCALE

2020 TRAFFIC ASSIGNMENT ADJUSTED FOR CAPACITY
FIGURE 5



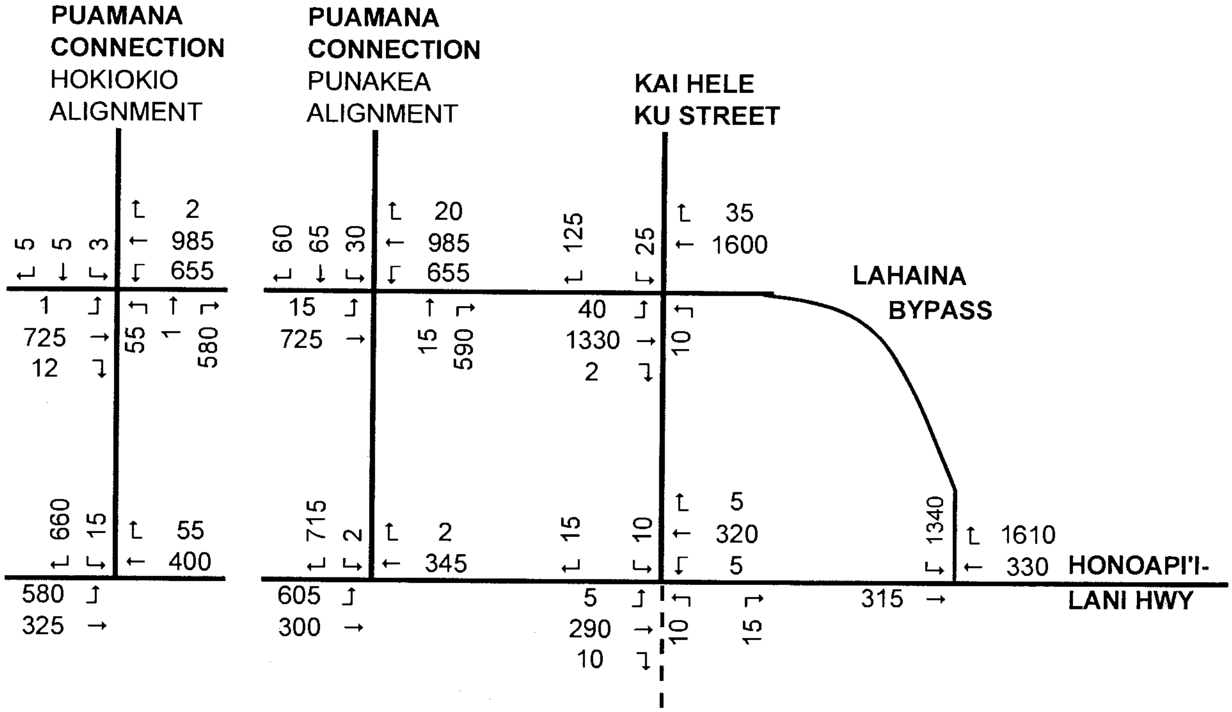
AM PEAK HOUR



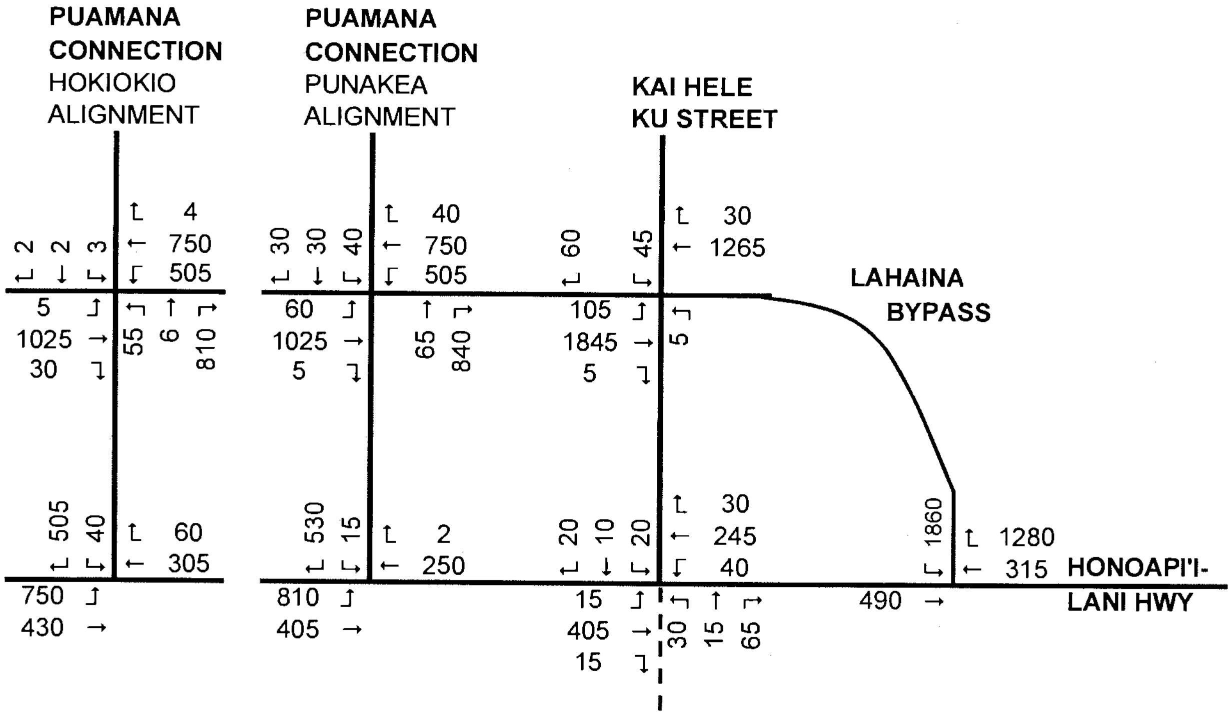
PM PEAK HOUR

NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 20% DIVERSION
FIGURE 6



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 33% DIVERSION
FIGURE 7

VI. DEVELOPMENT OF CONCEPTUAL INTERSECTION DESIGNS

Four sets of traffic forecast assignments were analyzed as the basis for developing conceptual designs for the study intersections:

- 2020 capacity constrained forecast (Figure 5)
- 2035 baseline traffic forecast (Figure 4)
- 2035 traffic forecast with 20% diversion (Figure 6)
- 2035 traffic forecast with 33% diversion (Figure 7)

For each study intersection, a level of service analysis was used to analyze the operations of an initial design. The design was then improved to mitigate unacceptable traffic conditions. The conceptual designs developed for the preferred mauka alternative would also be applicable to the other two alternative alignments since their traffic operations would not be different. In considering alternative intersection designs, roundabouts were not considered feasible since they do not conform to several guidelines set forth in the Hawaii DOT's memo on Modern Roundabouts Policy Guideline dated December 19, 2008. These non-conforming items include:

- The capacity of a single lane roundabout of 1,100 vehicles per hour is insufficient to handle the forecast volumes.
- Operating speeds through roundabouts should not exceed 35 miles per hour while the design speed of the roadways are 55 miles per hour.
- Roundabouts need not be considered when less that 10% of the traffic enters the intersection from a minor street, which is the case for several intersections.
- Roundabouts are best suited for level terrain while the bypass highway alignment is in rolling terrain.

The concept of level of service is used to quantify the quality of traffic flow on roadway facilities. The Transportation Research Board (TRB) has developed procedures to calculate level of service value(s) by measuring traffic volumes against the capacities of different types of roadway facilities. The TRB Highway Capacity Manual 2000 (HCM2000) describes the various procedures developed for freeways, highways, signalized and unsignalized intersections, etc.

Each of the five study intersections are expected to be signalized in the year 2020. The methodology for analyzing signalized intersections calculates the levels of service for individual movements, approaches and the intersection as a whole based on the average stopped delay per vehicle. The results range from level of service A (best with average delays less than ten seconds) to F (worst with average delays longer than 80 seconds). The definitions for level of service for signalized intersections are summarized below:

LEVEL OF SERVICE	SIGNALIZED INTERSECTION CONTROL DELAY (Seconds/Vehicle)
A	< 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.1

Many jurisdictions consider levels of service A to C as acceptable for areas like Maui, with levels of service E and F indicating the need for mitigating measures. For signalized intersections, the major streets can be designed to have a higher level of service than the side streets or major street turning lanes. Lower levels of service on the latter approaches can be tolerated if they permit the major street approaches to have acceptable levels of service. In many areas of the state, the traffic signal cycle lengths are increased to improve traffic flow on the main street while increasing delays and reducing levels of service on the minor side streets and movements. The results of the level of service analysis for the signalized intersections are shown on Table 1. The table shows the level of service, delay (seconds per vehicle), and volume/capacity ratio (V/C) for the morning and afternoon peak periods for both planning years. The results for each study intersection are discussed in the following paragraphs.

Several traffic movements are proposed to be made as on-ramp movements that would not be controlled by traffic signals. The HCM2000 does not have a procedure for analyzing this specific type of traffic movement. Therefore, the HCM2000 procedure for analyzing freeway on-ramp merges was utilized, realizing that the upstream traffic would be controlled by traffic signals that would leave gaps in the traffic. Hence; the actual results for the on-ramp movement can be expected to be better than calculated. The methodology for analyzing ramp merges calculates a level of service based on the density of vehicles at the merge as shown below:

LEVEL OF SERVICE	DENSITY (Pass. cars/mile/lane)
A	< 10
B	> 10 - 20
C	> 20 - 28
D	> 28 – 35
E	> 35

No density is shown for level of service F which exists when the total flow departing the merge area exceeds the capacity of the downstream segment. The procedure assumes at least two through lanes on the main highway link, which would not be the case in 2020. The results of the on-ramp level of service analysis are shown on Table 2.

The results of the level of service analyses for the signalized intersection and on-ramps are graphically summarized on Figures 8 to 12. The results for the 2020 traffic forecast are graphically summarized on Figure 8. The results for the 2035 baseline traffic forecast are shown on Figure 9. The results for the 2035 with 20% diversion traffic forecast are shown on Figure 10. The results for the 2035 with 33% diversion traffic forecast are shown on Figure 11. Figure 12 shows the levels of service for the 2035 baseline network with the recommended alternative traffic controls at two locations.

The capacity of a highway with signalized intersections is generally governed by the through capacity of the signalized intersection. For this study, the level of service for the 2035 four lane highway was also calculated using the HCM2000 procedure for multi-lane highways. The methodology for analyzing multi-lane highways calculates levels of service for different free flow speeds based on maximum density (pass. cars/mile/lane), maximum service flow rate (pass. cars/hr/lane), average speed (miles/hr) and maximum volume to capacity ratio (v/c). The HCM2000 defines levels of service for 55 miles per hour free flow speed and rolling terrain as shown below:

LEVEL OF SERVICE	AVERAGE SPEED	MAXIMUM DENSITY	MAX FLOW RATE
A	60.0	11	660
B	60.0	18	1080
C	59.4	26	1550
D	56.7	35	1980
E	55.0	40	2200

The multi-lane highway levels of service calculated for the 2035 AM and PM peak hour volumes forecast on the four lane bypass highway between the southern terminus and Kai Helu Ku Street is summarized below for several of the parameters:

	AM PEAK HOUR			PM PEAK HOUR		
SCENARIO SPEED	LOS	MAX FLOW	AVE. SPEED	LOS	MAX FLOW	AVE. SPEED
Baseline	C	1163	54.8	C	1357	54.8
20% diversion	B	1038	54.8	C	1207	54.8
33% diversion	B	959	54.8	C	1107	54.8

These results indicate that the four lane bypass highway proposed in 2035 would be adequate to handle the forecasted traffic volumes. Also, the highway operations should improve as more traffic is diverted to the makai section of Honoapi'ilani Highway.

The relationship between these results and the proposed intersection design are discussed below. It is noted that the design schematics presented in this report are conceptual. Detailed design including appropriate striping and signage will occur at later stages in the project. Detailed design also will provide for safe pedestrian and bicycle movements at all of the intersections.

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

Intersection Movement	YEAR 2020						YEAR 2035																	
							WITH NO DIVERSION						WITH 20% DIVERSION						WITH 33% DIVERSION					
	AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR		
	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Lahaina Bypass and Honoapiilani Highway																								
Intersection	C	22.4	0.63	C	25.5	0.72	NOT APPLICABLE						C	29.8	0.62	C	34.8	0.81	C	22.3	0.67	C	32.8	0.82
Bypass SB thru	B	19.4	0.62	C	23.7	0.79							C	31.3	0.94	C	34.7	0.99	C	21.4	0.81	C	31.6	0.96
Hon. Hwy NB "left"	C	28.5	0.75	C	30.2	0.79							B	19.8	0.34	D	37.0	0.57	C	26.2	0.60	D	40.3	0.71
Lahaina Bypass and Kai Hele Ku Street																								
Intersection	C	22.4	0.77	B	19.0	0.75	C	23.3	0.73	D	40.5	0.85	B	19.8	0.66	C	27.2	0.76	B	18.4	0.62	C	24.1	0.70
KHK St. EB	E	72.4	0.08	F	83.8	0.04	D	53.4	0.15	E	76.4	0.42	D	52.6	0.06	E	72.0	0.04	D	52.6	0.06	E	72.0	0.04
KHK St. WB	E	66.0		E	75.2		D	45.8		E	63.9		D	45.8		E	63.3		D	45.8		E	63.3	
Bypass NB	C	25.5		B	15.2		C	24.6		C	21.0		B	19.6		B	16.7		B	17.4		B	15.7	
Bypass SB	B	11.5		B	16.8		B	19.1		D	51.5		B	17.1		C	32.3		B	16.2		C	27.5	
left	F	91.2	0.49	F	97.4	0.65	E	67.5	0.39	F	86.5	0.60	E	67.5	0.39	F	86.5	0.60	E	67.5	0.39	F	86.5	0.60
through	A	7.8	0.64	A	9.7	0.79	B	17.8	0.74	D	50.0	1.00	B	15.6	0.66	C	29.6	0.90	B	14.6	0.61	C	24.3	0.83
Lahaina Bypass and Kai Hele Ku Street Eastbound Approach Eliminated																								
Intersection	C	21.5	0.77	B	19.9	0.75							B	16.2	0.66	B	16.8	0.69	B	15.1	0.62	B	15.9	0.64
KHK St. WB	E	66.4		E	73.9								D	44.2		E	60.7		D	45.8		E	60.7	
Bypass NB	C	25.5		B	17.5								B	19.5		B	19.5		B	17.4		B	18.4	
Bypass SB	A	10.0		B	17.3								A	9.3		B	12.9		A	8.9		B	11.8	
left	F	84.9	0.38	F	93.1	0.58							E	67.5	0.39	E	77.9	0.48	E	67.5	0.39	E	77.9	0.48
through	A	6.5	0.63	B	10.6	0.80							A	7.6	0.58	A	9.6	0.75	A	7.1	0.53	A	8.1	0.70

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

	YEAR 2020						YEAR 2035																							
							WITH NO DIVERSION						WITH 20% DIVERSION						WITH 33% DIVERSION					
Intersection	AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR		
Movement	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Lahaina Bypass and Puamana Connector (with Punakea Loop alignment)																								
	(with single north bound left turn lane)						(with double northbound left turn lanes)						(with double northbound left turn lanes)						(with double northbound left turn lanes)					
Intersection	D	42.1	0.68	D	35.6	0.75	D	45.5	0.62	D	46.6	0.63	D	40.9	0.56	D	42.2	0.58	D	37.3	0.52	D	39.3	0.55
Puamana C EB	D	48.9	0.05	D	48.0	0.26	E	69.5	0.05	E	78.4	0.24	E	69.5	0.05	E	70.8	0.22	E	59.8	0.05	E	63.3	0.21
Puamana C WB	D	48.3		D	44.7		E	72.5		E	79.0		E	72.5		E	71.3		E	62.3		E	63.6	
left/through	D	51.4	0.27	D	48.4	0.31	E	73.1	0.31	E	79.4	0.31	E	73.1	0.31	E	71.6	0.29	E	62.9	0.28	E	63.9	0.26
right	D	41.3	0.10	C	34.1	0.06	E	71.1	0.17	E	75.8	0.04	E	71.1	0.17	E	68.5	0.04	E	61.2	0.15	E	61.2	0.03
Bypass NB	D	39.7		C	25.7		D	40.5		D	40.3		C	33.1		C	34.8		C	29.2		C	31.4	
left	F	89.9	0.94	E	62.5	0.75	E	69.4	0.86	E	68.7	0.75	E	59.4	0.70	E	61.8	0.63	D	52.8	0.61	E	56.7	0.55
through	B	19.4	0.73	B	15.0	0.59	B	12.4	0.42	B	13.2	0.33	B	12.4	0.42	B	14.1	0.34	B	13.7	0.44	B	15.3	0.36
Bypass SB	D	45.1		D	43.2		D	53.2		D	51.2		D	53.2		D	47.9		D	50.3		D	45.3	
left	E	75.2	0.28	E	59.4	0.49	F	101.0	0.36	F	98.4	0.50	F	101.0	0.36	F	89.6	0.46	F	90.8	0.33	F	81.0	0.43
through	D	44.4	0.80	D	42.2	0.93	D	52.3	0.58	D	48.5	0.70	D	52.3	0.58	D	45.5	0.70	D	49.5	0.60	D	43.3	0.71
Lahaina Bypass and Puamana Connector (with Punakea Loop alignment and northbound left turn ramp)																								
Intersection							B	16.4	0.40	B	17.3	0.39	SAME RESULTS FOR ALL 2035 ALTERNATIVES											
Puamana C EB							C	32.7	0.04	D	45.9	0.17												
Puamana C WB							C	34.1		D	46.1													
left/through							C	34.4	0.21	D	46.3	0.21												
right							C	33.3	0.10	D	44.4	0.03												
Bypass NB through							B	17.6	0.54	B	18.1	0.41												
Bypass SB							B	11.3		B	12.9													
left							E	58.1	0.22	E	63.2	0.40												
through							B	10.4	0.35	A	9.9	0.45												

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

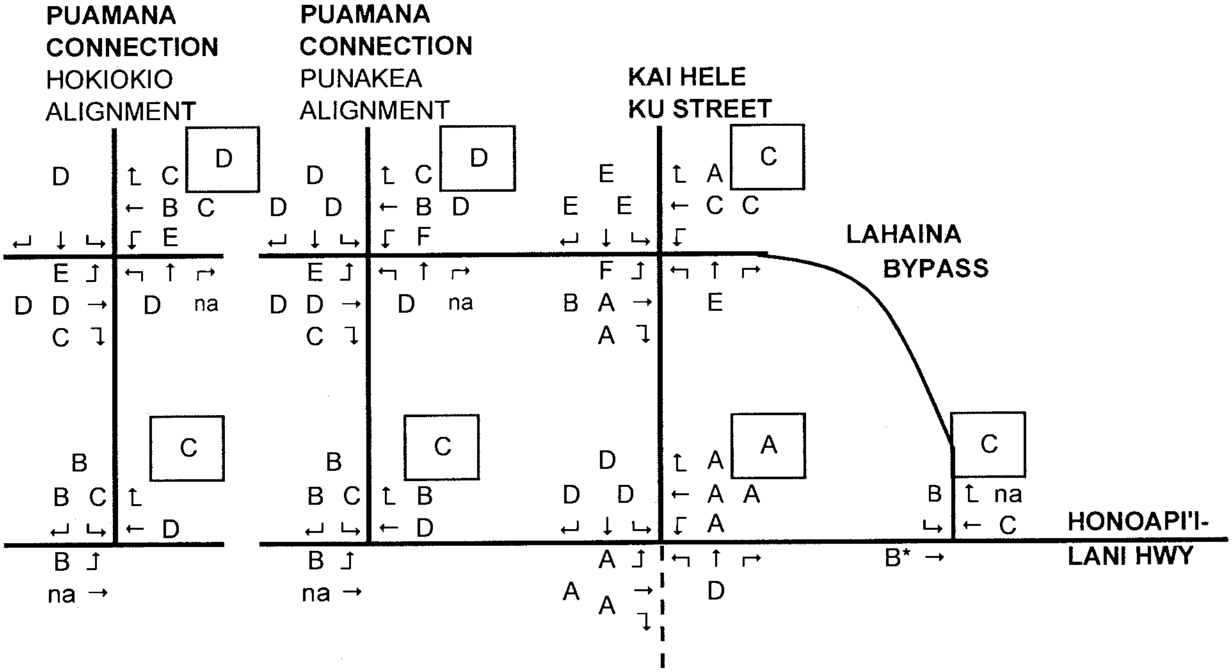
	YEAR 2020						YEAR 2035																	
							WITH NO DIVERSION						WITH 20% DIVERSION						WITH 33% DIVERSION					
Intersection	AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR		
Movement	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Lahaina Bypass and Puamana Connector (with Hokiokio Place alignment)																								
	(with single north bound left turn lane)																		(with double northbound left turn lanes)					
Intersection	D	37.4	0.67	C	34.6	0.75													C	34.1	0.5	D	35.3	0.55
Puamana C EB	D	53.3	0.24	D	48.5	0.32													E	63.7	0.24	E	65.7	0.29
Puamana C WB	D	44.0		D	42.6														E	61.4		E	62.7	
Bypass NB	C	29.8		C	26.3														C	27.0		C	29.6	
left	E	59.3	0.77	E	62.5	0.75													D	49.9	0.59	D	53.9	0.54
through	B	17.6	0.71	B	15.0	0.59													B	11.8	0.43	B	13.4	0.35
Bypass SB	D	49.5		D	41.3														D	46.5		D	40	
left	E	71.2	0.01	E	55.1	0.04													F	87.6	0.03	E	74.9	0.04
through	D	49.5	0.85	D	42.2	0.93													D	46.6	0.59	D	40.2	0.69
LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound																								
Honoapiilani Highway and Puamana Connector (with Punakea Loop alignment)																								
Intersection	C	24.6	0.59	C	33.5	0.59	B	11.8	0.68	C	34.4	0.87	B	18.0	0.68	C	29.5	0.79	C	23.1	0.68	C	27	0.75
Hon. Hwy SB	B	19.1	0.53	B	19.9	0.51	B	14.6	0.82	D	51.7	1.05	B	17.6	0.77	D	39.4	0.97	C	21.7	0.74	C	30.8	0.9
Puamana Con WB	B	13.3		B	14.5		A	8.9		A	4.1		B	12.3		A	8.5		B	16.0		B	10.2	
left	C	30.7	0.02	D	48.6	0.21	C	33.2	0.02	D	54.8	0.09	D	38.2	0.02	E	56.2	0.25	D	40.7	0.02	D	53.7	0.24
through	B	13.2	0.50	B	12.1	0.24	A	8.8	0.81	A	3.7	0.57	B	12.3	0.76	A	7.2	0.52	B	15.9	0.73	A	8.9	0.47
Hon. Hwy NB left	D	37.3	0.89	D	54.4	0.92	C	33.7	0.24	E	56	0.47	D	41.7	0.74	D	49.8	0.59	D	40.3	0.8	D	50.2	0.74
Honoapiilani Highway and Puamana Connector (with Hokiokio Place alignment)																								
Intersection	C	27.0	0.59	C	35.9	0.60													C	30.2	0.72	C	30.5	0.71
Hon. Hwy SB	C	21.2	0.53	C	29.4	0.51													C	24.7	0.75	C	33.3	0.85
Puamana Con WB	B	15.2		C	23.8														B	18.3		B	15.9	
left	C	33.0	0.13	D	54.9	0.34													D	43.5	0.17	E	57.4	0.35
through	B	14.5	0.46	B	17.4	0.24													B	17.7	0.71	B	12.5	0.48
Hon. Hwy NB left	D	37.8	0.90	D	45.1	0.85													D	55.0	0.93	D	49.6	0.73
Honoapiilani Highway and Kai Hele Ku Street																								
Intersection	A	7.9	0.34	B	11.9	0.61	NOT APPLICABLE						NOT APPLICABLE						A	8.7	0.25	B	10.8	0.42
Kai Hele Ku St EB	D	38.3		D	43.2														C	31.0		C	27.1	
Kai Hele Ku St WB	D	38.4		D	38.9														C	31.0		C	26.6	
Hon. Hwy NB	A	6.6		A	6.1														A	6.9		A	6.9	
Hon. Hwy SB	A	6.4		A	9.1														A	6.8		A	8.6	

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

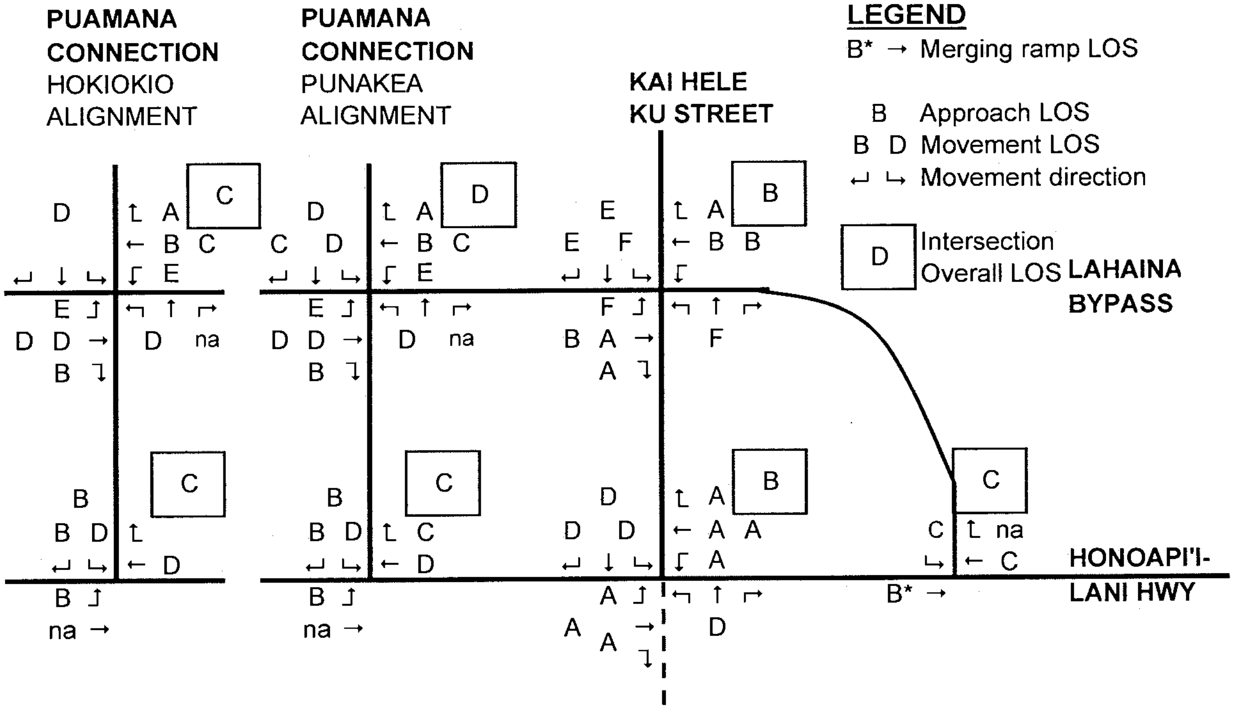
TABLE 2
ON-RAMP LEVEL OF SERVICE SUMMARY

Intersection	YEAR 2020				YEAR 2035											
					WITH NO DIVERSION				WITH 20% DIVERSION				WITH 33% DIVERSION			
	AM PEAK		PM PEAK		AM PEAK		PM PEAK		AM PEAK		PM PEAK		AM PEAK		PM PEAK	
Movement	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.
Lahaina Bypass and Honoapiilani Highway																
Hon. Hwy SB on-ramp	B	14.4	B	19.4	B	17.4	C	25.5	B	16.9	C	23.0	B	16.9	C	23.0
Lahaina Bypass and Kai Hele Ku Street Michigan U turn																
Kai Helu Ku WB on-ramp	NOT APPLICABLE				C	22	B	18.3	C	20.2	B	16.3	B	19.0	B	15.4
Left turn ramp to LBH SB	NOT APPLICABLE				B	19.7	C	26.6	B	18.1	C	23.8	B	17.0	C	22.3
Lahaina Bypass and Puamana Connector																
Puamana Conn EB on-ramp	NOT APPLICABLE				B	17.1	C	23.1	B	15.5	C	21.0	B	14.5	B	19.6

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound



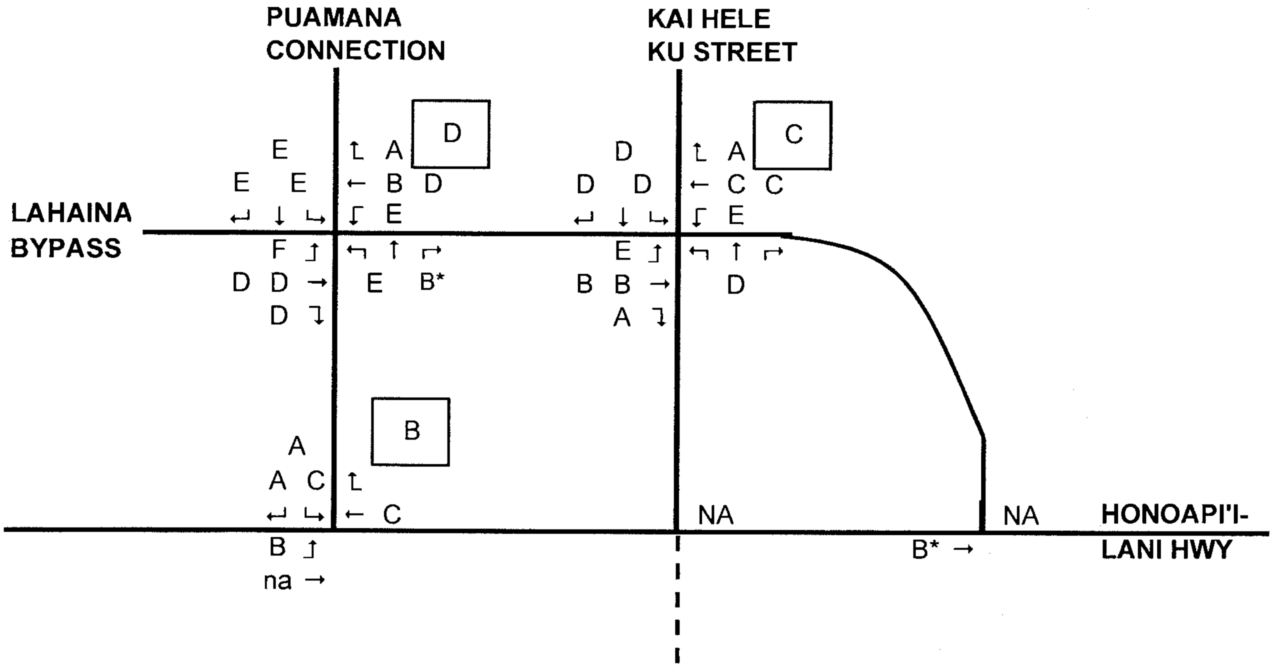
AM PEAK HOUR



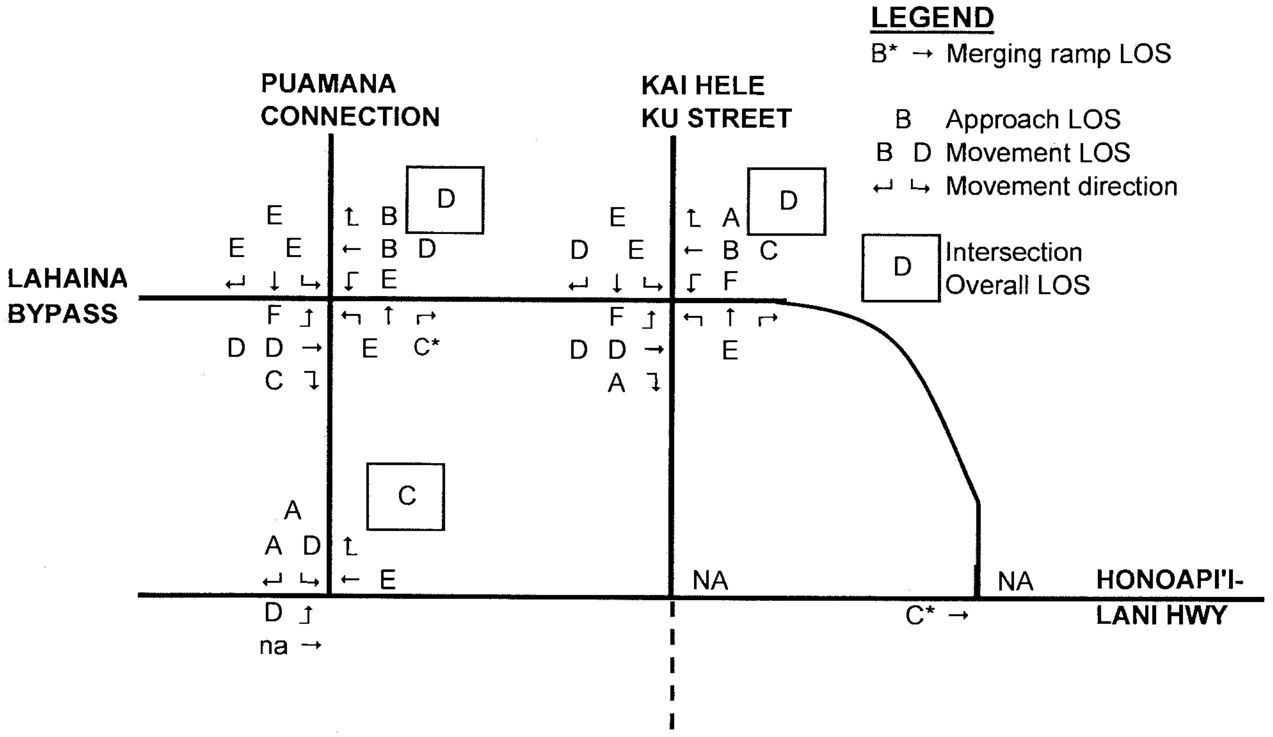
PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2020 ADJUSTED TRAFFIC ASSIGNMENT
FIGURE 8



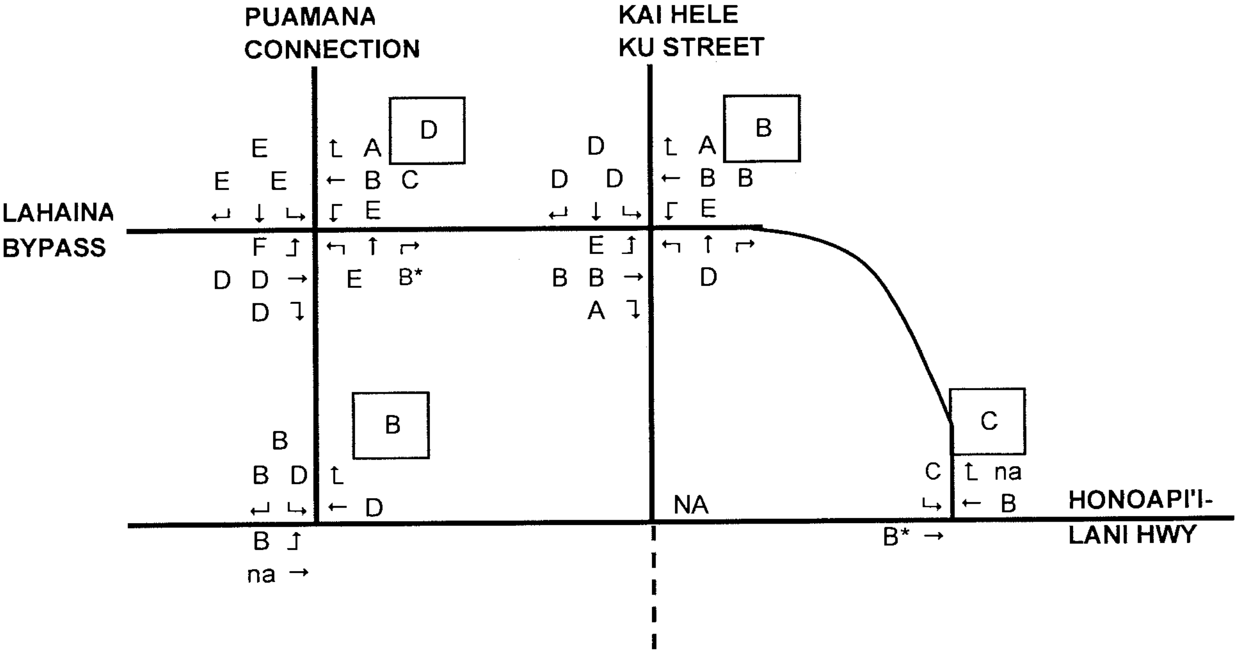
AM PEAK HOUR



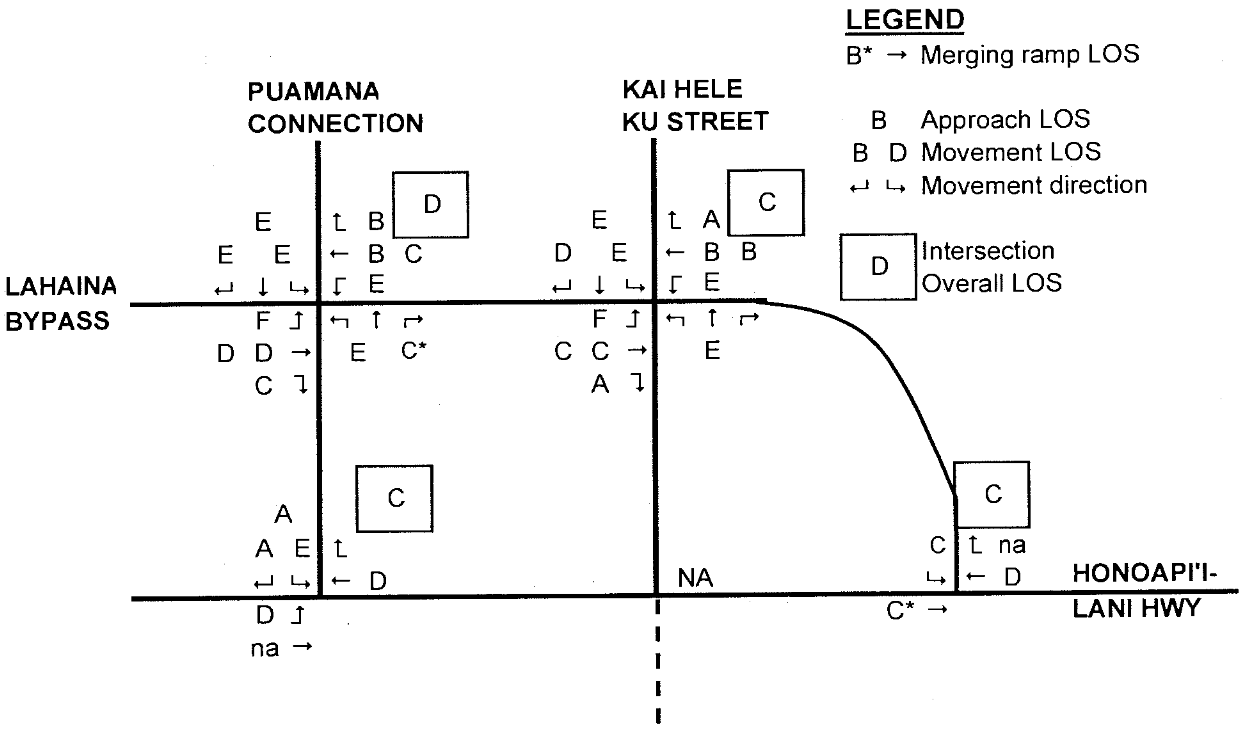
PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 BASE TRAFFIC ASSIGNMENT
FIGURE 9



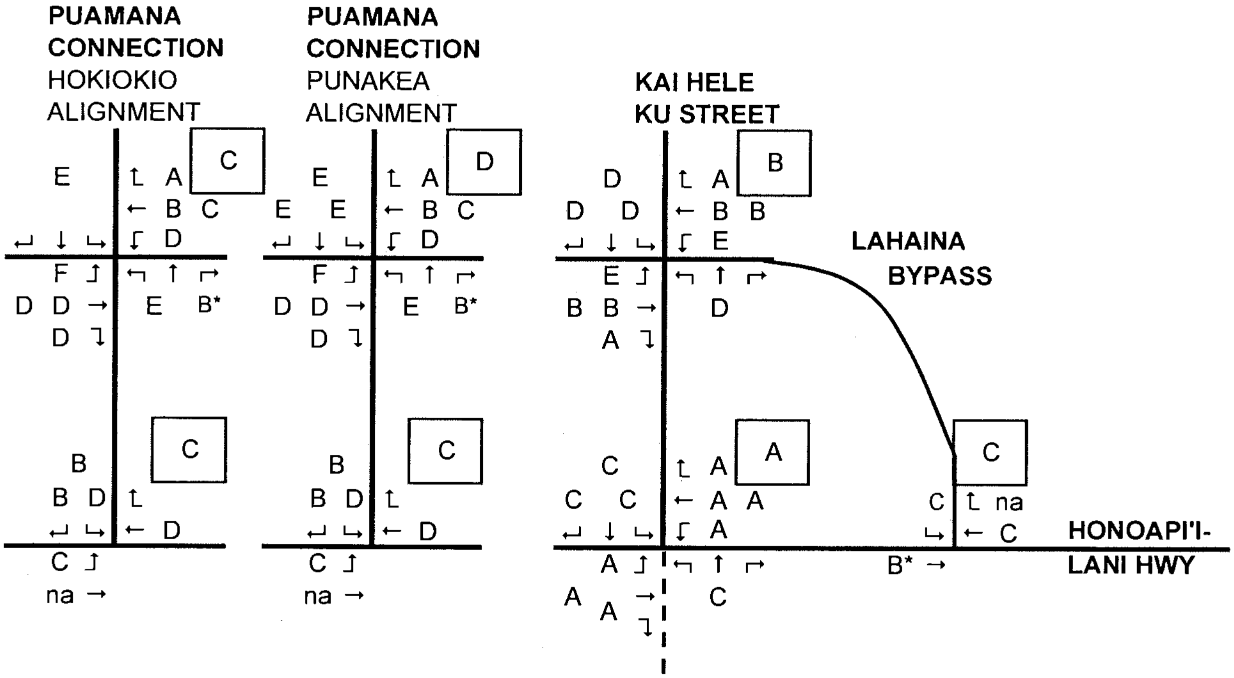
AM PEAK HOUR



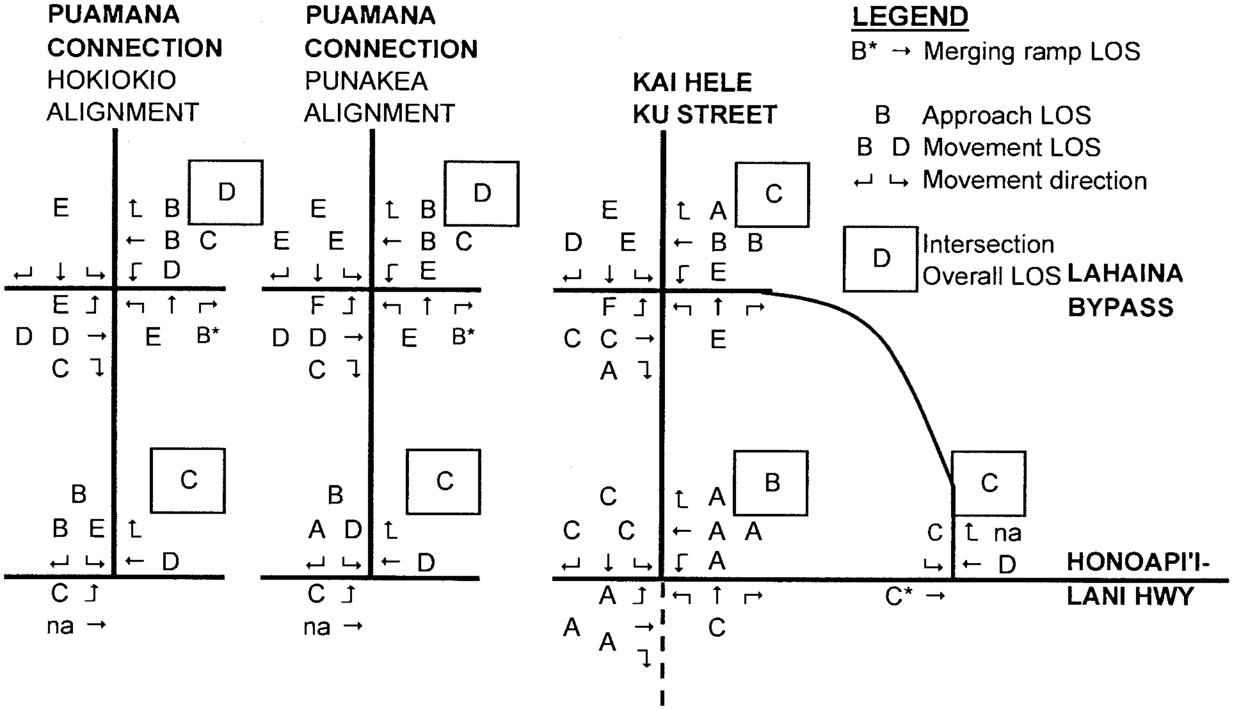
PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 TRAFFIC ASSIGNMENT WITH 20% DIVERSION
FIGURE 10



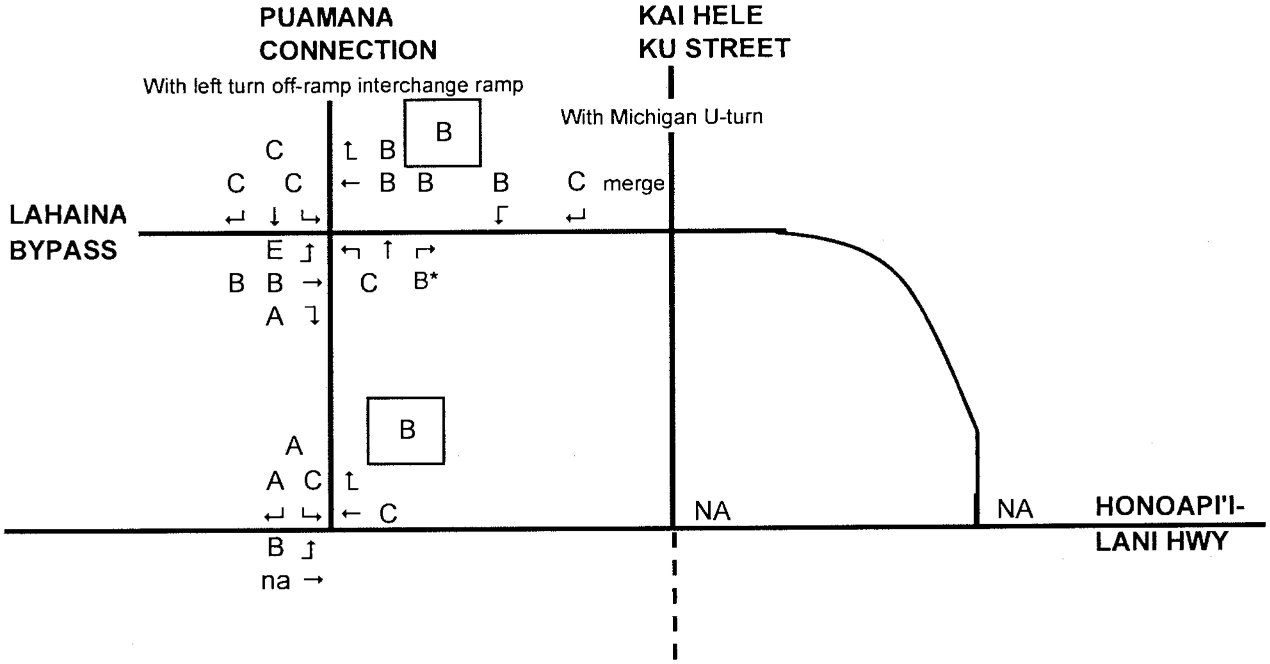
AM PEAK HOUR



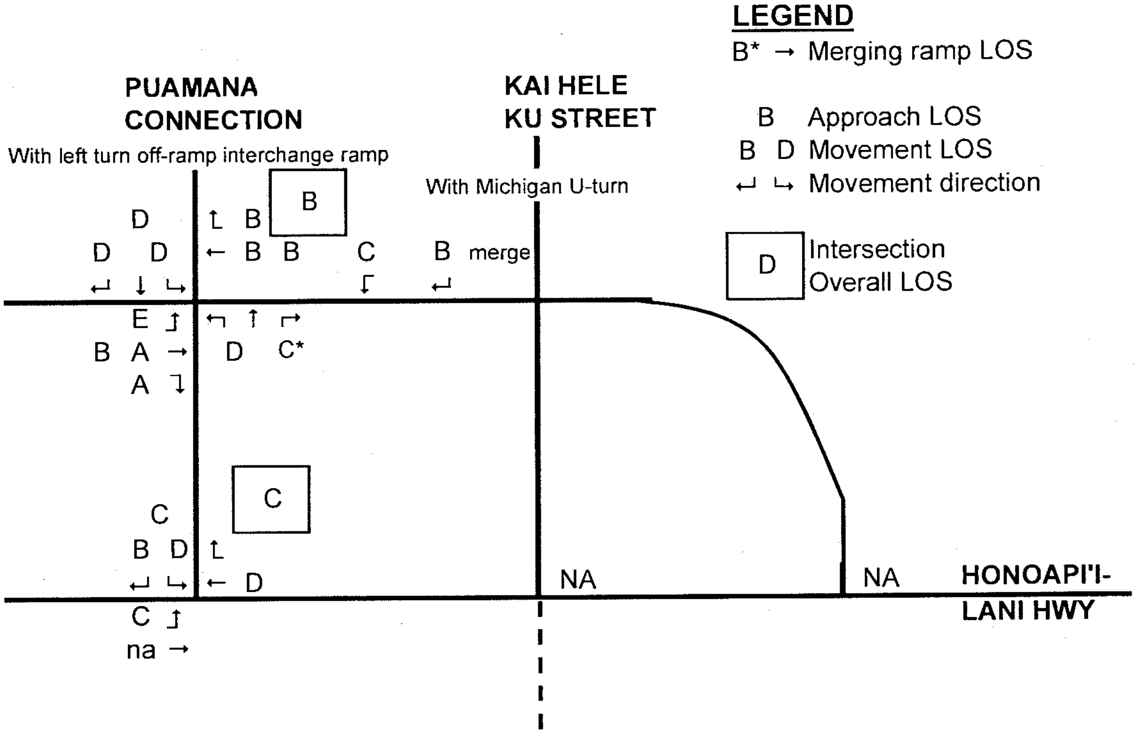
PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 TRAFFIC ASSIGNMENT WITH 33% DIVERSION
FIGURE 11



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 BASE TRAFFIC WITH ALTERNATE TRAFFIC DESIGNS
FIGURE 12

Lahaina Bypass Highway and Honoapi'ilani Highway (south)

The primary movements at this intersection are between the Lahaina Bypass Highway and the south leg of Honoapi'ilani Highway. The former roadway has one through lane in each direction while the latter was assumed to have two lanes in each direction in year 2020. The section of Honoapi'ilani Highway between the Puamana Connector and the north leg of this intersection would retain its current two lane design, but could be modified at either intersection.

The following design features are recommended for 2020:

- Honoapi'ilani Highway northbound "through lane" approach to Lahaina Bypass northbound – only one lane would be required since it would not be stopped by the traffic signal. The northbound right lane of the four-lane highway section south of the terminus would continue as the single northbound through lane of the bypass highway.
- Honoapi'ilani Highway northbound "left turn" approach –one lane with 450 feet of storage required. The left northbound lane of the four-lane highway section south of the terminus would become the "left turn" lane.
- Lahaina Bypass Highway southbound "through lane" approach to southbound Honoapi'ilani Highway – the single southbound through lane would expand to include an auxiliary through lane with 550 feet of storage, creating a two through lane approach.
- Honoapi'ilani Highway southbound "through lane" approach - the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the terminus.

The recommended design is shown on Figure D-1. With this design, the proposed intersection would be operating at level of service C in both peak periods. The Honoapi'ilani Highway northbound "left turn" approach would be operating at level of service C in the PM peak hour. The Honoapi'ilani Highway southbound "on-ramp" approach would be operating at level of service B or better in both peak hours.

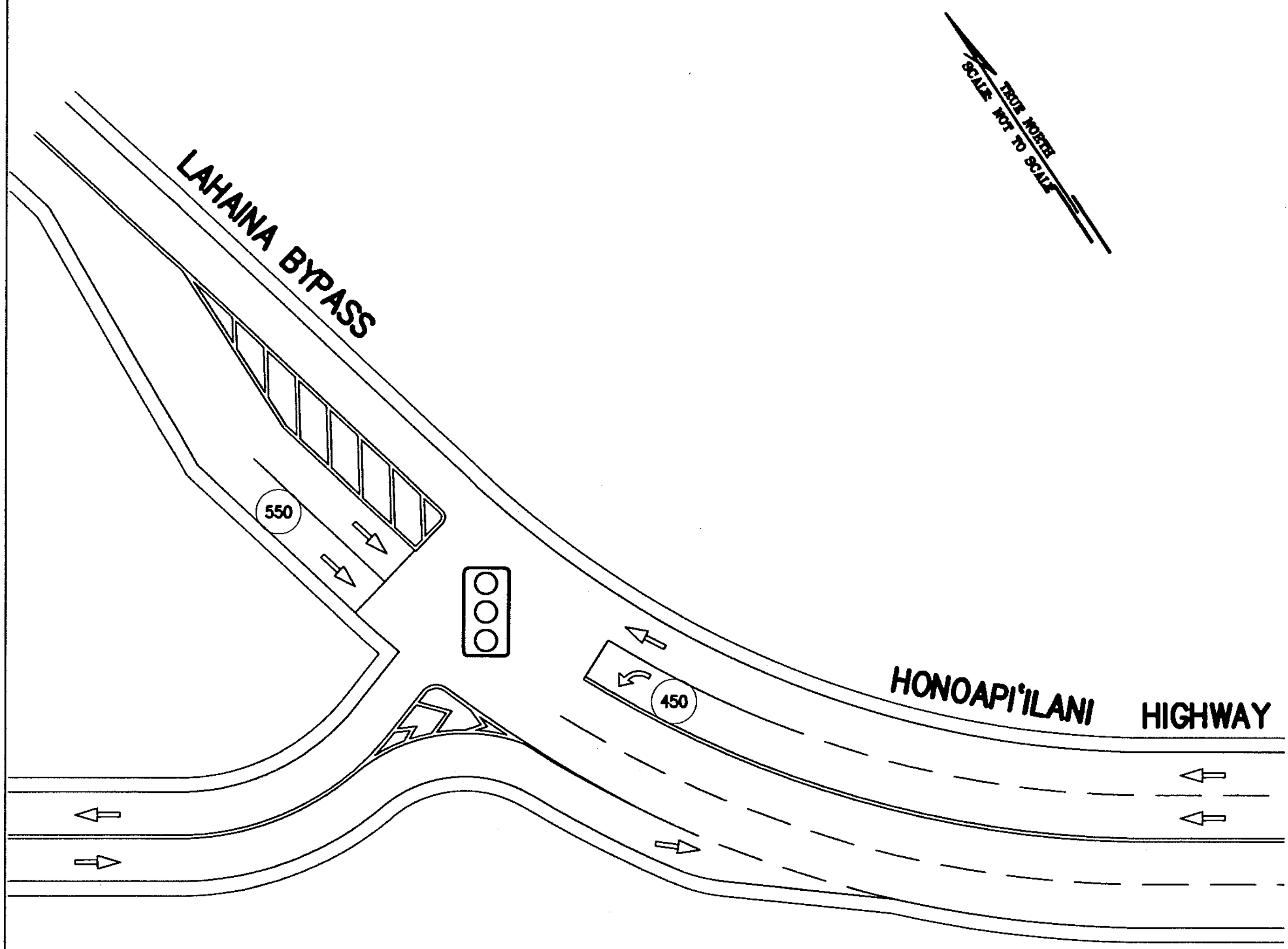
The year 2035 baseline network would not require an intersection at the southern terminus and would force traffic from East and Central Maui to enter the makai area via Kai Hele Ku Street. However, the southbound through lane from Honoapi'ilani Highway should be retained as an "on-ramp" approach as in the previous design. This would provide a convenient travel path for residents/ beach goers within the study area to travel south without having to travel mauka first to enter the highway network and minimize disrupting the major traffic flow on the bypass highway. This concept is schematically shown on Figure D-2. This "on-ramp" would operate at levels of service B and C in the morning and afternoon peak hours, respectively.

Figure D-3 shows the recommended intersection design for the year 2035 if Honoapi'ilani Highway were kept open between Puamana Connector and the southern teminus intersections. The following design features are recommended for 2035 based on the 33% diversion:

- Honoapi'ilani Highway northbound "through lane" approach to Lahaina Bypass northbound - the two northbound lanes of the four-lane highway section would continue as the two northbound through lanes of the bypass highway and would not be stopped by the traffic signal.
- Honoapi'ilani Highway northbound "left turn" lane – one lane with 275 feet of storage required. Traffic from the left northbound through lane of Honoapi'ilani Highway would merge into the "left turn" lane.
- Lahaina Bypass Highway southbound "through lane" approach to southbound Honoapi'ilani Highway –the two through lanes of the bypass highway would be controlled by the traffic signal.
- Honoapi'ilani Highway southbound "through lane" approach - the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the terminus.

The recommended design intersection as shown on Figure D-3 would be operating at level of service C in both the morning and afternoon peaks. The Honoapi'ilani Highway northbound "left turn" approach and would be operating at level of service D in the PM peak hour. The Honoapi'ilani Highway southbound "on-ramp" approach would be operating at level of service B or better in the morning peak hour and at level of service C or better in the afternoon peaks.

None of the three recommended design alternatives permit left turns from Honoapi'ilani Highway southbound to Lahaina Bypass Highway northbound. It is recommended that some form of median or raised barrier should be designed and constructed on the bypass highway to prohibit illegal left turns.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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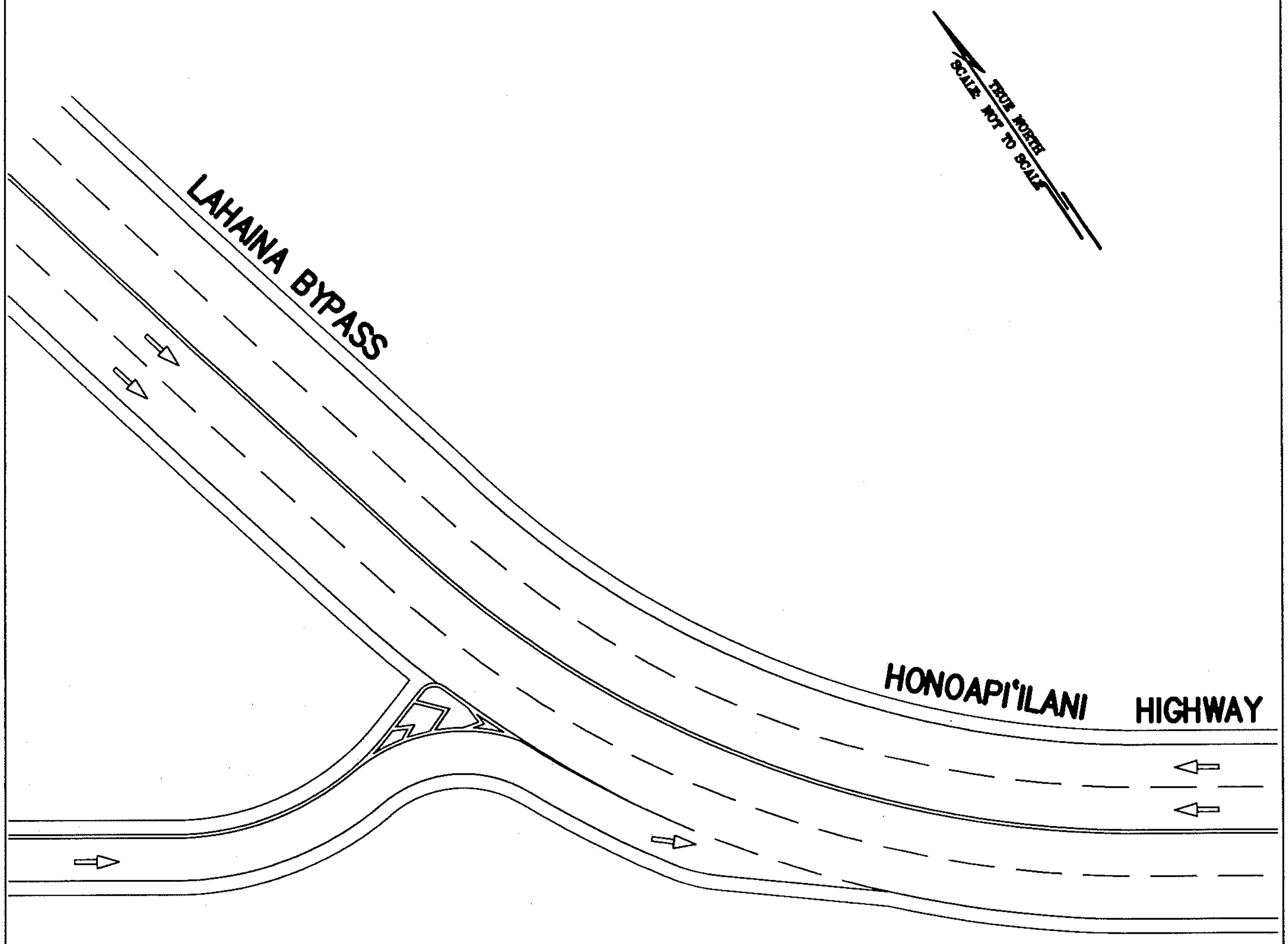
T-INTERSECTION AT LAHAINA BYPASS HIGHWAY AND HONOAPI'ILANI HIGHWAY 2020

FIGURE D-1

NOT TO SCALE

DATE: NOVEMBER 2009



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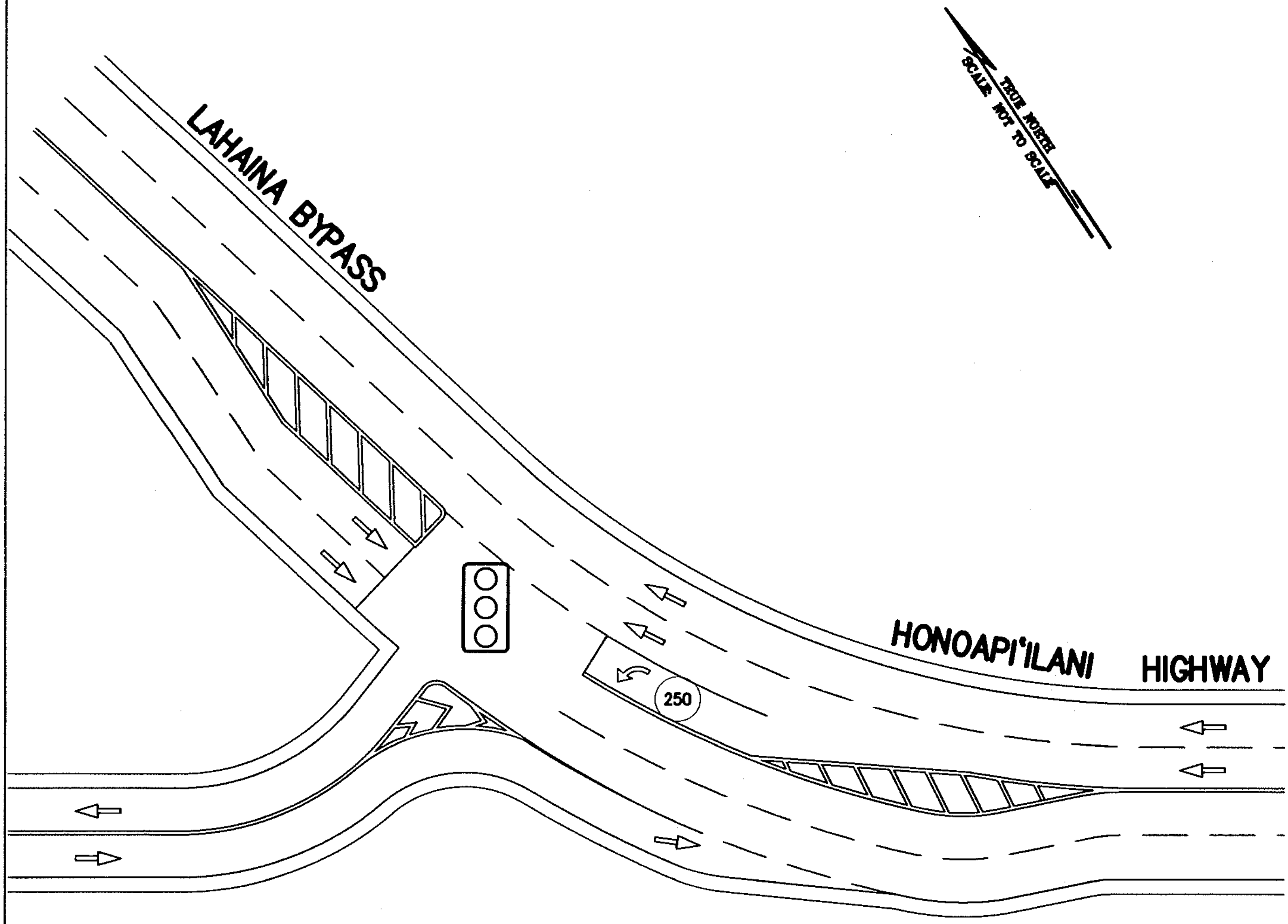
T–INTERSECTION AT LAHAINA BYPASS HIGHWAY AND
HONOAPI'ILANI HIGHWAY 2035
WITH BASELINE HIGHWAY NETWORK

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE
D–2



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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T-INTERSECTION AT LAHAINA BYPASS HIGHWAY AND HONOAPI'ILANI HIGHWAY 2035

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE D-3

Lahaina Bypass Highway and Kai Hele Ku Street

The Lahaina Bypass Highway would intersect Kai Hele Ku Street with one through lane in each direction in 2020 and with two through lanes in 2035. The proposed designs for the Kai Hele Ku Street approaches as a traditional signalized intersection are similar for both years:

- Lahaina Bypass Highway approaches would have separate left and right turn lanes with the storage length of the southbound left turn lane at 175 feet.
- Kai Hele Ku Street eastbound approach would be a single lane for all movements.
- Kai Hele Ku Street westbound approach would include a right turn lane and a shared left turn/through lane.

The recommended designs for the 2020 and 2035 signalized intersections are shown on Figures D-4 and D-5, respectively. Traffic at this intersection in 2020 is forecast to operate at levels of service C and B in the morning and afternoon peak hours, respectively. Traffic performance at this intersection in 2035 would improve as more vehicles are diverted to the makai route. With no diversion the intersection is forecast to operate at levels of service C and D in the morning and afternoon peak hours, respectively. With diversion the intersection is forecast to improve one level of service to B and C in the morning and afternoon peak hours, respectively. Many of the minor movements would be operating at levels of service E and F due to the long traffic signal cycle lengths and not capacity problems.

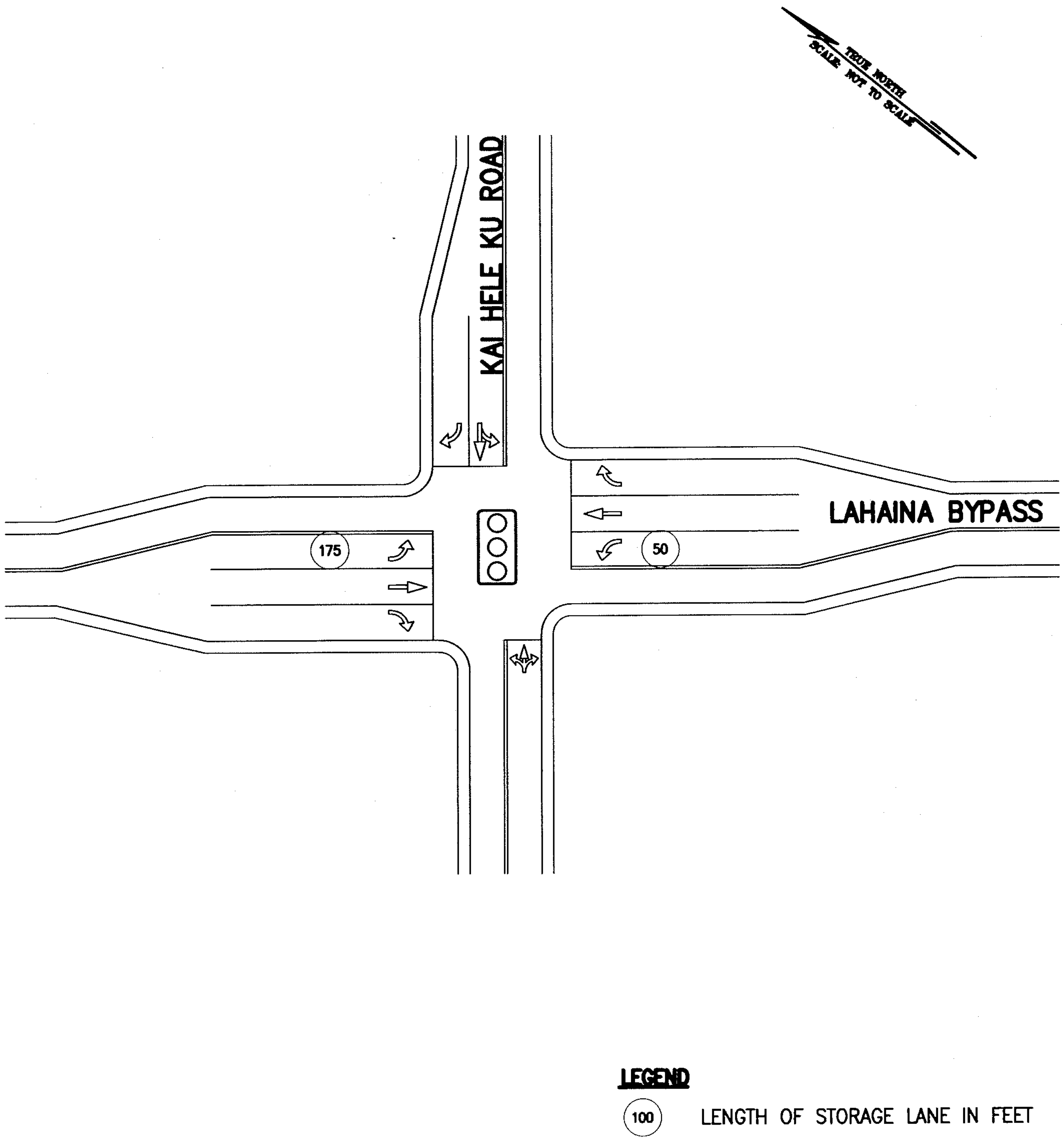
Due to the low volumes forecast on the eastbound approach for all but the 2035 baseline network and the availability of alternate routes, it is recommended that elimination of the west leg (eastbound approach) of Kai Hele Ku Street be considered. In this case, the northbound approach left turn lane would also not be required. Traffic to the makai areas would have to utilize the north or south intersections of Honoapi'ilani Highway, which is not expected to be a large inconvenience. If this approach were not connected to the intersection, the intersection levels of service would remain about the same for 2020 but show considerable improvements for 2035, especially in the PM peak hour. The PM intersection levels of service would improve one step from C to B and the southbound approach levels of service would improve by one level for both peak hours. The 2035 baseline network was not analyzed without the eastbound connection since the eastbound approach would be needed to allow access into the makai area.

A Michigan U-turn design would be an alternative to the signalized intersection design in 2035. The Michigan U-turn attempts to improve traffic operations and safety by permitting only right turn movements. The design eliminates inbound and outbound left turns and through movements with the placement of a median through the intersection. All outbound vehicles are forced to make a right turn onto the main roadway and the left turn/through movements make a U-turn upstream and merge onto the opposing traffic roadway. Inbound left turn vehicles continue past the intersection, make a U-turn upstream, and make a right turn into their original destination roadway. This design is intended for situations where there are high through volumes and low minor street volumes that do not warrant traffic signals or in lieu of traffic signals.

This alternative would require the north and south bound lanes of the bypass highway to be separated sufficiently to include a U-turn lane between the two roadways. A conceptual design on this alternative is shown on Figure D-6. With this design, the traffic on the highway would not experience delays while the westbound on-ramp traffic would operate at improved levels of service B and C in the morning and afternoon peak hours, respectively. This analysis indicates that the Michigan U-turn would be a feasible alternative at the Kai Hele Ku Street intersection in 2035 with all three scenarios. As with the signalized intersection design, it is recommended that elimination of the west leg (eastbound approach) be considered for the non-baseline networks.

The Michigan U-turn design could not be used with the 2020 network since the opposing lanes of traffic are assumed not to be separated in the two lane design. Although a formal traffic signal warrant analysis was not made, this intersection may warrant a traffic signal system by 2020 with the additional traffic from the mauka development. Another alternative that could be pursued if traffic signals are not warranted is not to provide a connection between the Lahaina Bypass Highway and Kai Hele Ku Road. The two roadways would be grade separated so that users of Kai Hele Ku Road would drive to Honoapi'ilani Highway to access the highway system. It would increase their travel times and increase traffic volumes at the two Honoapi'ilani Highway intersections. This alternative was not analyzed in this study but should be given future consideration. This alternative would afford better pedestrian and bicycle routes between the mauka communities and the coastal areas.

An implementation strategy may be to initially install traffic signals when the two lane highway is completed in about 2020 and convert to a Michigan U-turn when the four lane highway is built.



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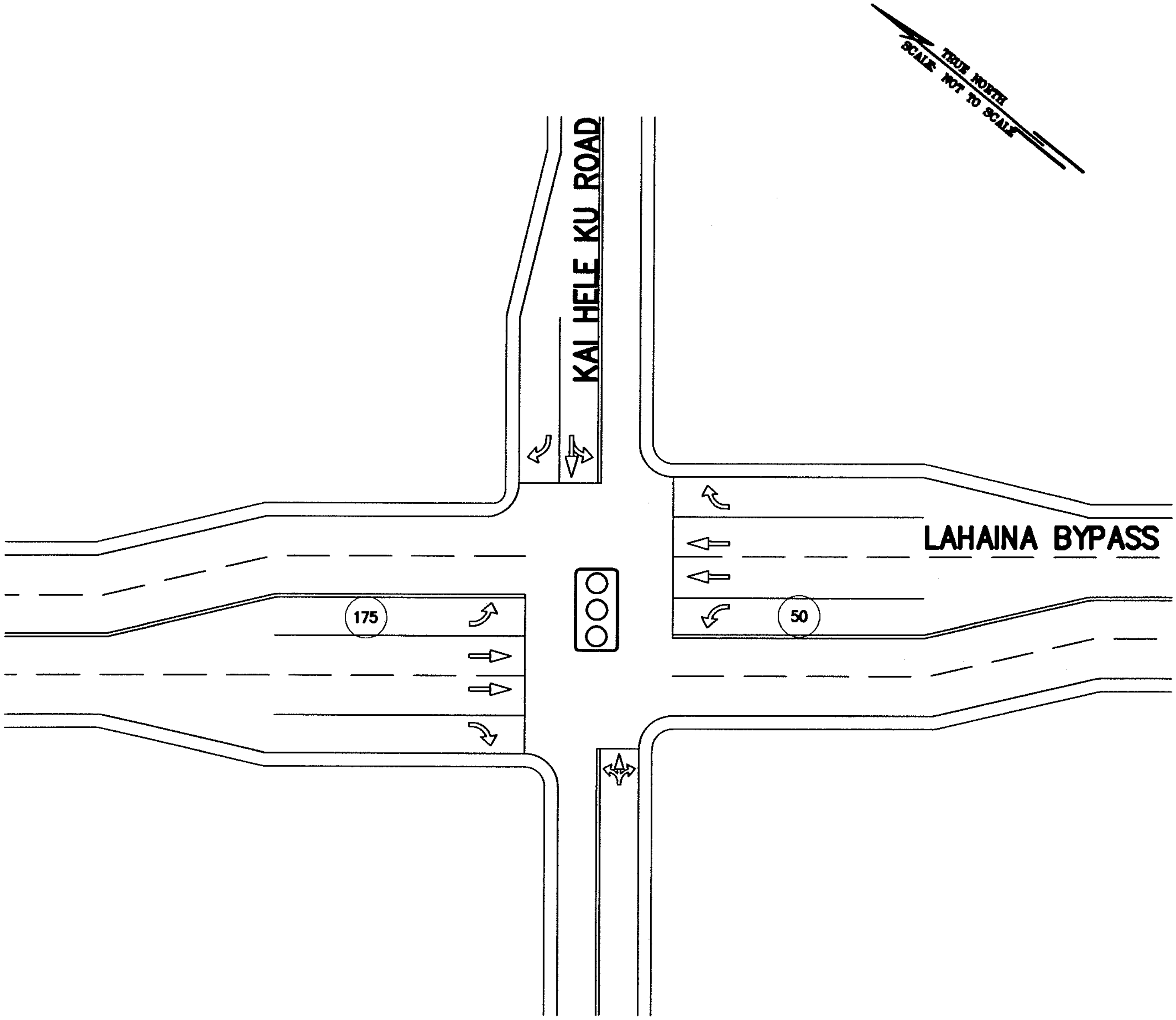
TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND KAI HELE KU ROAD 2020

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE D–4



LEGEND

(100)	LENGTH OF STORAGE LANE IN FEET

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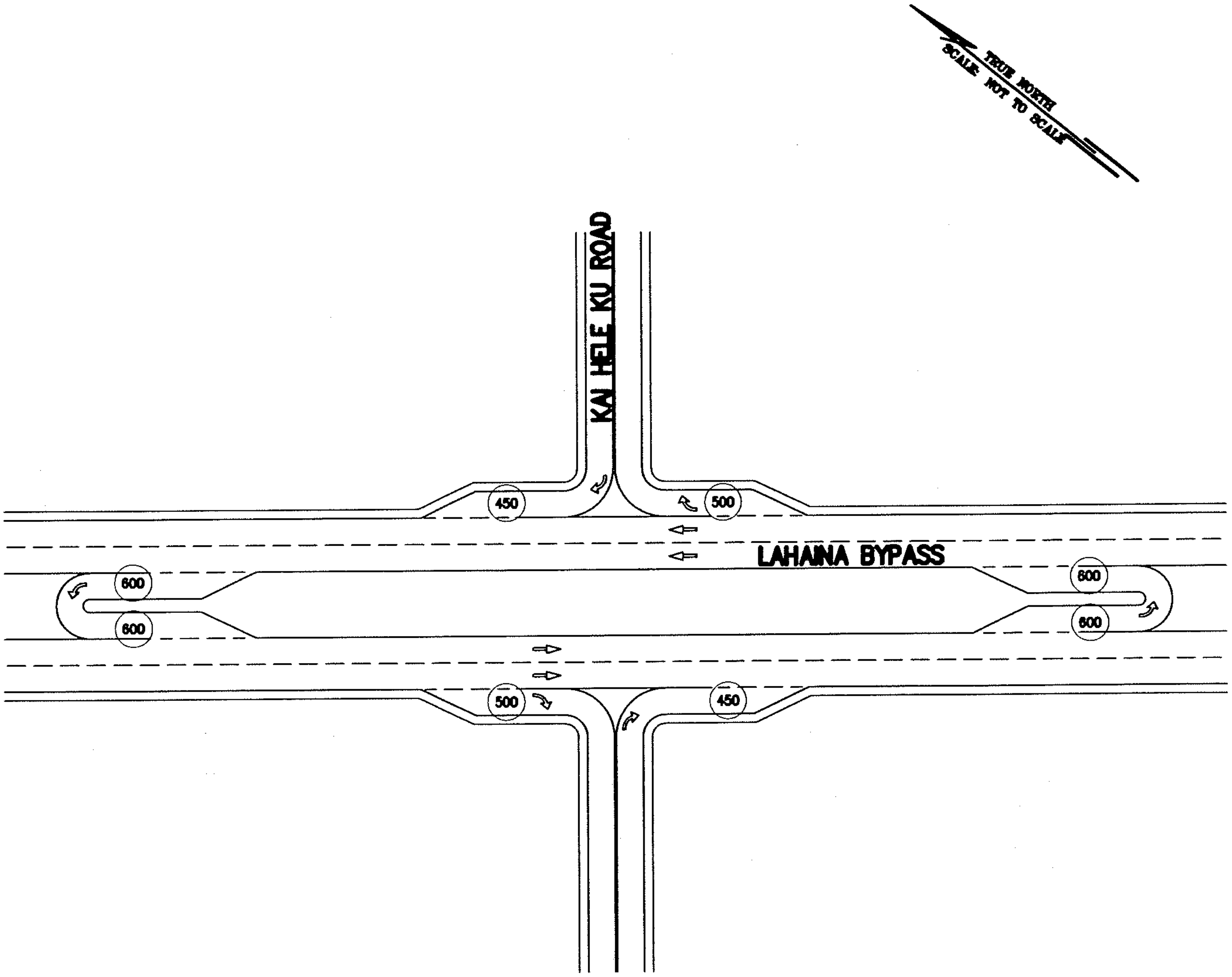
TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND KAI HELE KU ROAD 2035

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE

D-5



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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MICHIGAN U-TURN AT LAHAINA BYPASS HIGHWAY
AND KAI HELE KU ROAD 2035

FIGURE
D-6

NOT TO SCALE

DATE: NOVEMBER 2009

Lahaina Bypass Highway and Puamana Connector

As at the Kai Hele Ku intersection, the Lahaina Bypass Highway would intersect the Puamana Connector with one through lane in each direction in 2020 and with two through lanes in 2035. The 2020 signalized intersection design would include:

- Lahaina Bypass Highway northbound approach – separate right turn lane and separate left turn lane with 500 feet storage length.
- Lahaina Bypass Highway southbound approach – separate right turn lane and separate left turn lane with 75 feet storage length.
- Puamana Connector eastbound approach - shared left turn and through lane.
- Puamana Connector eastbound right turn - would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the Puamana Connector.
- Puamana Connector westbound approach - shared left turn/through lane and separate right turn lane for the Punakea Loop alignment, single shared lane for the Hokiokio Place alignment.

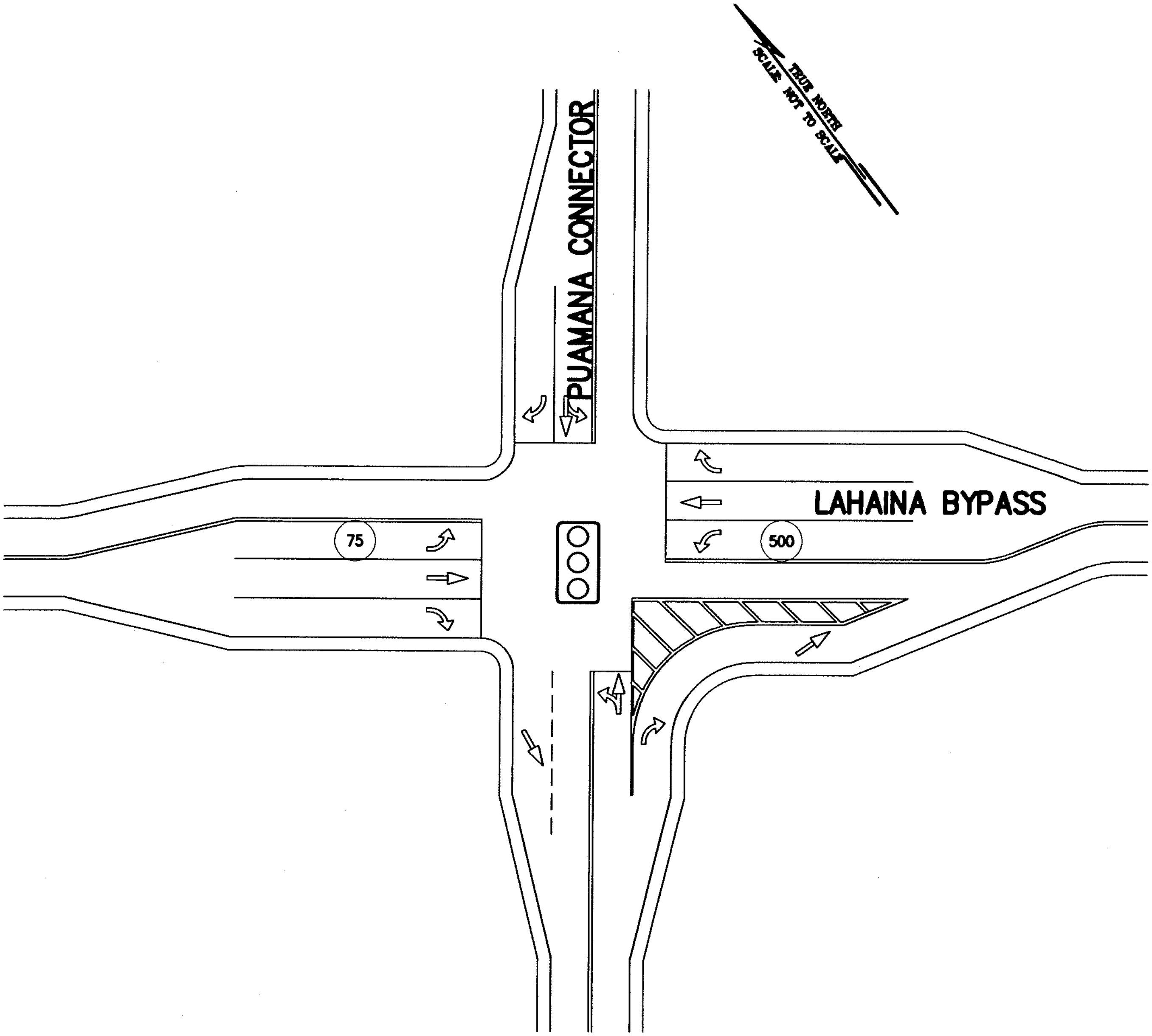
The recommended design as shown on Figure D-7 would be appropriate for both alignments of the Puamana Connector except as noted above. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service D in both peak periods of 2020. The bypass highway northbound left turn lane would be operating at levels of service F and E in the morning and afternoon peak hours, respectively. The Puamana Connector eastbound "on-ramp" approach level of service could not be calculated for 2020 since the level of service calculation procedure assumes two (southbound) through lanes. Traffic operations would be slightly better with the Hokiokio Place alignment due to a slightly shorter cycle length. The intersection level of service would improve from D to C in the PM peak and the northbound left turn lane level of service would improve from F to E in the AM peak.

The design for 2035 is similar to 2020 except that there would be two through lanes in each direction of highway and double left turn lanes on the northbound approach as shown on Figure D-8. The storage length for these lanes would range from 850 feet with the baseline network to 450 feet with 33% diversion network. The storage length of the southbound left turn lane would also increase to 100 feet. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service D in both peak periods for all alternatives although several approaches and movements would be operating at lower levels of service. The bypass highway northbound left turn lane would be operating at levels of service E in the afternoon peak hour (D in the AM peak hour with the 33% diversion network since the volume of opposing traffic would be less). Both Puamana Connector approaches would be operating at level of service E in both peak periods due to the long delays caused by the long cycle lengths required and not by capacity problems. Similarly, the bypass highway southbound left turn lane would be operating at level of service F due to the long delays caused by long cycle lengths and not capacity problems. The Puamana Connector eastbound "on-ramp" approach would be operating at acceptable levels of service B and C or better. As with the year 2020, traffic operations would improve slightly with the Hokiokio Place alignment of Puamana Connector.

The very high volumes of left turns from the northbound approach of the Lahaina Bypass Highway to the Puamana Connector require much of the traffic signal cycle time in both peak periods. Traffic operations would improve considerably if this movement were made on an interchange ramp that bypassed the traffic signal. An underpass rather than overpass ramp is initially proposed to minimize the aesthetic impacts. The specific ramp design would need to be studied further. If such a ramp were built, the peak hour intersection level of service would improve from D to B. The levels of service on all the other approaches also improve due to the shorter delays made possible with shorter traffic signal cycle lengths. A schematic of this proposal is shown on Figure D-9.

Another reason in favor of the interchange ramp is the much lower traffic signal cycle length that would be possible. This traffic signal would be in close proximity to the traffic signal at the Honoapiilani Highway/Puamana Connector intersection, which is forecast to have a much shorter traffic signal cycle length. Traffic signals in close proximity to one another should be operating at the same cycle length for maximum efficiency.

A partial cloverleaf design would represent the next level of design but was not analyzed in this study and should be given future consideration. A partial cloverleaf design would establish grade separation between the Lahaina Bypass Highway and Puamana Connector roadways and should reduce delays considerably. The partial cloverleaf would provide free flow movement for the northbound left turn movements. The grade separation would also afford better pedestrian and bicycle routes between the mauka communities and the coastline.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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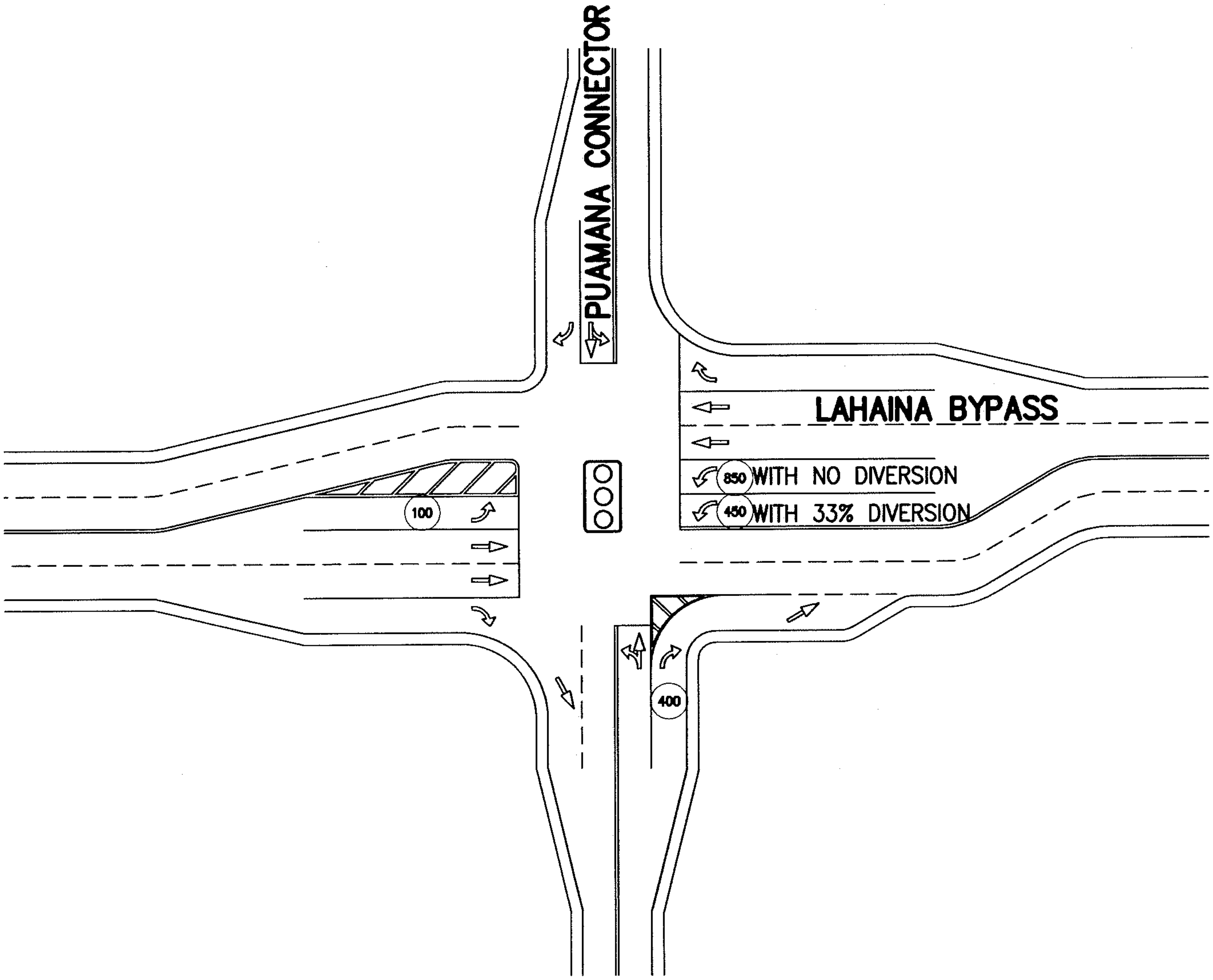
TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2020

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE D-7



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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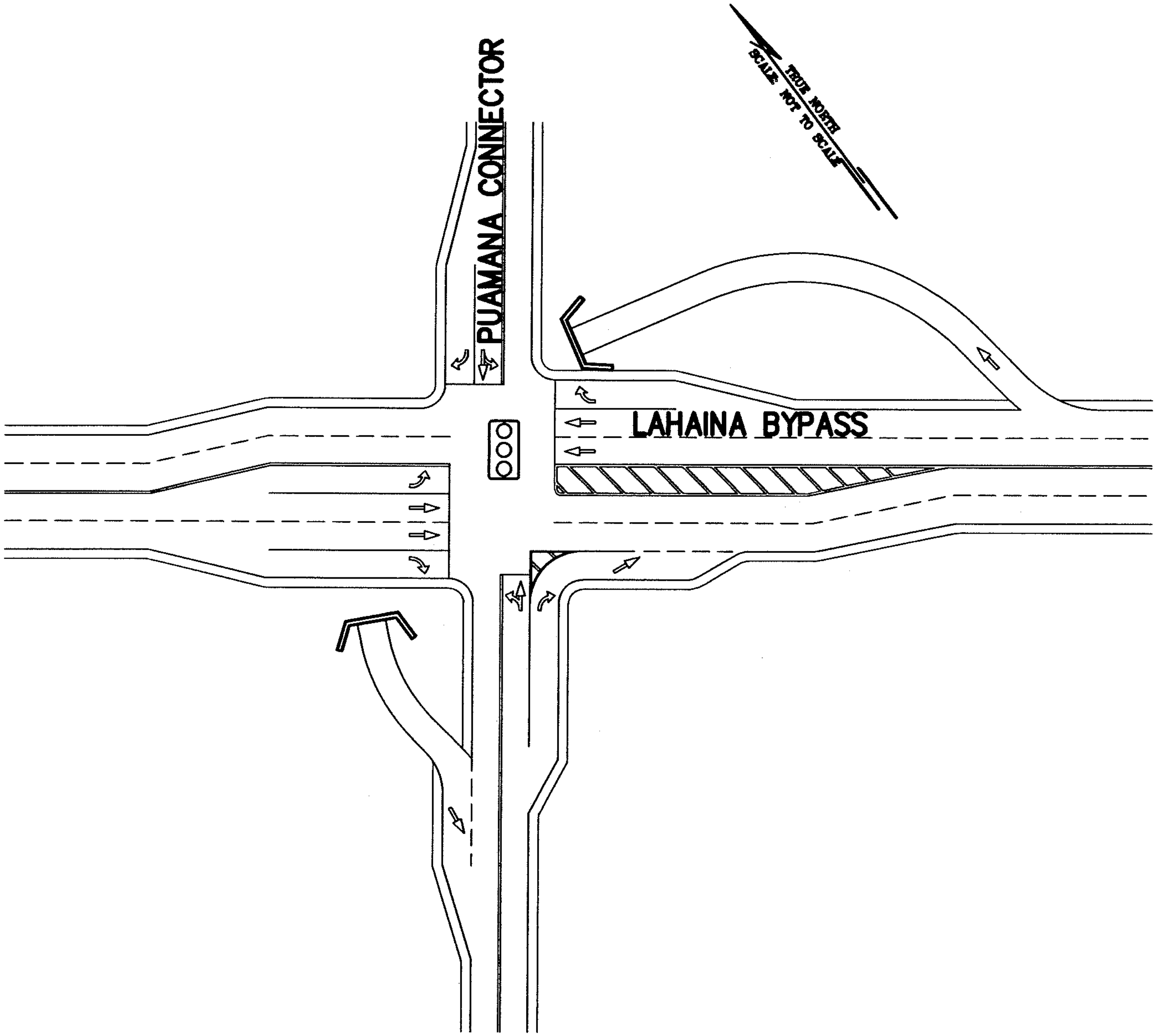
TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2035

NOT TO SCALE

DATE: FEBRUARY 2009

FIGURE

D-8



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

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PARTIAL INTERCHANGE AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2035

FIGURE D-9

NOT TO SCALE

DATE: NOVEMBER 2009

Honoapi'ilani Highway (north) and Puamana Connector

This intersection is expected to retain the same design for 2020 and 2035 (with diversion) networks since both Honoap'ilani Highway and the Puamana Connector are expected to remain at two lanes. The same design would also be appropriate for both Punakea Loop and Hokiokio Place alignments of the Puamana Connector:

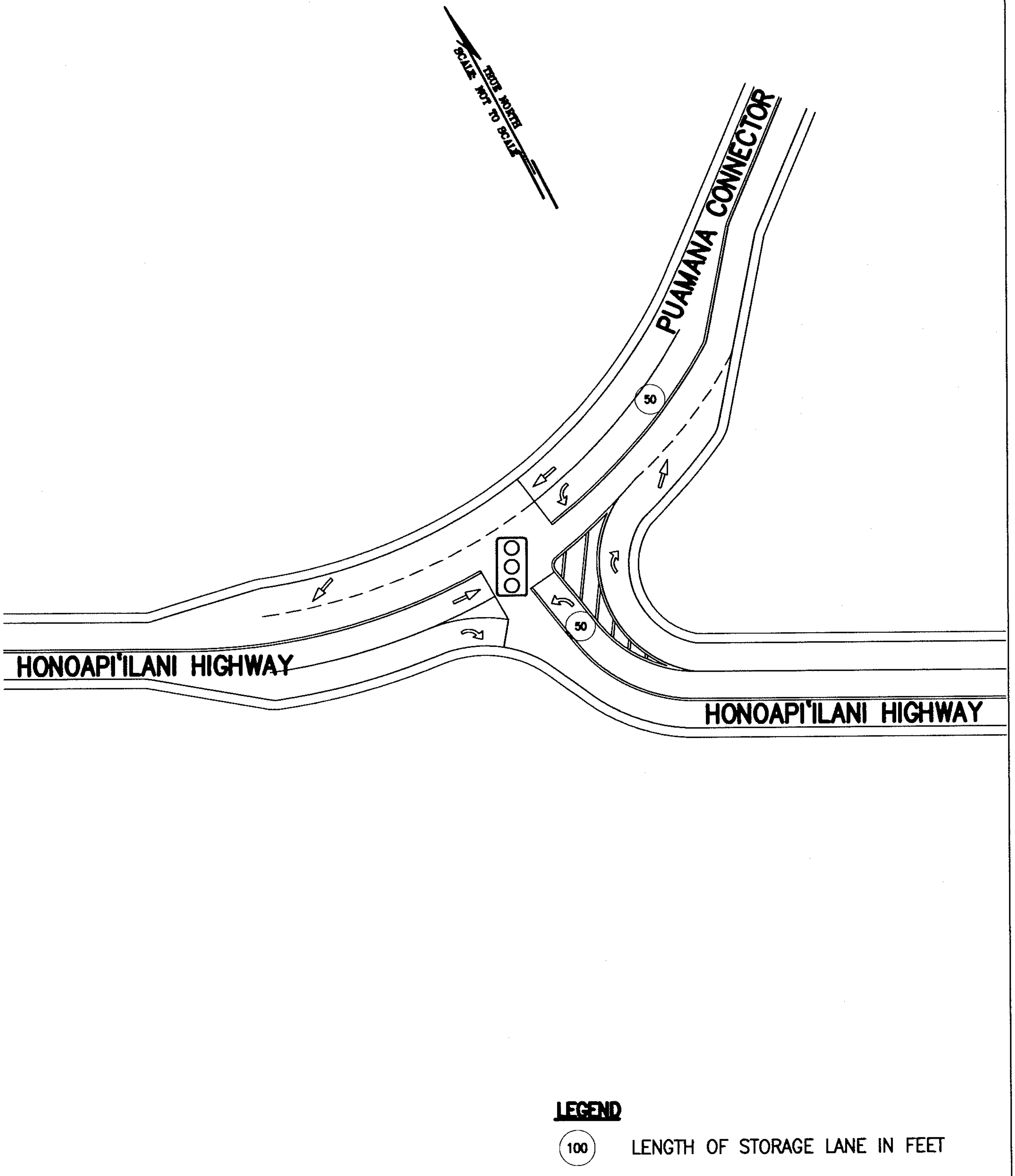
- Honoapi'ilani Highway southbound "through lane" to Puamana Connector eastbound – this one lane movement would be controlled by the traffic signal.
- Honoapi'ilani Highway southbound "right turn lane" to Honoapi'ilani Highway southbound- the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the intersection.
- Honoapi'ilani Highway northbound "left turn" lane to Honoapi'ilani Highway northbound – one lane would be the major movement on the approach.
- Honoapi'ilani Highway northbound right turn lane to Puamana Connector eastbound – the right turn lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the eastbound highway lanes east of the intersection.
- Puamana Connector westbound "through lane" to Honoapi'ilani Highway northbound – this one lane movement would be controlled by the traffic signal.
- Puamana Connector westbound left turn lane to Honoapi'ilani Highway southbound - one lane with the minimum 50 feet storage length.

The recommended design is shown on Figure D-10. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service C in both peak periods of 2020, when traffic volumes on the makai highway are forecast to be the highest. The intersection level of service would improve to B or remain at C for the 2035 alternatives when traffic volumes on the makai highway are forecast to decrease from the 2020 levels. The northbound approach is forecast to operate at level of service D in both forecast years in both AM and PM peak hours. The level of service for the Honoapi'ilani Highway northbound right turn lane could not be calculated since the level of service calculation procedure assumes two (eastbound) through lanes.

The traffic operations measures for the Hokiokio Place alignment are shown on Table 1 and discussed below in relative terms to those for the Punakea Loop alignment. The intersection levels of service would remain at C in both forecast years and both peak hours but the delay would increase by several seconds. The Honoapi'ilani Highway southbound approach level of service would change from B to C in 2020 but remain at C in 2035. The level of service for the Puamana Connector left turn lane would remain unchanged from 2020 but worsen from D to E in the 2035 PM peak hour.

Two alternate routes are being considered for the Puamana Connector: Hokiokio Place or Punakea Loop. The above level of service analysis did not indicate that either alternative was infeasible or that one alternative was "better" than the other. Other considerations will dictate which alternative would be selected. The Punakea Loop alignment provides a better opportunity for grade separation between the bypass highway and connector that could accommodate the interchange ramp. Another consideration in favor of the Punakea Loop alternative is the much larger number of residences that could be directly served. The Hokiokio Place route serves a landlocked area with a limited number of residences. With the Hokiokio Place alignment, residents using Punakea Loop would have to travel via an underpass from mauka to a new intersection with Honoapi'ilani Highway to access the highway system. This intersection would operate acceptably as an unsignalized intersection.

As discussed for the Honoapi'ilani Highway (south) and Lahaina Bypass Highway intersection, the baseline highway network could be implemented by 2035 if there is a desire to reduce traffic on Honoapi'ilani Highway between Puamana Connection and the southern terminus so that it could be made into a local recreational roadway. Traffic signals would not be required since only right turn in, right turn out movements would be permitted to the local recreation road. Several alternate entry and egress routes should be provided as a convenience for makai area residents and beach goers, without encouraging through traffic. A conceptual design of the baseline intersection is shown on Figure D - 11. There is no level of service calculations for these movements.



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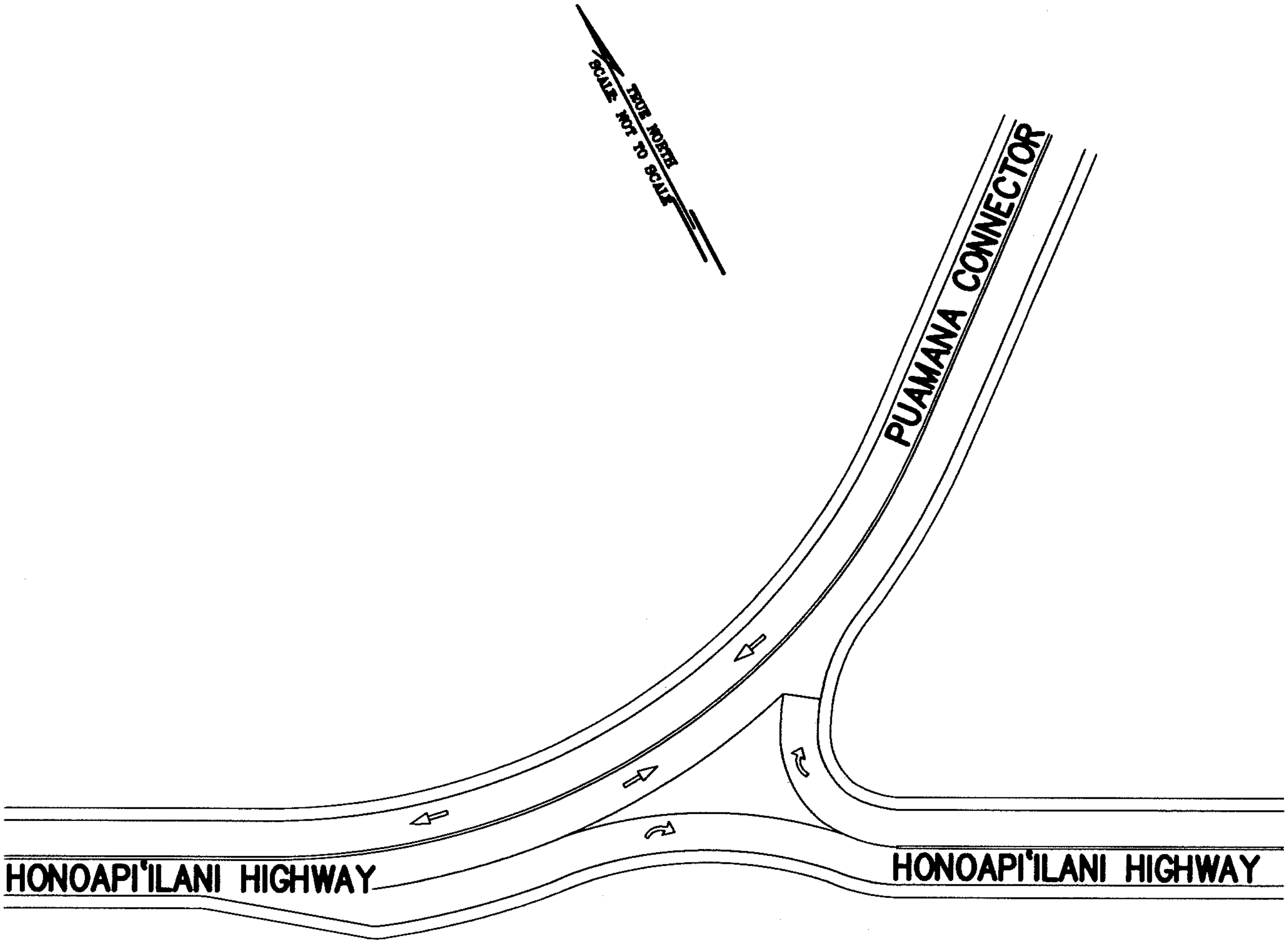
T-INTERSECTION AT HONOAPI'ILANI HIGHWAY AND PUAMANA CONNECTOR 2020 AND 2035

FIGURE
D-10

NOT TO SCALE

DATE: NOVEMBER 2009



ALTERNATIVE 1

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T-INTERSECTION AT HONOAPI'ILANI HIGHWAY
AND PUAMANA CONNECTOR 2035
WITH BASELINE HIGHWAY NETWORK

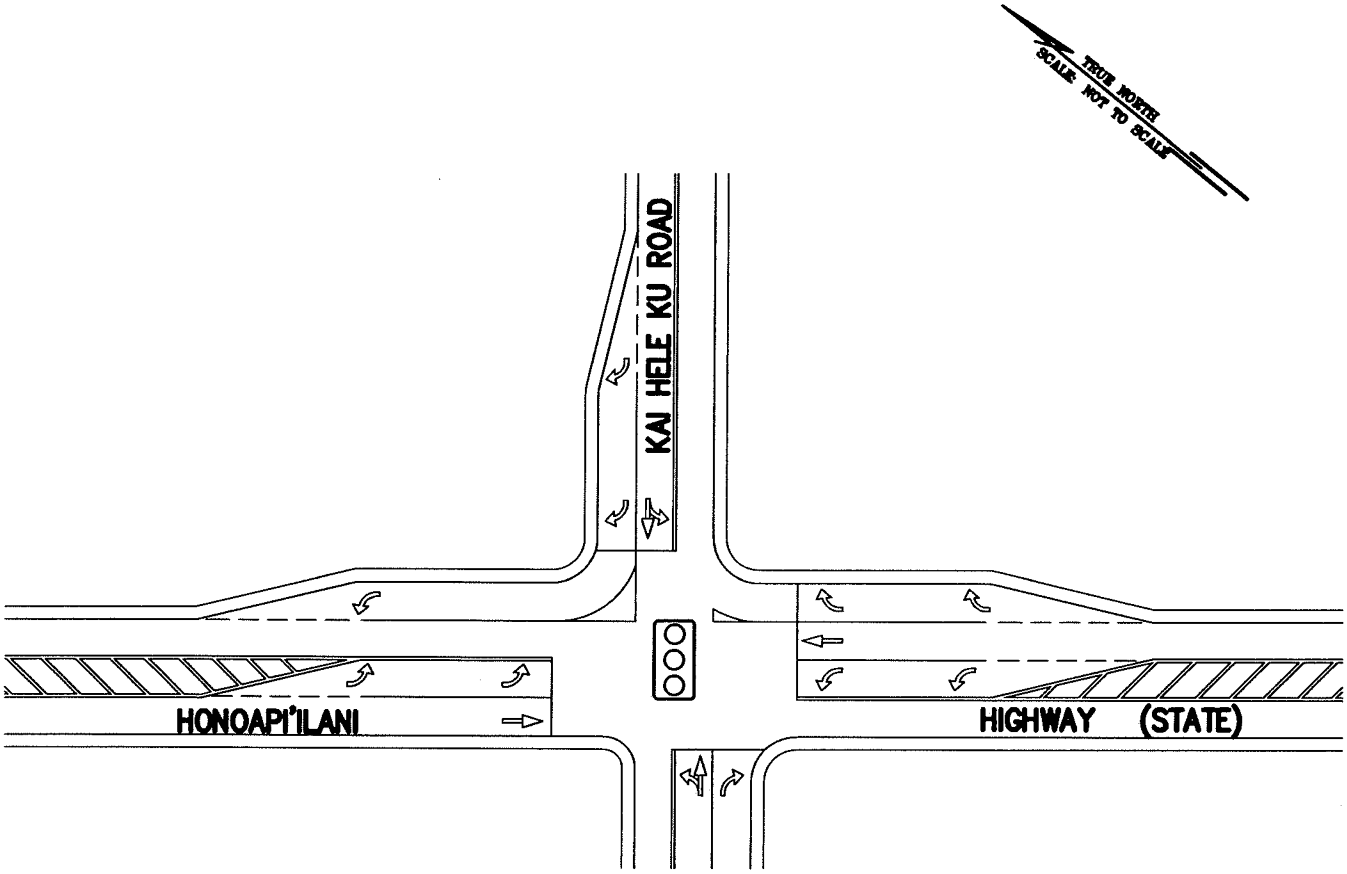
FIGURE
D-11

NOT TO SCALE

DATE: NOVEMBER 2009

Honoapi‘ilani Highway and Kai Hele Ku Street

The current design of the intersection is shown on Figure D-12. The mauka approach of Kai Hele Ku Street serves residential communities while the makai approach provides access to the Launiupoko Wayside Park. Although not warranted, traffic signals were installed at this intersection for pedestrian safety. Honoapi’ilani Highway would continue to have heavy traffic with the 2020 network and traffic forecast and the 2035 network with 33% diverted traffic forecast. It is expected that the traffic signals would need to remain in place for pedestrian safety and that the existing roadway design could be retained.



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CURRENT INTERSECTION AT
HONOAPI'ILANI HIGHWAY AND KAI HELE KU ROAD

FIGURE
D-12

NOT TO SCALE

DATE: NOVEMBER 2009

VII. CONCLUSIONS

The proposed relocation of the southern terminus of the Lahaina Bypass Highway with Honoapi'ilani Highway would not adversely affect future traffic operations relative to the approved alignment. The proposed relocation is considered appropriate in the context of current planning, policy and environmental considerations.

The proposed roadway network for the southern terminus of the Lahaina Bypass Highway is forecast to be operating over capacity by the year 2020 due to the high demand for travel forecast in northwest Maui. The proposed two-lane bypass highway would not be adequate to meet the forecast travel demand between its southern terminus and the Puamana Connector. The existing section of Honoapi'ilani Highway in this area would need to be maintained in service to provide sufficient roadway capacity. Expansion of this section of the bypass highway to four lanes should be facilitated. Also, Honoapi'ilani Highway would have to be widened to four lanes south of the southern terminus to meet the 2020 travel forecasts. All of the five study intersections would need to be signalized by 2020. The specific conceptual design recommendations are shown on Figures D-1, -4, -7, -10 and -12.

The baseline network with four lane bypass highway assumed for 2035 would have adequate capacity to handle all north-south traffic. The section of Honoapi'ilani Highway between the southern terminus and Puamana Conector could be made into a local recreational roadway. The intersections at the two ends of the Honoapiilani Highway would not permit cross traffic movements and would not have to be signalized. Implementing a Michigan U-turn at the Lahaina Bypass Highway/Kai Hele Ku Street intersection and a left turn interchange ramp at the Lahaina Bypass Highway/ Puamana Connector intersection would improve traffic operations on the bypass highway. The specific conceptual design recommendations are shown on Figures D-2, -6, -9, and -11.

Retaining the section of Honoapi'ilani Highway between the southern terminus and Puamana Connector in operation in 2035 would provide six highway lanes of capacity and improve traffic operations on the bypass highway. The intersections at the two ends of the Honoapiilani Highway would need to be signalized to allow cross traffic to enter the highway section. The other design features discussed above would also pertain to this scenario. The present design of the Honoapi'ilani Highway/ Kai Hele Ku Street intersection could be retained but the traffic signals might be removed depending on the amount of traffic remaining on the highway. The specific conceptual design recommendations are shown on Figures D-3, -6, -9, -10 and -12.

VIII. REFERENCES

1. Kaku and Associates, Maui Long-Range Land Transportation Plan, February 1997
2. FHWA, Record of Decision for the Lahaina Bypass Final Supplemental EIS, Exhibit "C-1" Traffic Analysis, September 2003
3. Transportation Research Board, National Research Council, Highway Capacity Manual, 2000 Edition.
4. CH2MHill, Honoapiilani Highway Widening/Realignment Maalaea to Launiupoko, Draft Traffic Technical Memorandum, April 28, 2008
5. Draft Maui Island Plan, March 2008
6. Institute of Transportation Engineers, Trip Generation, Seventh Edition, 2003.

Appendix A
Level of Service Worksheets

Signalized Intersection
Level of Service Worksheets

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV MIT 2020
Comment 2020 AM W/60% DIV & 2 SB LANES

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							477				928	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	35	41						
Yellow + All red (s)	7	7						

Cycle (s) 90 Lost time per cycle (s) 7 Critical v/c Ratio .626

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							518				1009	11
Capacity (veh/h)							688				1616	716
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.753				.624	.015
g/C ratio							.389				.456	.456
Average back of queue (veh)							12.8				11.1	.2
Uniform delay (s)							23.8				18.6	13.4
Incremental delay (s)							4.7				.8	0
Initial queue delay (s)							0				0	0
Delay (s)							28.5				19.4	13.4
LOS							C				B	B
Approach delay (s)/LOS		/			/		28.5	/	C	19.4	/	B
Intersection delay (s)/ LOS		22.4					/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV MIT 2020
Comment 2020 PM W/70% DIV & 2 SB LANES

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							497				1177	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	35	41						
Yellow + All red (s)	7	7						

Cycle (s) 90 Lost time per cycle (s) 7 Critical v/c Ratio .722

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							540				1279	11
Capacity (veh/h)							688				1616	716
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.785				.792	.015
g/C ratio							.389				.456	.456
Average back of queue (veh)							13.7				16.5	.2
Uniform delay (s)							24.2				20.9	13.4
Incremental delay (s)							6				2.8	0
Initial queue delay (s)							0				0	0
Delay (s)							30.2				23.7	13.4
LOS							C				C	B
Approach delay (s)/LOS		/			/		30.2	/	C	23.6	/	C
Intersection delay (s)/ LOS		25.5					/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information | **Site Information**

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 20% DIV 2035
Comment 2035 AM W/20% DIV & 4 LANES

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							199				1456	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	40						
Yellow + All red (s)	7	7						

Cycle (s) 84 Lost time per cycle (s) 7 Critical v/c Ratio .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							216				1583	11
Capacity (veh/h)							632				1689	748
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.342				.937	.015
g/C ratio							.357				.476	.476
Average back of queue (veh)							4				23.6	.1
Uniform delay (s)							19.8				20.8	11.6
Incremental delay (s)							0				10.5	0
Initial queue delay (s)							0				0	0
Delay (s)							19.8				31.3	11.6
LOS							B				C	B
Approach delay (s)/LOS		/			/		19.8	/	B	31.2	/	C
Intersection delay (s)/ LOS			29.8			/				C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information | **Site Information**

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 20% DIV 2035
Comment 2035 PM W/20% DIV & 4 LANES

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							219				2021	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	25	66						
Yellow + All red (s)	7	7						

Cycle (s) 105 Lost time per cycle (s) 7 Critical v/c Ratio .808

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	2			2	1
Flow rate (veh/h)							238				2197	11
Capacity (veh/h)							421				2229	987
Adjusted saturation flow (veh/h)							1770	3533			3547	1571
v/c ratio							.565				.985	.011
g/C ratio							.238				.629	.629
Average back of queue (veh)							6.7				42.8	.1
Uniform delay (s)							35.2				19	7.3
Incremental delay (s)							1.8				15.7	0
Initial queue delay (s)							0				0	0
Delay (s)							37				34.7	7.3
LOS							D				C	A
Approach delay (s)/LOS		/			/		37	/	D	34.6	/	C
Intersection delay (s)/ LOS			34.8			/				C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33% DIV 2035
Comment 2035 AM W/33% DIV & 4 LANES

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							329				1341	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	45						
Yellow + All red (s)	7	7						

Cycle (s) 89 Lost time per cycle (s) 7 Critical v/c Ratio .665

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							358				1458	11
Capacity (veh/h)							596				1793	794
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.6				.813	.014
g/C ratio							.337				.506	.506
Average back of queue (veh)							8.1				18.5	.1
Uniform delay (s)							24.5				18.5	11
Incremental delay (s)							1.7				3	0
Initial queue delay (s)							0				0	0
Delay (s)							26.2				21.5	11
LOS							C				C	B
Approach delay (s)/LOS		/			/		26.2	/	C	21.4	/	C
Intersection delay (s)/ LOS	22.3						/			C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33% DIV 2035
Comment 2035 PM W/33% DIV & 4 LANES

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street HONOAPIILA
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							317				1859	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	65						
Yellow + All red (s)	7	7						

Cycle (s) 109 Lost time per cycle (s) 7 Critical v/c Ratio .817

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	2			2	1
Flow rate (veh/h)							345				2021	11
Capacity (veh/h)							487				2115	937
Adjusted saturation flow (veh/h)							1770	3533			3547	1571
v/c ratio							.707				.955	.012
g/C ratio							.275				.596	.596
Average back of queue (veh)							10.5				38	.1
Uniform delay (s)							35.6				20.6	8.9
Incremental delay (s)							4.7				11	0
Initial queue delay (s)							0				0	0
Delay (s)							40.3				31.6	8.9
LOS							D				C	A
Approach delay (s)/LOS		/			/		40.3	/	D	31.5	/	C
Intersection delay (s)/ LOS	32.8						/			C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM SIG 2020
Comment 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date 11/10/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other   Analysis period .25 h   Signal type Actuated-Field   % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	2	2	27	1	127	0	1117	35	42	901	2
RTOR volume (veh/h)			0			15			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT   T: TH   R: RT   P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB		TR						
SB	LT	TR						
Green (s)	10	140	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190   Lost time per cycle (s) 10   Critical v/c Ratio .77

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		15			30	122	0	1214	38	46	979	2
Capacity (veh/h)		202			185	331		1373	1158	93	1520	1158
Adjusted saturation flow (veh/h)		1538			1409	1571	1770	1863	1571	1770	1863	1571
v/c ratio		.075			.164	.368		.885	.033	.49	.644	.002
g/C ratio		.132			.132	.211		.737	.737	.053	.816	.737
Average back of queue (veh)		.7			1.5	5.8		55.7	.6	2.6	22.5	0
Uniform delay (s)		72.4			73.2	64.2		18.9	6.7	87.5	6.8	6.6
Incremental delay (s)		0			0	0		7.2	0	3.7	1	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		72.4			73.2	64.2		26.1	6.7	91.2	7.8	6.6
LOS		E			E	E		C	A	F	A	A
Approach delay (s)/LOS	72.4	/	E	66	/	E	25.5	/	C	11.5	/	B
Intersection delay (s)/ LOS			22.4			/				C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM SIG 2020
Comment 2020 PM W/60% DIVERSION

Site Information

Jurisdiction/Date 11/10/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other   Analysis period .25 h   Signal type Actuated-Field   % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	0	46	1	60	0	830	32	103	1161	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT   T: TH   R: RT   P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB		TR						
SB	LT	TR						
Green (s)	20	150	20					
Yellow + All red (s)	5	5	5					

Cycle (s) 205   Lost time per cycle (s) 10   Critical v/c Ratio .752

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		5			51	60	0	902	35	112	1262	5
Capacity (veh/h)		154			132	345		1363	1150	173	1590	1150
Adjusted saturation flow (veh/h)		1578			1355	1571	1770	1863	1571	1770	1863	1571
v/c ratio		.035			.387	.173		.662	.03	.648	.794	.005
g/C ratio		.098			.098	.22		.732	.732	.098	.854	.732
Average back of queue (veh)		.3			2.9	2.9		29.3	.6	6.8	37.7	.1
Uniform delay (s)		83.8			86.7	64.9		14.3	7.5	89.1	6.8	7.4
Incremental delay (s)		0			.4	0		1.2	0	8.3	2.9	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		83.8			87.1	64.9		15.5	7.5	97.4	9.7	7.4
LOS		F			F	E		B	A	F	A	A
Approach delay (s)/LOS	83.8	/	F	75.2	/	E	15.2	/	B	16.8	/	B
Intersection delay (s)/ LOS			19			/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 0 DIV 2035
Comment 2035 AM W/NO DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	25	27	1	127	9	1922	35	42	1619	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .725

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		39			30	138	10	2089	38	46	1760	2
Capacity (veh/h)		261			235	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1569			1410	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.15			.129	.33	.083	.884	.036	.387	.744	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		1.5			1.1	4.9	.4	43.1	.6	2	28.4	0
Uniform delay (s)		53.4			53.2	44.2	65.7	20.3	8.5	67.1	16.5	8.3
Incremental delay (s)		0			0	0	0	4.4	0	.4	1.3	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		53.4			53.2	44.2	65.7	24.7	8.5	67.5	17.8	8.3
LOS		D			D	D	E	C	A	E	B	A
Approach delay (s)/LOS	53.4	/	D	45.8	/	D	24.6	/	C	19.1	/	B
Intersection delay (s)/ LOS			23.3				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 0 DIV 2035
Comment 2035 W/NO DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	86	46	1	60	72	1510	32	103	2248	5
RTOR volume (veh/h)			10			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .852

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		88			51	60	78	1641	35	112	2443	5
Capacity (veh/h)		210			131	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1597			994	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.419			.391	.145	.42	.676	.032	.601	1.007	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		4.6			2.7	2.5	4.1	29.2	.6	6.2	82.5	.1
Uniform delay (s)		75.8			75.5	53.6	79.6	17.6	9.7	81.2	30	9.5
Incremental delay (s)		.6			.4	0	.7	.8	0	5.3	20	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		76.4			75.9	53.6	80.3	18.4	9.7	86.5	50	9.5
LOS		E			E	D	F	B	A	F	D	A
Approach delay (s)/LOS	76.4	/	E	63.9	/	E	21	/	C	51.5	/	D
Intersection delay (s)/ LOS			40.5				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 20% DIV 2035
Comment 2035 AM W/20% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	2	27	1	127	1	1732	35	42	1444	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .663

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		14			30	138	1	1883	38	46	1570	2
Capacity (veh/h)		257			240	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1541			1439	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.055			.127	.33	.009	.796	.036	.387	.664	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		.5			1.1	4.9	0	33	.6	2	22.6	0
Uniform delay (s)		52.6			53.2	44.2	65.4	17.8	8.5	67.1	14.9	8.3
Incremental delay (s)		0			0	0	0	2	0	.4	.7	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		52.6			53.2	44.2	65.4	19.8	8.5	67.5	15.6	8.3
LOS		D			D	D	E	B	A	E	B	A
Approach delay (s)/LOS	52.6	/	D	45.8	/	D	19.6	/	B	17.1	/	B
Intersection delay (s)/ LOS			19.8				/			B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 20% DIV 2035
Comment 2035 W/20% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	2	46	2	60	1	1363	32	103	2005	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .756

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		8			52	60	1	1482	35	112	2179	5
Capacity (veh/h)		210			179	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1598			1362	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.036			.291	.145	.006	.611	.032	.601	.898	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		.4			2.6	2.5	.1	24.2	.6	6.2	57	.1
Uniform delay (s)		72			74.5	53.6	76.1	16.3	9.7	81.2	24.6	9.5
Incremental delay (s)		0			0	0	0	.5	0	5.3	5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		72			74.5	53.6	76.1	16.8	9.7	86.5	29.6	9.5
LOS		E			E	D	E	B	A	F	C	A
Approach delay (s)/LOS	72	/	E	63.3	/	E	16.7	/	B	32.3	/	C
Intersection delay (s)/ LOS			27.2				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33% DIV 2035
Comment 2035 AM 33% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	2	27	1	127	1	1602	35	42	1329	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (blc/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		14			30	138	1	1741	38	46	1445	2
Capacity (veh/h)		257			240	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1541			1439	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.055			.127	.33	.009	.736	.036	.387	.611	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		.5			1.1	4.9	0	27.7	.6	2	19.4	0
Uniform delay (s)		52.6			53.2	44.2	65.4	16.4	8.5	67.1	14.1	8.3
Incremental delay (s)		0			0	0	0	1.2	0	.4	.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		52.6			53.2	44.2	65.4	17.6	8.5	67.5	14.6	8.3
LOS		D			D	D	E	B	A	E	B	A
Approach delay (s)/LOS	52.6	/	D	45.8	/	D	17.4	/	B	16.2	/	B
Intersection delay (s)/ LOS			18.4				/			B		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33% DIV 2035
Comment 2035 33% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	2	46	2	60	1	1265	32	103	1843	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (blc/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .703

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		8			52	60	1	1375	35	112	2003	5
Capacity (veh/h)		210			179	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1598			1362	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.036			.291	.145	.006	.567	.032	.601	.826	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		.4			2.6	2.5	.1	21.3	.6	6.2	45.3	.1
Uniform delay (s)		72			74.5	53.6	76.1	15.5	9.7	81.2	21.8	9.5
Incremental delay (s)		0			0	0	0	.3	0	5.3	2.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		72			74.5	53.6	76.1	15.8	9.7	86.5	24.3	9.5
LOS		E			E	D	E	B	A	F	C	A
Approach delay (s)/LOS	72	/	E	63.3	/	E	15.7	/	B	27.5	/	C
Intersection delay (s)/ LOS			24.1				/			C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information **Site Information**

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM SIG NO EB 2020
Comment 2020 AM W/60% DIV & NO EB APPROACH

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1117	35	42	901	2
RTOR volume (veh/h)						15			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)					0			0			0	
Approach bicycle volume (bic/h)					0			0			0	
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	13	140	22					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .77

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		1	1	1	1	1
Flow rate (veh/h)				29		122		1214	38	46	979	2
Capacity (veh/h)				205		331		1373	1158	121	1549	
Adjusted saturation flow (veh/h)				1770		1571		1863	1571	1770	1863	1571
v/c ratio				.143		.368		.885	.033	.377	.632	
g/C ratio				.116		.211		.737	.737	.068	.832	
Average back of queue (veh)				1.5		5.8		55.7	.6	2.5	20.7	
Uniform delay (s)				75.5		64.2		18.9	6.7	84.6	5.7	
Incremental delay (s)				0		0		7.2	0	.3	.8	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				75.5		64.2		26.1	6.7	84.9	6.5	
LOS				E		E		C	A	F	A	
Approach delay (s)/LOS		/		66.4	/	E	25.5	/	C	10	/	A
Intersection delay (s)/ LOS			21.5			/				C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information **Site Information**

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM SIG NO EB 2020
Comment 2020 PM W/60% DIV & NO EB APPROACH

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)			0	46		60	0	830	32	103	1161	5
RTOR volume (veh/h)						5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)					0			0			0	
Approach bicycle volume (bic/h)					0			0			0	
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR	R					
SB	LT	T						
Green (s)	23	150	22					
Yellow + All red (s)	5	5	5					

Cycle (s) 210 Lost time per cycle (s) 10 Critical v/c Ratio .751

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		1	1	1	1	1
Flow rate (veh/h)				50		60		902	35	112	1262	5
Capacity (veh/h)				185		374		1331	1324	194	1579	
Adjusted saturation flow (veh/h)				1770		1571		1863	1571	1770	1863	1571
v/c ratio				.27		.16		.678	.026	.578	.799	
g/C ratio				.105		.238		.714	.843	.11	.848	
Average back of queue (veh)				2.8		2.9		31.9	.4	6.8	40.1	
Uniform delay (s)				86.6		63.4		16.6	2.7	88.9	7.6	
Incremental delay (s)				0		0		1.4	0	4.2	3	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				86.6		63.4		18	2.7	93.1	10.6	
LOS				F		E		B	A	F	B	
Approach delay (s)/LOS		/		73.9	/	E	17.5	/	B	17.3	/	B
Intersection delay (s)/ LOS			19.9			/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 20% DIV 2035
Comment 2035 AM W/20% DIV & NO EB APPRAOCH

Site Information

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1732	35	42	1444	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .663

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration					LT	R		T	R	L	T	R
No. of lanes					1	1		2	1	1	2	1
Flow rate (veh/h)					30	138		1883	38	46	1570	2
Capacity (veh/h)						419		2364	1047	118	2719	
Adjusted saturation flow (veh/h)					1777	1571		3547	1571	1770	3547	1571
v/c ratio						.33		.796	.036	.387	.577	
g/C ratio						.267		.667	.667	.067	.767	
Average back of queue (veh)						4.9		33	.6	2	15.9	
Uniform delay (s)						44.2		17.8	8.5	67.1	7.3	
Incremental delay (s)						0		2	0	.4	.3	
Initial queue delay (s)						0		0	0	0	0	
Delay (s)						44.2		19.8	8.5	67.5	7.6	
LOS						D		B	A	E	A	
Approach delay (s)/LOS	/			44.2 / D			19.5 / B			9.3 / A		
Intersection delay (s)/ LOS	16.2 / B											

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 20% DIV 2035
Comment 2035 W/20% DIV & NO EBAPPRAOCH

Site Information

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	46	0	60	0	1363	32	103	2005	5
RTOR volume (veh/h)						5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)				0			0			0		
Approach bicycle volume (bic/h)				0			0			0		
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	25	125	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .689

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		2	1	1	2	1
Flow rate (veh/h)				50		60		1482	35	112	2179	5
Capacity (veh/h)				233		455		2333	1034	233	2893	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3547	1571
v/c ratio				.215		.131		.635	.034	.481	.753	
g/C ratio				.132		.289		.658	.658	.132	.816	
Average back of queue (veh)				2.5		2.4		26.2	.7	5.9	32.8	
Uniform delay (s)				73.7		49.9		19.1	11.4	76.5	8.4	
Incremental delay (s)				0		0		.6	0	1.4	1.2	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				73.7		49.9		19.7	11.4	77.9	9.6	
LOS				E		D		B	B	E	A	
Approach delay (s)/LOS	/			60.7 / E			19.5 / B			12.9 / B		
Intersection delay (s)/ LOS	16.8 / B											

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33% DIV 2035
Comment 2035 AM 33% DIV & NO EB APPPROACH

Site Information

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1602	35	42	1329	0
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		2	1	1	2	1
Flow rate (veh/h)				29		138		1741	38	46	1445	0
Capacity (veh/h)				295		419		2364	1047	118	2719	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3547	1571
v/c ratio				.1		.33		.736	.036	.387	.531	
g/C ratio				.167		.267		.667	.667	.067	.767	
Average back of queue (veh)				1.1		4.9		27.7	.6	2	13.7	
Uniform delay (s)				53		44.2		16.4	8.5	67.1	6.9	
Incremental delay (s)				0		0		1.2	0	.4	.2	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				53		44.2		17.6	8.5	67.5	7.1	
LOS				D		D		B	A	E	A	
Approach delay (s)/LOS		/		45.8	/	D	17.4	/	B	8.9	/	A
Intersection delay (s)/ LOS		15.1				/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33% DIV 2035
Comment 2035 33% DIV & NO EB APPROACH

Site Information

Jurisdiction/Date 12/14/2008
EB/WB Street KAI HELE K
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	46	0	60	0	1265	32	103	1843	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	25	125	25					
Yellow + All red (s)	5	5	5					

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .639

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	
No. of lanes				1		1		2	1	1	2	
Flow rate (veh/h)				50		60		1375	35	112	2003	
Capacity (veh/h)				233		455		2333	1034	233	2882	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3533	
v/c ratio				.215		.131		.589	.034	.481	.695	
g/C ratio				.132		.289		.658	.658	.132	.816	
Average back of queue (veh)				2.5		2.4		23	.7	5.9	26.6	
Uniform delay (s)				73.7		49.9		18.2	11.4	76.5	7.4	
Incremental delay (s)				0		0		.4	0	1.4	.7	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				73.7		49.9		18.6	11.4	77.9	8.1	
LOS				E		D		B	B	E	A	
Approach delay (s)/LOS		/		60.7	/	E	18.4	/	B	11.8	/	B
Intersection delay (s)/ LOS		15.9				/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV 2020
Comment 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other   Analysis period .25 h   Signal type Actuated-Field   % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	292	29	63	61	338	816	22	14	594	2
RTOR volume (veh/h)			70			20			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT   T: TH   R: RT   P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LT	TR					
SB	L		TR					
Green (s)	5	30	70	35				
Yellow + All red (s)	1	6	6	6				

Cycle (s) 159   Lost time per cycle (s) 12   Critical v/c Ratio .675

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		18			100	45	367	887	24	15	646	2
Capacity (veh/h)		394			372	455	393	1218	684	55	804	684
Adjusted saturation flow (veh/h)		1789			1690	1571	1736	1827	1553	1736	1827	1553
v/c ratio		.047			.269	.098	.935	.728	.035	.279	.803	.003
g/C ratio		.22			.22	.289	.226	.667	.44	.031	.44	.44
Average back of queue (veh)		.7			3.9	1.5	19.6	28.1	.6	.7	27.7	.1
Uniform delay (s)		48.9			51.4	41.3	60.4	17.2	25.3	75.2	38.5	24.9
Incremental delay (s)		0			0	0	29.5	2.2	0	0	5.9	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		48.9			51.4	41.3	89.9	19.4	25.3	75.2	44.4	24.9
LOS		D			D	D	F	B	C	E	D	C
Approach delay (s)/LOS	48.9	/	D	48.3	/	D	39.7	/	D	45.1	/	D
Intersection delay (s)/ LOS			42.1				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV 2020
Comment 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date 11/10/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other   Analysis period .25 h   Signal type Actuated-Field   % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	65	331	38	30	29	196	624	40	60	850	5
RTOR volume (veh/h)			75			5			5			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT   T: TH   R: RT   P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	10	5	70	20				
Yellow + All red (s)	6	6	6	6				

Cycle (s) 129   Lost time per cycle (s) 12   Critical v/c Ratio .747

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		73			74	26	213	678	38	65	924	5
Capacity (veh/h)		281			235	438	283	1147	975	135	991	843
Adjusted saturation flow (veh/h)		1815			1516	1571	1736	1827	1553	1736	1827	1553
v/c ratio		.259			.314	.06	.754	.591	.039	.485	.932	.006
g/C ratio		.155			.155	.279	.163	.628	.628	.078	.543	.543
Average back of queue (veh)		2.4			2.5	.7	8.4	15.7	.6	2.5	37.2	.1
Uniform delay (s)		48			48.4	34.1	51.5	14.2	9.2	57	27.3	13.5
Incremental delay (s)		0			0	0	11	.8	0	2.4	14.9	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		48			48.4	34.1	62.5	15	9.2	59.4	42.2	13.5
LOS		D			D	C	E	B	A	E	D	B
Approach delay (s)/LOS	48	/	D	44.7	/	D	25.7	/	C	43.2	/	D
Intersection delay (s)/ LOS			35.6				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/NO DIV 2035
Comment 2035 AM W/ NO DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	881	29	63	61	976	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	65	80	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 210 Lost time per cycle (s) 10 Critical v/c Ratio .619

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	1061	1072	13	15	786	1
Capacity (veh/h)		345			321	299	1227	2533	1122	42	1351	598
Adjusted saturation flow (veh/h)		1812			1686	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.054			.311	.167	.864	.423	.012	.361	.582	.002
g/C ratio		.19			.19	.19	.357	.714	.714	.024	.381	.381
Average back of queue (veh)		.9			5.3	2.5	33.7	14.4	.2	1	20.4	0
Uniform delay (s)		69.5			73.1	71.1	62.8	12.3	8.6	100.9	51.7	40.3
Incremental delay (s)		0			0	0	6.6	.1	0	.1	.6	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		69.5			73.1	71.1	69.4	12.4	8.6	101	52.3	40.3
LOS		E			E	E	E	B	A	F	D	D
Approach delay (s)/LOS	69.5	/	E	72.5	/	E	40.5	/	D	53.2	/	D
Intersection delay (s)/ LOS			45.5				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/NO DIV 2035
Comment 2035 PM W/ NO DIV, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1243	38	30	29	748	751	40	60	1025	5
RTOR volume (veh/h)			100			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	47	97	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 215 Lost time per cycle (s) 10 Critical v/c Ratio .631

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	813	816	33	65	1114	5
Capacity (veh/h)		300			238	256	1087	2458	1089	132	1600	709
Adjusted saturation flow (veh/h)		1844			1460	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.239			.311	.038	.748	.332	.03	.495	.696	.008
g/C ratio		.163			.163	.163	.316	.693	.693	.074	.451	.451
Average back of queue (veh)		3.9			4.1	.5	24.6	10.9	.6	4.1	30.2	.2
Uniform delay (s)		78.4			79.4	75.8	65.8	13.2	10.3	95.6	47.2	32.5
Incremental delay (s)		0			0	0	2.9	0	0	2.8	1.3	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		78.4			79.4	75.8	68.7	13.2	10.3	98.4	48.5	32.5
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	78.4	/	E	79	/	E	40.3	/	D	51.2	/	D
Intersection delay (s)/ LOS			46.6				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/20% DIV 2035
Comment 2035 AM W/20% DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	706	29	63	61	786	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	65	80	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 210 Lost time per cycle (s) 10 Critical v/c Ratio .556

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	854	1072	13	15	786	1
Capacity (veh/h)		345			321	299	1227	2533	1122	42	1351	598
Adjusted saturation flow (veh/h)		1812			1686	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.054			.311	.167	.696	.423	.012	.361	.582	.002
g/C ratio		.19			.19	.19	.357	.714	.714	.024	.381	.381
Average back of queue (veh)		.9			5.3	2.5	23.8	14.4	.2	1	20.4	0
Uniform delay (s)		69.5			73.1	71.1	57.7	12.3	8.6	100.9	51.7	40.3
Incremental delay (s)		0			0	0	1.7	.1	0	.1	.6	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		69.5			73.1	71.1	59.4	12.4	8.6	101	52.3	40.3
LOS		E			E	E	E	B	A	F	D	D
Approach delay (s)/LOS	69.5	/	E	72.5	/	E	33.1	/	C	53.2	/	D
Intersection delay (s)/ LOS			40.9				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/20% DIV 2035
Comment 2035 PM W/ 20% DIV, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1000	38	30	29	601	751	40	60	1025	5
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	39	90	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 200 Lost time per cycle (s) 10 Critical v/c Ratio .583

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	653	816	33	65	1114	5
Capacity (veh/h)		323			258	275	1031	2376	1053	142	1596	707
Adjusted saturation flow (veh/h)		1844			1477	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.222			.286	.036	.634	.344	.031	.461	.698	.008
g/C ratio		.175			.175	.175	.3	.67	.67	.08	.45	.45
Average back of queue (veh)		3.6			3.8	.5	17.4	10.9	.6	3.7	28.2	.2
Uniform delay (s)		70.8			71.6	68.5	60.5	14.1	11.1	87.9	44.1	30.4
Incremental delay (s)		0			0	0	1.3	0	0	1.7	1.4	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		70.8			71.6	68.5	61.8	14.1	11.1	89.6	45.5	30.4
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	70.8	/	E	71.3	/	E	34.8	/	C	47.9	/	D
Intersection delay (s)/ LOS			42.2				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/33% DIV 2035
Comment 2035 AM W/33% DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	591	29	63	61	656	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	55	70	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 190 Lost time per cycle (s) 10 Critical v/c Ratio .515

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	713	1072	13	15	786	1
Capacity (veh/h)		382			356	331	1176	2427	1075	47	1307	579
Adjusted saturation flow (veh/h)		1813			1691	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.048			.281	.151	.606	.442	.012	.327	.601	.002
g/C ratio		.211			.211	.211	.342	.684	.684	.026	.368	.368
Average back of queue (veh)		.8			4.7	2.3	17.3	14.4	.2	.9	18.9	0
Uniform delay (s)		59.8			62.9	61.2	51.9	13.6	9.6	90.8	48.7	37.9
Incremental delay (s)		0			0	0	.9	.1	0	0	.8	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		59.8			62.9	61.2	52.8	13.7	9.6	90.8	49.5	37.9
LOS		E			E	E	D	B	A	F	D	D
Approach delay (s)/LOS	59.8	/	E	62.3	/	E	29.2	/	C	50.3	/	D
Intersection delay (s)/ LOS		37.3				/				D		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/33% DIV 2035
Comment 2035 PM W/ 33% DIV, 2 LT LANES

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	838	38	30	29	503	751	40	60	1025	5
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	32	82	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 185 Lost time per cycle (s) 10 Critical v/c Ratio .551

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	547	816	33	65	1114	5
Capacity (veh/h)		349			290	297	985	2281	1011	153	1572	696
Adjusted saturation flow (veh/h)		1845			1530	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.206			.255	.033	.555	.358	.032	.426	.709	.008
g/C ratio		.189			.189	.189	.286	.643	.643	.086	.443	.443
Average back of queue (veh)		3.3			3.4	.4	13.1	10.9	.6	3.4	26.6	.2
Uniform delay (s)		63.3			63.9	61.2	56	15.3	12	80.1	41.8	28.8
Incremental delay (s)		0			0	0	.7	0	0	.9	1.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		63.3			63.9	61.2	56.7	15.3	12	81	43.3	28.8
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	63.3	/	E	63.6	/	E	31.4	/	C	45.3	/	D
Intersection delay (s)/ LOS		39.3				/				D		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM NO DIV W/IC 2035
Comment 2035 AM NO DIV W/INTERCHANGE

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	881	29	63	61	765	986	22	14	723	1
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LT					
WB			LTR					
NB		TR						
SB	LTR	TR						
Green (s)	5	70	35					
Yellow + All red (s)	5	5	5					

Cycle (s) 125 Lost time per cycle (s) 10 Critical v/c Ratio .401

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R		T	R	L	T	R
No. of lanes		1			1	1		2	1	1	2	1
Flow rate (veh/h)		18			100	45		1072	13	15	786	1
Capacity (veh/h)		508			478	440		1986	880	71	2270	1005
Adjusted saturation flow (veh/h)		1816			1707	1571		3547	1571	1770	3547	1571
v/c ratio		.036			.209	.101		.54	.015	.215	.346	.001
g/C ratio		.28			.28	.28		.56	.56	.04	.64	.64
Average back of queue (veh)		.5			2.8	1.2		13.3	.2	.6	7.1	0
Uniform delay (s)		32.7			34.4	33.3		17.3	12.2	58.1	10.4	8.1
Incremental delay (s)		0			0	0		.3	0	0	0	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		32.7			34.4	33.3		17.6	12.2	58.1	10.4	8.1
LOS		C			C	C		B	B	E	B	A
Approach delay (s)/LOS	32.7	/	C	34.1	/	C	17.6	/	B	11.3	/	B
Intersection delay (s)/ LOS			16.4				/			B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM NODIV W/IC 2035
Comment 2035 PM NO DIV W/INTERCHANGE

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1243	38	30	29	785	751	40	60	1025	5
RTOR volume (veh/h)			100			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LT					
WB			LTR					
NB		TR						
SB	LTR	TR						
Green (s)	15	85	35					
Yellow + All red (s)	5	5	5					

Cycle (s) 150 Lost time per cycle (s) 10 Critical v/c Ratio .388

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R		T	R	L	T	R
No. of lanes		1			1	1		2	1	1	2	1
Flow rate (veh/h)		72			74	10		816	33	65	1114	5
Capacity (veh/h)		430			356	367		2010	890	177	2483	1100
Adjusted saturation flow (veh/h)		1845			1527	1571		3547	1571	1770	3547	1571
v/c ratio		.167			.207	.027		.406	.037	.369	.449	.005
g/C ratio		.233			.233	.233		.567	.567	.1	.7	.7
Average back of queue (veh)		2.5			2.6	.3		10.7	.6	2.7	11.6	.1
Uniform delay (s)		45.9			46.3	44.4		18.3	14.4	63.1	9.8	6.8
Incremental delay (s)		0			0	0		0	0	.1	.1	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		45.9			46.3	44.4		18.3	14.4	63.2	9.9	6.8
LOS		D			D	D		B	B	E	A	A
Approach delay (s)/LOS	45.9	/	D	46.1	/	D	18.1	/	B	12.9	/	B
Intersection delay (s)/ LOS			17.3				/			B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV HOK 2020
Comment 2020 AM W/60% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	55	1	292	3	6	5	338	816	2	1	594	12
RTOR volume (veh/h)			70			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LT	TR					
SB	L		TR					
Green (s)	7	35	65	30				
Yellow + All red (s)	1	6	6	6				

Cycle (s) 156
Lost time per cycle (s) 12
Critical v/c Ratio .662

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		1	1	1	1	1	1
Flow rate (veh/h)		61			10		367	887	2	1	646	13
Capacity (veh/h)		255			335		478	1241	647	78	761	647
Adjusted saturation flow (veh/h)		1326			1743		1736	1827	1553	1736	1827	1553
v/c ratio		.239			.029		.768	.714	.003	.014	.848	.02
g/C ratio		.192			.192		.276	.679	.417	.045	.417	.417
Average back of queue (veh)		2.4			.4		16.4	26.5	.1	0	28.9	.3
Uniform delay (s)		53.3			51.2		51.9	15.6	26.6	71.2	41	26.8
Incremental delay (s)		0			0		7.4	2	0	0	8.9	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		53.3			51.2		59.3	17.6	26.6	71.2	49.9	26.8
LOS		D			D		E	B	C	E	D	C
Approach delay (s)/LOS	53.3	/	D	51.2	/	D	29.8	/	C	49.5	/	D
Intersection delay (s)/ LOS			37.2				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV HOK 2020
Comment 2020 PM W/70% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/13/2009
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	56	6	331	3	2	2	196	624	5	5	850	31
RTOR volume (veh/h)			75			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	10	5	70	20				
Yellow + All red (s)	6	6	6	6				

Cycle (s) 129
Lost time per cycle (s) 12
Critical v/c Ratio .748

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		1	1	1	1	1	1
Flow rate (veh/h)		67			5		213	678	5	5	924	34
Capacity (veh/h)		210			255		283	1147	975	135	991	843
Adjusted saturation flow (veh/h)		1357			1642		1736	1827	1553	1736	1827	1553
v/c ratio		.32			.021		.754	.591	.006	.04	.932	.04
g/C ratio		.155			.155		.163	.628	.628	.078	.543	.543
Average back of queue (veh)		2.3			.2		8.4	15.7	.1	.2	37.2	.6
Uniform delay (s)		48.5			46.2		51.5	14.2	9	55.1	27.3	13.8
Incremental delay (s)		0			0		11	.8	0	0	14.9	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		48.5			46.2		62.5	15	9	55.1	42.2	13.8
LOS		D			D		E	B	A	E	D	B
Approach delay (s)/LOS	48.5	/	D	46.2	/	D	26.3	/	C	41.3	/	D
Intersection delay (s)/ LOS			34.6				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/33% HOK 2035
Comment 2035 AM W/33% DIVERSION, HOKIOKIO

Site Information

Jurisdiction/Date 1/19/2009
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	55	1	591	3	6	5	656	986	2	1	723	12
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, o (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	55	70	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 185
Lost time per cycle (s) 10
Critical v/c Ratio .501

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		2	2	1	1	2	1
Flow rate (veh/h)		61			15		713	1072	2	1	786	13
Capacity (veh/h)		255			321		1207	2492	1104	48	1342	594
Adjusted saturation flow (veh/h)		1346			1697		3437	3547	1571	1770	3547	1571
v/c ratio		.239			.047		.591	.43	.002	.023	.586	.022
g/C ratio		.189			.189		.351	.703	.703	.027	.378	.378
Average back of queue (veh)		2.8			.7		16.6	13.3	0	.1	18.1	.4
Uniform delay (s)		63.7			61.4		49.1	11.7	8.2	87.6	45.9	36
Incremental delay (s)		0			0		.8	.1	0	0	.7	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		63.7			61.4		49.9	11.8	8.2	87.6	46.6	36
LOS		E			E		D	B	A	F	D	D
Approach delay (s)/LOS	63.7 / E			61.4 / E			27 / C			46.5 / D		
Intersection delay (s)/ LOS	33.9 / C											

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/33% HOK 2035
Comment 2035 PM W/ 33% DIV, HOKIOKIO

Site Information

Jurisdiction/Date 1/19/2009
EB/WB Street PUAMANA CO
NB/SB Street LAHAINA BY

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	56	6	838	3	3	2	503	751	4	5	1025	31
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	32	82	30				
Yellow + All red (s)	5	5	5	5				

Cycle (s) 180
Lost time per cycle (s) 10
Critical v/c Ratio .553

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		2	2	1	1	2	1
Flow rate (veh/h)		67			7		547	816	4	5	1114	34
Capacity (veh/h)		229			284		1012	2345	1039	157	1616	716
Adjusted saturation flow (veh/h)		1377			1703		3437	3547	1571	1770	3547	1571
v/c ratio		.294			.023		.54	.348	.004	.035	.69	.047
g/C ratio		.167			.167		.294	.661	.661	.089	.456	.456
Average back of queue (veh)		3.1			.3		12.6	10.1	.1	.3	25.2	1
Uniform delay (s)		65.7			62.7		53.3	13.4	10.4	74.9	38.9	27.3
Incremental delay (s)		0			0		.6	0	0	0	1.3	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		65.7			62.7		53.9	13.4	10.4	74.9	40.2	27.3
LOS		E			E		D	B	B	E	D	C
Approach delay (s)/LOS	65.7 / E			62.7 / E			29.6 / C			40 / D		
Intersection delay (s)/ LOS	35.2 / D											

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV 2020
Comment 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		306	443	2	399		493		2			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	25	25					
Yellow + All red (s)	4	6	6					

Cycle (s) 71 Lost time per cycle (s) 4 Critical v/c Ratio .589

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		333		2	434		536					
Capacity (veh/h)		632		121	860		601					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.526		.018	.504		.892					
g/C ratio		.352		.07	.479		.352					
Average back of queue (veh)		5.7		0	6.4		12.7					
Uniform delay (s)		18.3		30.7	12.7		21.7					
Incremental delay (s)		.8		0	.5		15.6					
Initial queue delay (s)		0		0	0		0					
Delay (s)		19.1		30.7	13.2		37.3					
LOS		B		C	B		D					
Approach delay (s)/LOS	19.1	/	B	13.3	/	B	37.3	/	D		/	
Intersection delay (s)/ LOS			24.6				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV 2020
Comment 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		394	719	16	225		476		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	50	35					
Yellow + All red (s)	4	6	6					

Cycle (s) 106 Lost time per cycle (s) 6 Critical v/c Ratio .585

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		428		17	245		517					
Capacity (veh/h)		847		81	999		563					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.506		.214	.245		.919					
g/C ratio		.472		.047	.557		.33					
Average back of queue (veh)		9.4		.5	3.9		18.3					
Uniform delay (s)		19.4		48.6	12.1		34.1					
Incremental delay (s)		.5		0	0		20.3					
Initial queue delay (s)		0		0	0		0					
Delay (s)		19.9		48.6	12.1		54.4					
LOS		B		D	B		D					
Approach delay (s)/LOS	19.9	/	B	14.5	/	B	54.4	/	D		/	
Intersection delay (s)/ LOS			33.5				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM NO DIV 2035
Comment 2035 AM W/NO DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		895	13	2	1037		25		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	50	5					
Yellow + All red (s)	4	6	6					

Cycle (s) 76
Lost time per cycle (s) 4
Critical v/c Ratio .679

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		973		2	1127		27					
Capacity (veh/h)		1181		113	1394		112					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.824		.019	.809		.242					
g/C ratio		.658		.066	.776		.066					
Average back of queue (veh)		18.2		0	17.3		.6					
Uniform delay (s)		9.7		33.2	5.1		33.7					
Incremental delay (s)		4.9		0	3.7		0					
Initial queue delay (s)		0		0	0		0					
Delay (s)		14.6		33.2	8.8		33.7					
LOS		B		C	A		C					
Approach delay (s)/LOS	14.6	/	B	8.9	/	A	33.7	/	C		/	
Intersection delay (s)/ LOS			11.8				/			B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM NO DIV 2035
Comment 2035 PM W/NO DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		1306	25	6	777		50		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	90	8					
Yellow + All red (s)	4	6	6					

Cycle (s) 119
Lost time per cycle (s) 6
Critical v/c Ratio .87

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		1420		7	845		54					
Capacity (veh/h)		1358		72	1494		115					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		1.045		.09	.565		.474					
g/C ratio		.756		.042	.832		.067					
Average back of queue (veh)		64.5		.2	10.2		1.9					
Uniform delay (s)		14.5		54.8	3.2		53.5					
Incremental delay (s)		37.2		0	.5		2.5					
Initial queue delay (s)		0		0	0		0					
Delay (s)		51.7		54.8	3.7		56					
LOS		D		D	A		E					
Approach delay (s)/LOS	51.7	/	D	4.1	/	A	56	/	E		/	
Intersection delay (s)/ LOS			34.4				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 20% DIV 2035
Comment 2035 AM W/20% DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		720	186	2	847		215		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		50			50			50				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	49	16					
Yellow + All red (s)	4	6	6					

Cycle (s) 86
Lost time per cycle (s) 4
Critical v/c Ratio .681

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		783		2	921		234					
Capacity (veh/h)		1023		100	1211		317					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.765		.022	.76		.736					
g/C ratio		.57		.058	.674		.186					
Average back of queue (veh)		16.3		.1	16.9		6.1					
Uniform delay (s)		14.1		38.2	9.4		33					
Incremental delay (s)		3.5		0	2.9		8.7					
Initial queue delay (s)		0		0	0		0					
Delay (s)		17.6		38.2	12.3		41.7					
LOS		B		D	B		D					
Approach delay (s)/LOS	17.6	/	B	12.3	/	B	41.7	/	D		/	
Intersection delay (s)/ LOS			18				/			B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 20% DIV 2035
Comment 2035 PM W/20% DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		1063	253	16	630		152		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	80	20					
Yellow + All red (s)	4	6	6					

Cycle (s) 121
Lost time per cycle (s) 6
Critical v/c Ratio .79

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		1155		17	685		165					
Capacity (veh/h)		1187		71	1321		282					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.973		.245	.519		.586					
g/C ratio		.661		.041	.736		.165					
Average back of queue (veh)		46.6		.6	10.9		5.7					
Uniform delay (s)		19.5		56.2	6.8		46.7					
Incremental delay (s)		19.9		0	.4		3.1					
Initial queue delay (s)		0		0	0		0					
Delay (s)		39.4		56.2	7.2		49.8					
LOS		D		E	A		D					
Approach delay (s)/LOS	39.4	/	D	8.5	/	A	49.8	/	D		/	
Intersection delay (s)/ LOS			29.5				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33% DIV 2035
Comment 2035 AM W/33% DIVERSION

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		605	301	2	717		345		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		50			50			50				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	45	25					
Yellow + All red (s)	4	6	6					

Cycle (s) 91
Lost time per cycle (s) 4
Critical v/c Ratio .684

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		658		2	779		375					
Capacity (veh/h)		888		94	1065		469					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.741		.023	.731		.8					
g/C ratio		.495		.055	.593		.275					
Average back of queue (veh)		15		.1	16		10.4					
Uniform delay (s)		18.3		40.7	13.3		30.7					
Incremental delay (s)		3.4		0	2.6		9.6					
Initial queue delay (s)		0		0	0		0					
Delay (s)		21.7		40.7	15.9		40.3					
LOS		C		D	B		D					
Approach delay (s)/LOS	21.7	/	C	16	/	B	40.3	/	D		/	
Intersection delay (s)/ LOS			23.1				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33% DIV 2035
Comment 2035 PM W/33% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		901	430	16	532		250		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	70	25					
Yellow + All red (s)	4	6	6					

Cycle (s) 116
Lost time per cycle (s) 6
Critical v/c Ratio .754

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		979		17	578		272					
Capacity (veh/h)		1083		74	1223		368					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.904		.235	.473		.739					
g/C ratio		.603		.043	.681		.216					
Average back of queue (veh)		33.1		.6	9.6		9.3					
Uniform delay (s)		20.1		53.7	8.7		42.5					
Incremental delay (s)		10.7		0	.2		7.7					
Initial queue delay (s)		0		0	0		0					
Delay (s)		30.8		53.7	8.9		50.2					
LOS		C		D	A		D					
Approach delay (s)/LOS	30.8	/	C	10.2	/	B	50.2	/	D		/	
Intersection delay (s)/ LOS			27				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV HOK 2020
Comment 2020 AM W/60% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		294	443	14	344		549		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)	0			0			0					
Approach bicycle volume (bic/h)	0			0			0					
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	25	29					
Yellow + All red (s)	4	6	6					

Cycle (s) 75
Lost time per cycle (s) 4
Critical v/c Ratio .59

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		320		15	374		597					
Capacity (veh/h)		598		115	814		660					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.534		.133	.459		.905					
g/C ratio		.333		.067	.453		.387					
Average back of queue (veh)		5.9		.3	5.8		15					
Uniform delay (s)		20.3		33	14.2		21.7					
Incremental delay (s)		.9		0	.3		16.1					
Initial queue delay (s)		0		0	0		0					
Delay (s)		21.2		33	14.5		37.8					
LOS		C		C	B		D					
Approach delay (s)/LOS	21.2	/	C	15.2	/	B	37.8	/	D		/	
Intersection delay (s)/ LOS	27					/				C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV HOK 2020
Comment 2020 PM W/70% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/16/2009
EB/WB Street PUAMANA CO
NB/SB Street HONOAPIILA

Intersection Data

Area type Other
Analysis period .25 h
Signal type Actuated-Field
% Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		335	719	42	201		532		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)	0			0			0					
Approach bicycle volume (bic/h)	0			0			0					
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	10	50	50					
Yellow + All red (s)	4	6	6					

Cycle (s) 126
Lost time per cycle (s) 6
Critical v/c Ratio .597

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		364		46	218		578					
Capacity (veh/h)		712		136	912		677					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.511		.335	.24		.854					
g/C ratio		.397		.079	.508		.397					
Average back of queue (veh)		10.4		1.6	4.5		21.6					
Uniform delay (s)		28.8		54.9	17.4		34.7					
Incremental delay (s)		.6		0	0		10.4					
Initial queue delay (s)		0		0	0		0					
Delay (s)		29.4		54.9	17.4		45.1					
LOS		C		D	B		D					
Approach delay (s)/LOS	29.4	/	C	23.8	/	C	45.1	/	D		/	
Intersection delay (s)/ LOS	35.7					/				D		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year AM 33% DIVHOK 2035

Comment 2035 AM W/33% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/16/2009

EB/WB Street PUAMANA CO

NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		580	301	14	662		456		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	45	30					
Yellow + All red (s)	4	6	6					

Cycle (s) 96 Lost time per cycle (s) 4 Critical v/c Ratio .721

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		630		15	720		496					
Capacity (veh/h)		842		90	1010		533					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.749		.17	.712		.93					
g/C ratio		.469		.052	.563		.313					
Average back of queue (veh)		15.6		.4	15.7		16.5					
Uniform delay (s)		20.9		43.5	15.3		32					
Incremental delay (s)		3.8		0	2.4		23					
Initial queue delay (s)		0		0	0		0					
Delay (s)		24.7		43.5	17.7		55					
LOS		C		D	B		D					
Approach delay (s)/LOS	24.7	/	C	18.3	/	B	55	/	D		/	
Intersection delay (s)/ LOS			30.2				/			C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year PM 33% DIVHOK 2035

Comment 2035 PM W/33% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date 1/16/2009

EB/WB Street PUAMANA CO

NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		750	430	42	506		306		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB	R		LR					
SB								
Green (s)	10	70	35					
Yellow + All red (s)	4	6	6					

Cycle (s) 131 Lost time per cycle (s) 6 Critical v/c Ratio .708

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		815		46	550		333					
Capacity (veh/h)		959		131	1151		456					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.85		.348	.478		.73					
g/C ratio		.534		.076	.641		.267					
Average back of queue (veh)		29.2		1.7	11.2		12.4					
Uniform delay (s)		26		57.4	12.2		43.7					
Incremental delay (s)		7.3		0	.3		5.9					
Initial queue delay (s)		0		0	0		0					
Delay (s)		33.3		57.4	12.5		49.6					
LOS		C		E	B		D					
Approach delay (s)/LOS	33.3	/	C	15.9	/	B	49.6	/	D		/	
Intersection delay (s)/ LOS			30.5				/			C		

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV 2020
Comment 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date 11/12/2008
EB/WB Street KAI HELE K
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	11	O	5	10	1	16	5	468	4	3	430	10
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		50			0			50			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	65	10					
Yellow + All red (s)	5	5	5					

Cycle (s) 95 Lost time per cycle (s) 15 Critical v/c Ratio .344

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	12		5		12	17	5	509	4	3	478	
Capacity (veh/h)	147		126		120	165	655	1262	1064	630	1248	
Adjusted saturation flow (veh/h)	1397		1198		1144	1571	1752	1845	1556	1752	1824	
v/c ratio	.081		.043		.099	.105	.008	.403	.004	.005	.383	
g/C ratio	.105		.105		.105	.105	.789	.684	.684	.789	.684	
Average back of queue (veh)	.3		.1		.3	.4	0	6.4	0	0	5.9	
Uniform delay (s)	38.4		38.2		38.4	38.5	2.7	6.5	4.8	2.8	6.4	
Incremental delay (s)	0		0		0	0	0	.1	0	0	0	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	38.4		38.2		38.4	38.5	2.7	6.6	4.8	2.8	6.4	
LOS	D		D		D	D	A	A	A	A	A	
Approach delay (s)/LOS	38.3	/	D	38.4	/	D	6.6	/	A	6.4	/	A
Intersection delay (s)/ LOS		7.9				/				A		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV 2020
Comment 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date 11/12/2008
EB/WB Street KAI HELE K
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	32	15	65	21	10	20	40	426	32	15	700	15
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		50			0			50			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	65	10					
Yellow + All red (s)	5	5	5					

Cycle (s) 95 Lost time per cycle (s) 15 Critical v/c Ratio .605

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT	R		LT	R	L	T	R	L	TR	
No. of lanes		1	1		1	1	1	1	1	1	1	
Flow rate (veh/h)		51	71		34	22	43	463	35	16	777	
Capacity (veh/h)		152	126		127	165	433	1262	1026	663	1248	
Adjusted saturation flow (veh/h)		1444	1198		1211	1571	1752	1845	1499	1752	1825	
v/c ratio		.336	.56		.264	.131	.101	.367	.034	.025	.623	
g/C ratio		.105	.105		.105	.105	.789	.684	.684	.789	.684	
Average back of queue (veh)		1.4	2		.9	.6	.3	5.6	.3	.1	12.6	
Uniform delay (s)		39.4	40.4		39.1	38.6	5.1	6.3	4.8	2.7	8.3	
Incremental delay (s)		0	5.6		0	0	0	0	0	0	1	
Initial queue delay (s)		0	0		0	0	0	0	0	0	0	
Delay (s)		39.4	46		39.1	38.6	5.1	6.3	4.8	2.7	9.3	
LOS		D	D		D	D	A	A	A	A	A	
Approach delay (s)/LOS	43.2	/	D	38.9	/	D	6.1	/	A	9.1	/	A
Intersection delay (s)/ LOS		11.9				/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33 DIV 2035
Comment 2035 AM W/ 33% DIVERSION

Site Information

Jurisdiction/Date 11/12/2008
EB/WB Street KAI HELE K
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	11	0	15	10	1	16	5	320	4	3	290	10
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		50			0			50			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	50	10					
Yellow + All red (s)	5	5	5					

Cycle (s) 80 Lost time per cycle (s) 15 Critical v/c Ratio .252

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	12		16		12	17	5	348	4	3	326	
Capacity (veh/h)	175		157		151	196	738	1153	972	718	1138	
Adjusted saturation flow (veh/h)	1397		1257		1205	1571	1752	1845	1556	1752	1821	
v/c ratio	.068		.104		.079	.089	.007	.302	.004	.005	.286	
g/C ratio	.125		.125		.125	.125	.75	.625	.625	.75	.625	
Average back of queue (veh)	.3		.3		.3	.4	0	3.9	0	0	3.6	
Uniform delay (s)	30.9		31		30.9	31	2.8	6.9	5.6	2.8	6.9	
Incremental delay (s)	0		0		0	0	0	0	0	0	0	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	30.9		31		30.9	31	2.8	6.9	5.6	2.8	6.9	
LOS	C		C		C	C	A	A	A	A	A	
Approach delay (s)/LOS	31	/	C	31	/	C	6.9	/	A	6.8	/	A
Intersection delay (s)/ LOS			8.7				/			A		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33 DIV 2035
Comment 2035 PM W/33% DIVERSION

Site Information

Jurisdiction/Date 11/12/2008
EB/WB Street KAI HELE K
NB/SB Street HONOAPIILA

Intersection Data

Area type Other Analysis period .25 h Signal type Actuated-Field % Back of queue 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	32		65	21	10	20	40	245	32	15	405	15
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		50			0			50			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	40	10					
Yellow + All red (s)	5	5	5					

Cycle (s) 70 Lost time per cycle (s) 15 Critical v/c Ratio .42

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	35		71		34	22	43	266	35	16	457	
Capacity (veh/h)	196		185		103	224	584	1054	889	749	1040	
Adjusted saturation flow (veh/h)	1369		1296		-1093:	1571	1752	1845	1556	1752	1821	
v/c ratio	.178		.382		.328	.097	.074	.253	.039	.022	.439	
g/C ratio	.143		.143		.143	.143	.714	.571	.571	.714	.571	
Average back of queue (veh)	.6		1.4			.4	.3	2.8	.3	.1	5.5	
Uniform delay (s)	26.4		27.2		27	26.1	3.7	7.5	6.6	3.1	8.6	
Incremental delay (s)	0		.2		0	0	0	0	0	0	.2	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	26.4		27.4		27	26.1	3.7	7.5	6.6	3.1	8.8	
LOS	C		C		C	C	A	A	A	A	A	
Approach delay (s)/LOS	27.1	/	C	26.6	/	C	6.9	/	A	8.6	/	A
Intersection delay (s)/ LOS			10.8				/			B		

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Unsignalized Intersection
Level of Service Worksheets

CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AMDIVHOK 2020
Comment: 2020 AM WITH HOKIOKIO PUAMAN CONNEC

Site Information

Jurisdiction/Date: 1/13/2009
Major Street: HONOAPIILANI HWY
Minor Street: PUNAKEA CONNECTOR

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	25	443			493	20				27		111
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	28	492			548	22				30		123
Flare storage (# of vehs)												0
Median storage (# of vehs)										0		

Signal upstream of Movement 2 ______ ft   Movement 5 ______ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	153	417	.367	2	18.5	C	18.5
	2								C
	3								
		①	28	997	.028	<1	8.7	A	
		④							

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PMDIVHOK 2020
Comment: 2020 PM WITH HOKIOKIO PUAMAN CONNEC

Site Information

Jurisdiction/Date: 1/13/2009
Major Street: HONOAPIILANI HWY
Minor Street: PUNAKEA CONNECTOR

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	53	735			476	37				37		112
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	59	817			529	41				41		124
Flare storage (# of vehs)												0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 ______ ft   Movement 5 ______ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	165	299	.551	3	30.8	D	30.8
	2								D
	3								
		①	59	997	.059	<1	8.8	A	
		④							

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information		Site Information	
Analyst	WY	Jurisdiction/Date	1/13/2009
Agency or Company	SSFM	Major Street	HONOAPIILANI HWY
Analysis Period/Year	AMDIVHOK 2035	Minor Street	PUNAKEA CONNECTOR
Comment	2035 AM WITH HOKIOKIO PUAMAN CONNEC		

Input Data

Lane Configuration	SB			NB			EB			WB		
Lane 1 (curb)	LT			TR						LR		
Lane 2												
Lane 3												
	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	25	302			345	20				27		111
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	28	336			383	22				30		123
Flare storage (# of vehs)												1
Median storage (# of vehs)										0		

Signal upstream of Movement 2 ______ ft   Movement 5 ______ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	153	1003	.152	1	9.2	A	9.2 A
	2								
	3								
		①	28	1148	.024	<1	8.2	A	
		④							

CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information		Site Information	
Analyst	WY	Jurisdiction/Date	1/13/2009
Agency or Company	SSFM	Major Street	HONOAPIILANI HWY
Analysis Period/Year	PMDIVHOK 2035	Minor Street	PUNAKEA CONNECTOR
Comment	2035 PM WITH HOKIOKIO PUAMANA CONN		

Input Data

Lane Configuration	SB			NB			EB			WB		
Lane 1 (curb)	LT			TR						LR		
Lane 2												
Lane 3												
	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	53	446			250	37				37		112
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	59	496			278	41				41		124
Flare storage (# of vehs)												0
Median storage (# of vehs)										0		

Signal upstream of Movement 2 ______ ft   Movement 5 ______ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	165	532	.31	1	14.8	B	14.8 B
	2								
	3								
		①	59	1235	.048	<1	8.1	A	
		④							

On Ramp Merge

Level of Service Worksheets

CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM DIV 2020
Comment 2020 AM W/60% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	10310	.09	1	928	.9	5	.976	1	1057
v_R	5060	.09		455	.9	5	.976	1	519
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1057 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1575	See Exhibit 25-7	
v_{R12}	1575	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 14.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .305 (Exhibit 25-19)
S_R = 61.5 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 61.5 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM DIV 2020
Comment 2020 PM W/70%DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	13100	.09	1	1179	.9	5	.976	1	1343
v_R	8750	.09		788	.9	5	.976	1	897
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1343 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2240	See Exhibit 25-7	
v_{R12}	2240	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 19.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .323 (Exhibit 25-19)
S_R = 61 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 61 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM BASE 2035
Comment 2035 AM BASELINE CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 12/17/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	18555	.09	1	1670	.9	5	.976	1	1902
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1902 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1933	See Exhibit 25-7	
v_{R12}	1933	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 17.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_S = .313 (Exhibit 25-19)
S_R = 61.2 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 61.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM BASE 2035
Comment 2035 PM BASELINE CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 12/17/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 140 ft
S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	25222	.09	1	2270	.9	5	.976	1	2585
v_R	950	.09		86	.9	5	.976	1	97
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 2585 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2683	See Exhibit 25-7	
v_{R12}	2683	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 25.5 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_S = .368 (Exhibit 25-19)
S_R = 59.7 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 59.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 20 DIV 2035
Comment 2035 AM W/20% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	16180	.09	1	1456	.9	5	.976	1	1658
v_R	2222	.09		200	.9	5	.976	1	228
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation (Exhibit 25-5)
v_{12} = 1658 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1886	See Exhibit 25-7	
v_{R12}	1886	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 16.9 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .312 (Exhibit 25-19)
S_R = 61.3 mi/h (Exhibit 25-19)
S_0 = mi/h (Exhibit 25-19)
S = 61.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
v_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = pc/mi/ln
LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R = mi/h (Exhibit 25-19)
S_0 = mi/h (Exhibit 25-19)
S = mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 20 DIV 2035
Comment 2035 PM W/20% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	22444	.09	1	2020	.9	5	.976	1	2301
v_R	3655	.09		329	.9	5	.976	1	375
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation (Exhibit 25-5)
v_{12} = 2301 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2675	See Exhibit 25-7	
v_{R12}	2675	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 23 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .343 (Exhibit 25-19)
S_R = 60.4 mi/h (Exhibit 25-19)
S_0 = mi/h (Exhibit 25-19)
S = 60.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
v_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = pc/mi/ln
LOS = (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R = mi/h (Exhibit 25-19)
S_0 = mi/h (Exhibit 25-19)
S = mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM 33 DIV 2035
Comment 2035 AM W/33% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	14900	.09	1	1341	.9	5	.976	1	1527
v_R	3500	.09		315	.9	5	.976	1	359
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F \cdot P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1527 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1886	See Exhibit 25-7	
v_{R12}	1886	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 16.9 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .312 (Exhibit 25-19)
S_R = 61.3 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 61.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM 33 DIV 2035
Comment 2035 PM W/33% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date 11/16/2008
Freeway/Direction of Travel LAHAINA BYPASS WB
Junction HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	20655	.09	1	1859	.9	5	.976	1	2117
v_R	5460	.09		491	.9	5	.976	1	560
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F \cdot P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 2117 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2677	See Exhibit 25-7	
v_{R12}	2677	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 23 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .343 (Exhibit 25-19)
S_R = 60.4 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 60.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM PK 0 DIV 2035
Comment 2035 AM PEAK MICH U-TURN NO DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	21840	.09	1	1966	.9	5	.93	1	2348
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 2348 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2533	See Exhibit 25-7	
v_{R12}	2533	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 22 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .335 (Exhibit 25-19)
S_R = 54 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM PK 0 DIV 2035
Comment 2035 PM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	17900	.09	1	1611	.9	5	.93	1	1924
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1924 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2051	See Exhibit 25-7	
v_{R12}	2051	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 18.3 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .316 (Exhibit 25-19)
S_R = 54.3 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM PK 20% DIV 2035
Comment 2035 AM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	19640	.09	1	1768	.9	5	.93	1	2111
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 2111 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2296	See Exhibit 25-7	
v_{R12}	2296	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 20.2 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .325 (Exhibit 25-19)
S_R = 54.2 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM PK 20% DIV 2035
Comment 2035 PM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	15500	.09	1	1395	.9	5	.93	1	1666
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1666 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1793	See Exhibit 25-7	
v_{R12}	1793	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 16.3 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .309 (Exhibit 25-19)
S_R = 54.4 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM PK 33% DIV 2035
Comment 2035 AM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	18200	.09	1	1638	.9	5	.93	1	1957
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1957 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2142	See Exhibit 25-7	
v_{R12}	2142	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 19 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .319 (Exhibit 25-19)
S_R = 54.3 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM PK 33% DIV 2035
Comment 2035 PM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BYPASS NB
Junction KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	14410	.09	1	1297	.9	5	.93	1	1549
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$
L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1549 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1676	See Exhibit 25-7	
v_{R12}	1676	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 15.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .307 (Exhibit 25-19)
S_R = 54.5 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.5 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$
L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM PK 0 DIV 2035
Comment 2035 AM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008
Freeway/Direction of Travel LAHAINA BYPASS SB
Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☐ Right side ☑ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 140 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	18500	.09	1	1665	.9	5	.976	1	1896
v_R	400	.09		36	.9	5	.976	1	41
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1896 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1937	See Exhibit 25-7	
v_{R12}	1937	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 19.7 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .338 (Exhibit 25-19)
S_R = 53.9 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 53.9 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_U$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM PK 0 DIV 2035
Comment 2035 PM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008
Freeway/Direction of Travel LAHAINA BYPASS SB
Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☐ Right side ☑ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 140 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_f	26180	.09	1	2356	.9	5	.976	1	2683
v_R	1470	.09		132	.9	5	.976	1	151
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2683 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2834	See Exhibit 25-7	
v_{R12}	2834	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 26.6 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .378 (Exhibit 25-19)
S_R = 53.2 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 53.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year AM PK 20% DIV 2035

Comment 2035 AM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008

Freeway/Direction of Travel LAHAINA BYPASS SB

Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = ____ ft

V_u = ____ veh/h

Freeway terrain Level

Ramp terrain Level

Ramp Type

☑ Merge ☐ Diverge

☐ Right side ☑ Left side

Number of freeway lanes 2

Number of ramp lanes 1

Length of ramp roadway 140 ft

S_{FF} = 60 mi/h

S_{FR} = 35 mi/h

Downstream Adjacent Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ____ ft

V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	16550	.09	1	1490	.9	5	.976	1	1696
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F \cdot P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)

P_{FM} = 1 using Equation ____ (Exhibit 25-5)

v_{12} = 1696 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1727	See Exhibit 25-7	
v_{R12}	1727	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 18.1 pc/mi/ln

LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .333 (Exhibit 25-19)

S_R = 54 mi/h (Exhibit 25-19)

S_0 = ____ mi/h (Exhibit 25-19)

S = 54 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)

P_{FD} = ____ using Equation ____ (Exhibit 25-12)

v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln

LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)

S_R = ____ mi/h (Exhibit 25-19)

S_0 = ____ mi/h (Exhibit 25-19)

S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year PM PK 20% DIV 2035

Comment 2035 PM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008

Freeway/Direction of Travel LAHAINA BYPASS SB

Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp

☑ Yes ☐ On

☐ No ☐ Off

L_{up} = ____ ft

V_u = ____ veh/h

Freeway terrain Level

Ramp terrain Level

Ramp Type

☑ Merge ☐ Diverge

☐ Right side ☑ Left side

Number of freeway lanes 2

Number of ramp lanes 1

Length of ramp roadway 140 ft

S_{FF} = 60 mi/h

S_{FR} = 35 mi/h

Downstream Adjacent Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ____ ft

V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	23500	.09	1	2115	.9	5	.976	1	2409
v_R	522	.09		47	.9	5	.976	1	54
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F \cdot P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)

P_{FM} = 1 using Equation ____ (Exhibit 25-5)

v_{12} = 2409 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2462	See Exhibit 25-7	
v_{R12}	2462	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 23.8 pc/mi/ln

LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .357 (Exhibit 25-19)

S_R = 53.6 mi/h (Exhibit 25-19)

S_0 = ____ mi/h (Exhibit 25-19)

S = 53.6 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)

P_{FD} = ____ using Equation ____ (Exhibit 25-12)

v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln

LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)

S_R = ____ mi/h (Exhibit 25-19)

S_0 = ____ mi/h (Exhibit 25-19)

S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM PK 33% DIV 2035
Comment 2035 AM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008
Freeway/Direction of Travel LAHAINA BYPASS SB
Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☐ Right side ☑ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 140 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	15250	.09	1	1373	.9	5	.976	1	1563
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1563 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1594	See Exhibit 25-7	
v_{R12}	1594	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 17 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .33 (Exhibit 25-19)
S_R = 54.1 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 54.1 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM PK 33% DIV 2035
Comment 2035 PM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date 12/14/2008
Freeway/Direction of Travel LAHAINA BYPASS SB
Junction LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Level
Ramp terrain Level
Ramp Type
☑ Merge ☐ Diverge
☐ Right side ☑ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 140 ft
S_{FF} = 60 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	21680	.09	1	1951	.9	5	.976	1	2222
v_R	515	.09		46	.9	5	.976	1	53
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 2222 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2275	See Exhibit 25-7	
v_{R12}	2275	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 22.3 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .349 (Exhibit 25-19)
S_R = 53.7 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 53.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year AM W/NO DIV 2035

Comment 2035 AM W/NO DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008

Freeway/Direction of Travel LAHAINA BP SB

Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp

☑ Yes ☐ On

☐ No ☐ Off

L_{up} = ______ ft

V_u = ______ veh/h

Freeway terrain Rolling

Ramp terrain Rolling

Ramp Type

☑ Merge ☐ Diverge

☑ Right side ☐ Left side

Number of freeway lanes 2

Number of ramp lanes 1

Length of ramp roadway 500 ft

S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ______ ft

V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	9800	.09		882	.9	5	.93	1	1054
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)

P_{FM} = 1 using Equation ______ (Exhibit 25-5)

v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1951	See Exhibit 25-7	
v_{R12}	1951	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 17.1 pc/mi/ln

LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .313 (Exhibit 25-19)

S_R = 61.2 mi/h (Exhibit 25-19)

S_0 = ______ mi/h (Exhibit 25-19)

S = 61.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)

P_{FD} = ______ using Equation ______ (Exhibit 25-12)

v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln

LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)

S_R = ______ mi/h (Exhibit 25-19)

S_0 = ______ mi/h (Exhibit 25-19)

S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY

Agency or Company SSFM

Analysis Period/Year PM W/NO DIV 2035

Comment 2035 PM W/NO DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008

Freeway/Direction of Travel LAHAINA BP SB

Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp

☑ Yes ☐ On

☐ No ☐ Off

L_{up} = ______ ft

V_u = ______ veh/h

Freeway terrain Rolling

Ramp terrain Rolling

Ramp Type

☑ Merge ☐ Diverge

☑ Right side ☐ Left side

Number of freeway lanes 2

Number of ramp lanes 1

Length of ramp roadway 500 ft

S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ______ ft

V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	13800	.09		1242	.9	5	.93	1	1484
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)

P_{FM} = 1 using Equation ______ (Exhibit 25-5)

v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2753	See Exhibit 25-7	
v_{R12}	2753	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 23.1 pc/mi/ln

LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .347 (Exhibit 25-19)

S_R = 60.3 mi/h (Exhibit 25-19)

S_0 = ______ mi/h (Exhibit 25-19)

S = 60.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)

P_{FD} = ______ using Equation ______ (Exhibit 25-12)

v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ______ pc/mi/ln

LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)

S_R = ______ mi/h (Exhibit 25-19)

S_0 = ______ mi/h (Exhibit 25-19)

S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/20% DIV 2035
Comment 2035 AM W/20% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BP SB
Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	7850	.09		707	.9	5	.93	1	844
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1742	See Exhibit 25-7	
v_{R12}	1742	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 15.5 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .308 (Exhibit 25-19)
S_R = 61.4 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 61.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/20% DIV 2035
Comment 2035 PM W/20% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BP SB
Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	11111	.09		1000	.9	5	.93	1	1194
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2464	See Exhibit 25-7	
v_{R12}	2464	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 21 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .332 (Exhibit 25-19)
S_R = 60.7 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 60.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year AM W/33% DIV 2035
Comment 2035 AM W/33% DIV, PUAMANA CONN, RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BP SB
Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	6570	.09		591	.9	5	.93	1	706
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1604	See Exhibit 25-7	
v_{R12}	1604	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 14.5 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .305 (Exhibit 25-19)
S_R = 61.4 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 61.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst WY
Agency or Company SSFM
Analysis Period/Year PM W/33% DIV 2035
Comment 2035 PM W/33% DIV, PUAMANA CONN, RIGHT TURN RAMP

Site Information

Jurisdiction/Date 11/11/2008
Freeway/Direction of Travel LAHAINA BP SB
Junction PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = ______ ft
V_u = ______ veh/h

Freeway terrain Rolling
Ramp terrain Rolling
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes 2
Number of ramp lanes 1
Length of ramp roadway 500 ft
S_{FF} = 70 mi/h
S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ______ ft
V_D = ______ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	9310	.09		838	.9	5	.93	1	1001
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ______ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ______ (Exhibit 25-5)
v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2270	See Exhibit 25-7	
v_{R12}	2270	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 19.6 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .324 (Exhibit 25-19)
S_R = 60.9 mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = 60.9 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ______ (Equation 25-8 or 25-9)
P_{FD} = ______ using Equation ______ (Exhibit 25-12)
v_{12} = ______ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ______ pc/mi/ln
LOS = ______ (Exhibit 25-4)

Speed Estimation

D_s = ______ (Exhibit 25-19)
S_R = ______ mi/h (Exhibit 25-19)
S_0 = ______ mi/h (Exhibit 25-19)
S = ______ mi/h (Equation 25-15)

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APPENDIX M-1.

2014 Traffic Addendum

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PROPOSED RELOCATION OF THE SOUTHERN TERMINUS OF THE LAHAINA BYPASS – TRAFFIC ADDENDUM

February 27, 2014

I. INTRODUCTION

This purpose of this traffic addendum is to supplement the *Traffic Impact Analysis Report for The Proposed Relocation of the Southern Terminus of the Lahaina Bypass* (SSFM, 2009), hereinafter referred to as the *TIAR*. The *TIAR* was an appendix to the *Proposed Relocation of Lahaina Bypass Southern Terminus Draft Environmental Assessment* (M&H, 2012), hereinafter referred to as the *DEA*. This traffic addendum will serve to provide clarification to two key items that were commented on by the public and reviewing agencies during the *DEA* review period. These items were the location of the Puamana Connector and the analysis of intersection alternatives. The study area limits are identified as Phase 1B-2 of the Lahaina Bypass and include Hokiokio Place as the northern boundary and the southern terminus of the Lahaina Bypass with Honoapiilani Highway near Olowalu as the southern boundary.

The Puamana Connector is one of eight connectors identified in the FEIS for the Lahaina Bypass project for the purpose of circulation between the Lahaina Bypass and Honoapiilani Highway. It was determined in the FEIS that the Puamana Connector would be a new roadway spanning from mauka (mountain side) to makai (ocean side) providing access between the Lahaina Bypass and the portion of Honoapiilani Highway entering Lahaina town from the south. Although not reflected in the *TIAR*, the Puamana Connector is being proposed as a full build of four travel lanes. This will be reflected for 2035 conditions. The general location of the makai intersection of this new roadway would be in the vicinity of the Puamana Beach Park. The Puamana Connector would be extended mauka of the Lahaina Bypass to provide access to existing and proposed mauka residential development. Two possible routes considered for the Puamana Connector are in alignment with Hokiokio Place or Punakea Loop. The alignment with Hokiokio Place would serve a mauka community of about 25 parcels. Punakea Loop would be extended further makai to connect with Honoapiilani Highway. Only one of these possible routes may be selected to intersect the access-controlled bypass highway due to the proximity to each other as provided in the FEIS for the Lahaina Bypass. Traffic volume forecasts and analysis were completed and provided in the *TIAR* for the two alternative alignments of the Puamana Connector.

Secondly, the *TIAR* provides the analysis for the years 2020 and 2035 at the following intersections to consider various intersection alternatives:

- Lahaina Bypass at Puamana Connector
- Lahaina Bypass at Kai Hele Ku Street
- Lahaina Bypass at Honoapiilani Highway
- Honoapiilani Highway at Puamana Connector
- Honoapiilani Highway at Kai Hele Ku Street

Traffic forecasts were developed for both build years and a level of service (LOS) analysis was completed to identify traffic impacts and develop mitigating measures for the purposes of identifying the preferred intersection type.

II. PUAMANA CONNECTOR LOCATION

The *TIAR* considered the potential for the Puamana Connector to be aligned as an extension of Hokiokio Place or Punakea Loop. For future development, assumptions were used, and the LOS analysis did not indicate that either alternative was infeasible or that one alternative was "better" than the other. Therefore, additional considerations were identified and used to compare the connector location. This comparison resulted in the following information included in Table 1.

Table 1: Puamana Connector Location Comparison

Criteria	Punakea Loop	Hokiokio Place
Proximity to Lahaina town	-2,400 feet further away -Lahaina town-bound traffic travels along coastal roadway that has potential conflicts with surfers parking on shoulder and crossing pedestrians.	-2,400 feet closer -More direct route to Lahaina town, with few conflicts along stretch.
Secondary Mauka Access	-Yes, with frontage road connection to Hokiokio Place.	-Yes, with Lahaina Bypass underpass at intersection with Punakea Loop.
Intersection of Honoapiilani Hwy at Puamana Connector	-Requires new intersection at Honoapiilani Hwy. -New intersection in close proximity to ocean.	-Can utilize existing intersection which is being improved as part of Phase 1B-1 (reconfiguration constrained due to flood control channel). -Located inland, away from coastline. -Potential need for realignment.
Coastal Resources	-Routes traffic along coastal roadway exposed to erosion. -Maintains conflicts with ocean users and future coastal park expansion opportunities.	-Avoids stretch of coastal roadway. -Avoids conflicts with beach users. -Avoids conflict with future coastal park expansion opportunities.
Puamana Connector, between Lahaina Bypass and Honoapiilani Hwy	-Requires upgrades to Makila Ranches II subdivision road. -Requires new segment connecting to Honoapiilani Hwy through proposed County of Maui park land.	-Utilizes existing connector road to be improved as part of Lahaina Bypass Phase 1B-1.
Major cost implications	-New intersection at Honoapiilani Hwy ($600K). -Upgrade to connector road ($400K). -New connector road segment ($900K). -Hokiokio frontage road ($1.9 million).	-Underpass at Punakea Loop ($1.5 million.
Total Cost	**$3.8 million**	**$1.5 million**

The alternative aligned with Punakea Loop provides a secondary access for residents located mauka of the Lahaina Bypass, however it would require a new intersection along Honoapiilani Highway south of the flood control channel. Additionally, a mauka frontage road connection would be required from Hokiokio Place to Punakea Loop since there would be no access to the Lahaina Bypass at Hokiokio Place. Punakea Loop is an Agricultural subdivision road as part of the proposed Makila Ranches subdivisions. The makai portion would require upgrades to meet connector roadway standards. Additionally, an additional leg would need to be built to provide a connection to Honoapiilani Highway. A new intersection would also be constructed at Honoapiilani Highway.

In summary, Hokiokio Place is the preferred connector location based on its proximity to Lahaina town and the avoidance of conflicts that would come from the Punakea Loop alternative that routes Lahaina town-bound traffic along the shoreline. In addition, the Hokiokio Place alternative utilizes an existing roadway and intersection as opposed to constructing a new intersection and roadway improvements to provide a new connector between Honoapiilani Highway and the Lahaina Bypass. An underpass at Punakea Loop would provide emergency/secondary access for mauka residents.

The *TIAR* noted that the preferred intersection design of Puamana Connector and Honoapiilani Highway was to provide a through movement from southeast-bound Honoapiilani Highway to Puamana Connector (see Figure 1, *TIAR* Figure D-10 edited). This figure does not reflect the potential number of lanes on the Puamana Connector. Hokiokio Place currently intersects Honoapiilani Highway at a signalized "T-intersection" which requires mauka-bound vehicles to make a left off Honoapiilani Highway. There are issues with regards to reconfiguring the Honoapiilani Highway and Hokiokio Place intersection due to the future flood control channel. If reconfigured to reflect the preferred intersection alignment, additional culverts may be needed to span the flood control channel. The ultimate intersection alignment may need to be modified to address these constraints.

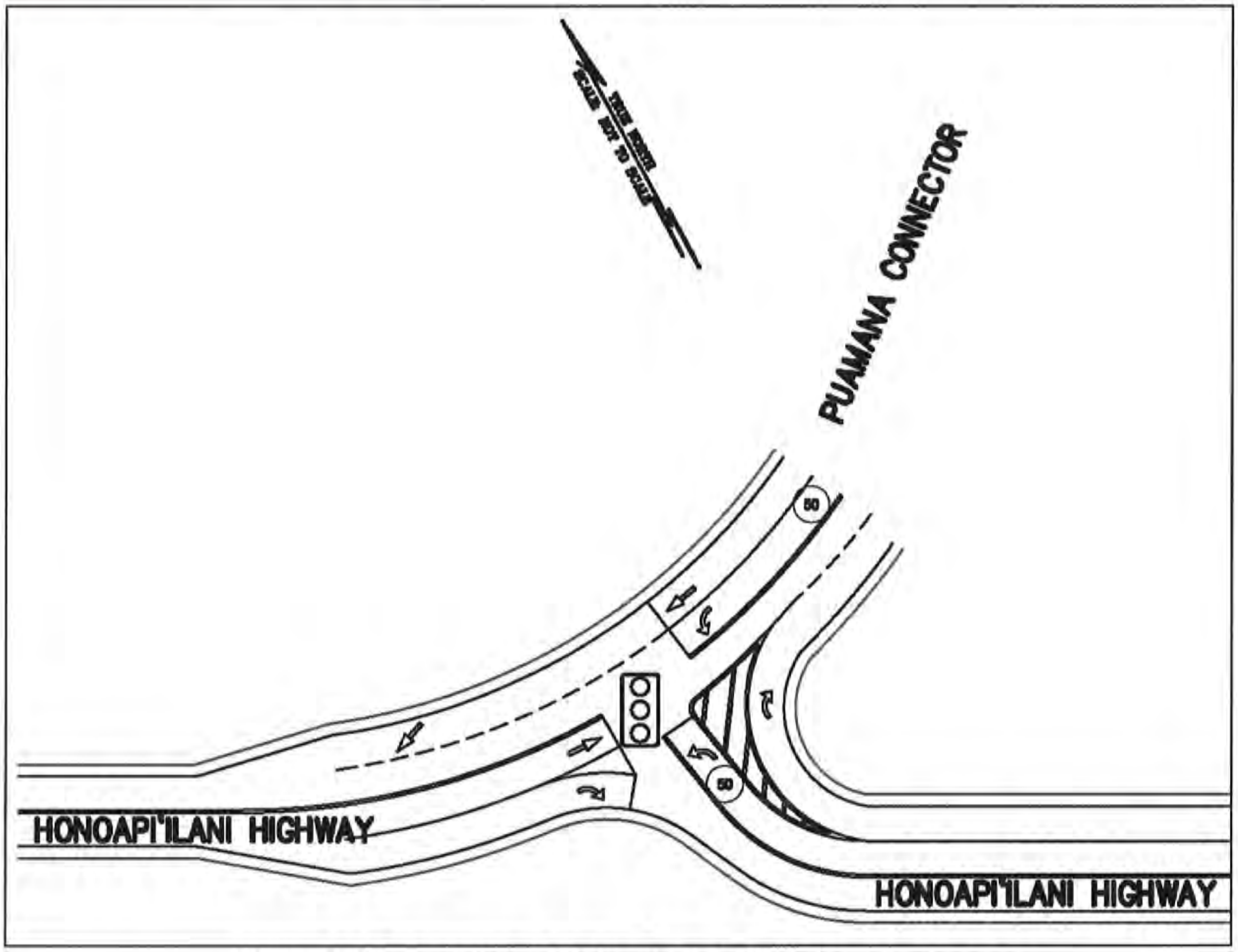


Figure 1: Honoapiilani Highway and Puamana Connector

III. INTERSECTION ALTERNATIVE ANALYSIS

The *TIAR* concluded that the proposed roadway network for the southern terminus of the Lahaina Bypass Highway is forecast to be operating over capacity by the year 2020 and that the existing section of Honoapiilani Highway in this area would need to be maintained in service following the construction of the Lahaina Bypass to provide sufficient roadway capacity. It was also concluded that all of the study intersections would need to be signalized by 2020 to operate appropriately. Intersection vehicular volumes were forecast for the years 2020 and 2035.

As noted in the *TIAR*, two highway network scenarios were assumed for the year 2035. The first scenario assumed the baseline network with the section of Honoapiilani Highway between the Puamana Connector and southern terminus restricted to local recreational traffic. The second scenario assumed that the existing section of Honoapiilani Highway between the Puamana Connector and the southern terminus would continue to be in service to maintain six lanes of highway capacity through this study area. Two levels of diversion, upper and lower bounds, were estimated regarding the percentage of trips that would use the makai route. It was estimated that 20 percent and 33 percent of the peak hour trips would divert to Honoapiilani Highway. These low levels of diversion assume that the highway network would be designed to encourage most of the trips to utilize the bypass highway route.

Forecasted intersection traffic volumes in the *TIAR*, including supplemental volumes, are included in Appendix A. This included intersection volumes with the Lahaina Bypass and with Honoapiilani Highway for the option of the Puamana Connector aligning with Hokiokio Place or with Punakea Loop. The *TIAR* included volumes at the intersections of Lahaina Bypass at Kai Hele Ku Street, Lahaina Bypass at Honoapiilani Highway, and Honoapiilani Highway at Kai Hele Ku Street for the alignment of the Puamana Connector at Punakea Loop. Changes in intersection volumes at these intersections as a result of the Puamana Connector aligning with Hokiokio Place do not significantly change the previous analysis at these intersections.

A. Traffic Signal Warrant Analysis

The *Manual on Uniform Traffic Control Devices (MUTCD)* (FHWA, 2009) states that prior to the signalization of an intersection, an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic signal is justified. With the forecasted vehicular traffic volumes included in Appendix A, Warrant 3 - Peak Hour signal warrants were run for the study intersection alternatives. For the conditions at the intersection of Lahaina Bypass and Puamana Connector (Hokiokio Place) where side street volumes are minor although major street left-turn volumes are high the *MUTCD* (FHWA, 2009) states, "…the signal warrant analysis may be performed in a manner that considers the higher of the major-street left-turn volumes as the "minor-street" volume."

Traffic signal peak hour warrant results are documented in Table 2 with detailed analysis included in Appendix B. Traffic signal warrants passed for most intersection scenarios. In 2020, the intersection of Lahaina Bypass at Puamana Connector (Hokiokio Place) did not pass signal warrants due to the small minor road volume and major road left turn conflicts. The intersections of Honoapiilani Highway at Puamana Connector, for both Punakea Loop and Hokiokio Place scenarios, did not pass signal warrants for the 2035 baseline option in the proposed intersection reconfiguration due to the small minor road (Honoapiilani Highway) volume. With the 20% and 35% diversion scenarios for 2035, additional volumes utilize Honoapiilani Highway which result in signal warrants passing. The intersection of Honoapiilani Highway at Kai Hele Ku Street did not pass the vehicular volume traffic signal warrants although the intersection is currently signalized, providing pedestrians a safe crossing between Launiupoko Beach Park and a mauka overflow parking lot. Future traffic control should consider vehicle and pedestrian conflicts at that time and a traffic signal should be retained if pedestrian safety concerns warrant it.

Table 2: Peak Hour Traffic Signal Warrant Results

Intersection	**Peak Hour Traffic Signal Warrant**			
	2020	**2035 (base)**	**2035 (20%)**	**2035 (33%)**
Lahaina Bypass at Puamana Connector (Punakea Loop)	Pass	Pass	Pass	Pass
Lahaina Bypass at Puamana Connector (Hokiokio Place)	*Not*	Pass	Pass	Pass
Lahaina Bypass at Kai Hele Ku Street	Pass	Pass	Pass	Pass
Lahaina Bypass at Honoapiilani Hwy	Pass	*Not* *	Pass	Pass
Honoapiilani Hwy at Puamana Connector (Punakea Loop)	Pass	*Not*	Pass	Pass
Honoapiilani Hwy at Puamana Connector (Hokiokio Place)	Pass	*Not*	Pass	Pass
Honoapiilani Hwy at Kai Hele Ku Street	*Not*	*Not*	*Not*	*Not*

* - Intersection configuration in *TIAR* Figure D-2 only allows for turns from eastbound Honoapiilani Highway onto southeast-bound Honoapiilani Highway.

B. Roundabout Analysis

Hawaii Department of Transportation's (HDOT) December 18, 2008 *Modern Roundabout Policy Guideline* provides general guidelines, concepts and design elements regarding modern roundabouts as an alternative form of intersection configuration that should be considered. These guidelines provide the following criteria for consideration of a roundabout at an intersection: functional classification, traffic operations and capacity limitations, right-of-way needs, terrain, approach alignment, intersection geometries, entry volumes, adjacent intersections and highway segments, delineation and pavement markings, community enhancement, and traffic calming.

The *Modern Roundabout Policy Guideline* (HDOT, 2008) states, "it is the policy of the department to generally limit consideration to modern single-lane roundabouts only. While modern multi-lane roundabouts can accommodate high volumes of traffic, there are inherent operational and design complexities with modern multi-lane roundabouts."

With the guidelines provided, study intersections were evaluated for consideration of a roundabout using the future forecast volume scenarios (see Table 3). Intersections along the Lahaina Bypass and Puamana Connector are precluded from considering a roundabout due to the latest HDOT policy that limits consideration to single-lane roundabouts only. Full build-out operations of the Lahaina Bypass and Puamana Connector are planned for four lanes which would require a multi-lane roundabout at intersections. The Honoapiilani Highway intersection with Kai Hele Ku Street is possible for roundabout installation for all scenarios.

Table 3: Roundabout Analysis Results

Intersection	Scenario	Does it meet Functional Classification?	Single Lane - Is there a single thru lane at each approach?	Is the right-of-way available?	Is the Terrain Level?	Is the Approach alignment acceptable?	Is the Alignment normal?	Is the Entry Volume on the minor street > 10% major volume?	Roundabout is appropriate with adjacent intersections?	Proper markings will be delineated?	Traffic Calming is NOT the sole purpose of the Roundabout?	Roundabout Possible?
Lahaina Bypass at Puamana Connector (Punakea Loop)	2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N*
	2035 (base)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Lahaina Bypass at Puamana Connector (Hokiokio Place)	2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N*
	2035 (base)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Lahaina Bypass at Kai Hele Ku Street	2020	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (base)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
Lahaina Bypass at Honoapiilani Highway	2020	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (base)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Honoapiilani and Puamana Connector (Punakea Loop)	2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N*
	2035 (base)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Honoapiilani Hwy and Puamana Connector (Hokiokio Place)	2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N*
	2035 (base)	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N
	2035 (20%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
	2035 (33%)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Honoapiilani Hwy and Kai Hele Ku Street	2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	2035 (base)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	2035 (20%)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	2035 (33%)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

* Per *HDOT 2008 Modern Roundabouts Police Guideline*, modern roundabout designs must be based on long-term traffic projections and consider full build-out needs. If an intersection is not acceptable in 2035 than it is not possible in 2020.

C. Alternative Intersection Analysis

Additional alternative intersection traffic control options were evaluated for potential applicability, using the individual intersection geometric and forecast volume constraints at the two primary intersections with the Lahaina Bypass.

1. Lahaina Bypass at Kai Hele Ku Street

Due to the high cost and relatively low side-street traffic volumes, a grade separated interchange was not considered appropriate at the intersection of Lahaina Bypass and Kai Hele Ku Street. A Michigan U-Turn (see Figure 2, *TIAR* Figure D-6) provides an alternative to a standard two-way stop sign controlled intersection. There are potential safety concerns for vehicles and pedestrians in this stop-sign control configuration although safety can be enhanced by providing a sufficient median refuge for pedestrians as well as a refuge area for turning vehicles.

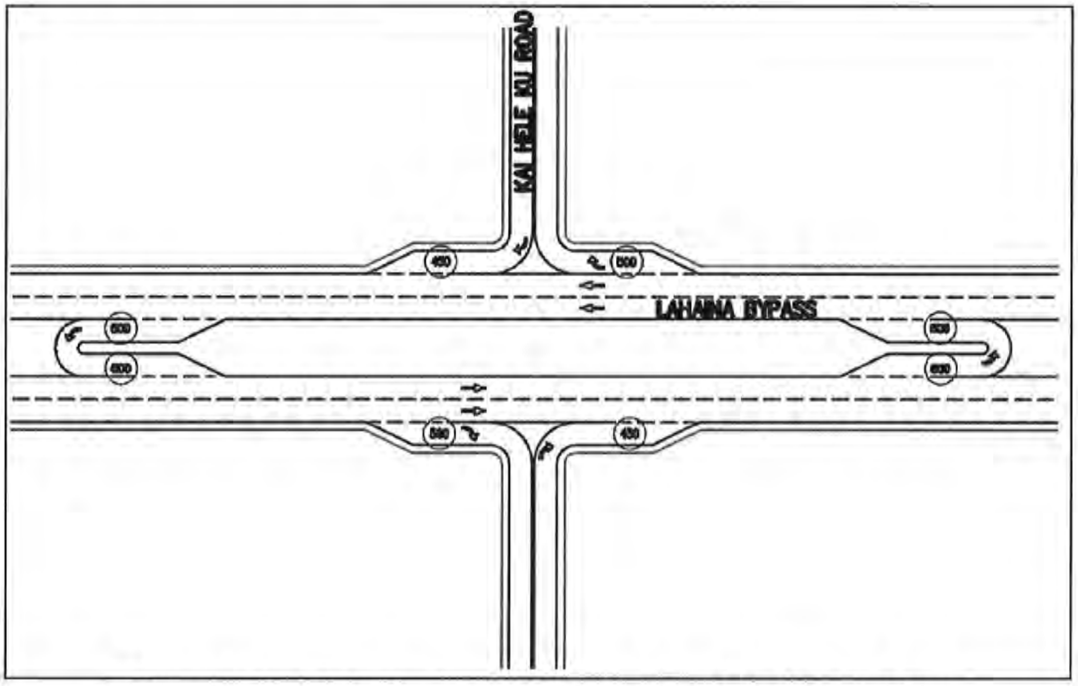


Figure 2: Kai Hele Ku Street Intersection - Michigan U-Turn

The Michigan U-Turn alternative requires additional right-of-way (ROW) width as well as approximately 4,800 linear feet of additional 12-foot wide lanes to accommodate required acceleration and deceleration lanes as shown in the *TIAR* conceptual design, in addition to taper lengths. The additional ROW width increases costs in terms of land acquisition as well as construction costs. Additional increase in construction costs are in part due to the sloping terrain, since a relatively flat profile is required to accommodate the U-turn movement for WB-50 vehicles. The wider profile increases earthwork quantities on the sloping terrain. In addition, given the sloping terrain, a wider horizontal profile also results in a larger vertical mass from the down slope perspective. The additional 80 feet of graded ROW will increase the vertical height of the downslope edge by approximately six feet over approximately 4,400 linear feet.

Comparison of the ROW and cost of a Michigan U-Turn as compared to a standard at-grade intersection at Lahaina Bypass and Kai Hele Ku Street is summarized in Table 4.

Table 4: Michigan U-Turn Comparison

Criteria	Standard At-Grade Intersection	Michigan U-Turn
Additional ROW requirements *	0*	10 acres
Additional Lanes	620 linear feet	4,840 linear feet
Total Estimated Costs	$500,000	$4,000,000

* Based on preferred alignment which does not require realignment of Kai Hele Ku Street

2. Lahaina Bypass at Puamana Connector

The *TIAR* concluded that for year 2020 and year 2035 with 33% diversion volumes, the intersection of the Lahaina Bypass with the future Puamana Connector has a minimal difference in traffic volume and LOS operations whether it is located at Hokiokio Place or at Punakea Loop. The *TIAR* provides intersection LOS information for analysis of the two options. The Hokiokio Place option results in a slightly better LOS than the Punakea Loop option (when comparing the option with two left-turn lanes at a signalized intersection). The traffic volumes are significantly higher at this intersection as compared to the intersection with Kai Hele Ku Street for the left and right-turn movements between the southern Lahaina Bypass leg and makai connector leg. In particular, the northbound left turn movement off of the Lahaina Bypass provides the largest need for mitigation due its conflicts with the southbound through-traveling Lahaina Bypass traffic. To accommodate this volume of traffic, options include signalization, grade-separated interchange, or some alternative options/combination of the two.

i. Partial Grade Separation

An alternative to the signalized intersection is grade separation, of which there are multiple options and respective cost. This would remove traffic delay resulting from the traffic signal although would cost significantly more and take additional ROW. A partial grade separation (see Figure 3, *TIAR* Figure D-9), through use of an underpass/overpass for the high volume turn movement, would allow the traffic signal to provide signal timing for the major movements resulting in intersection LOS B.

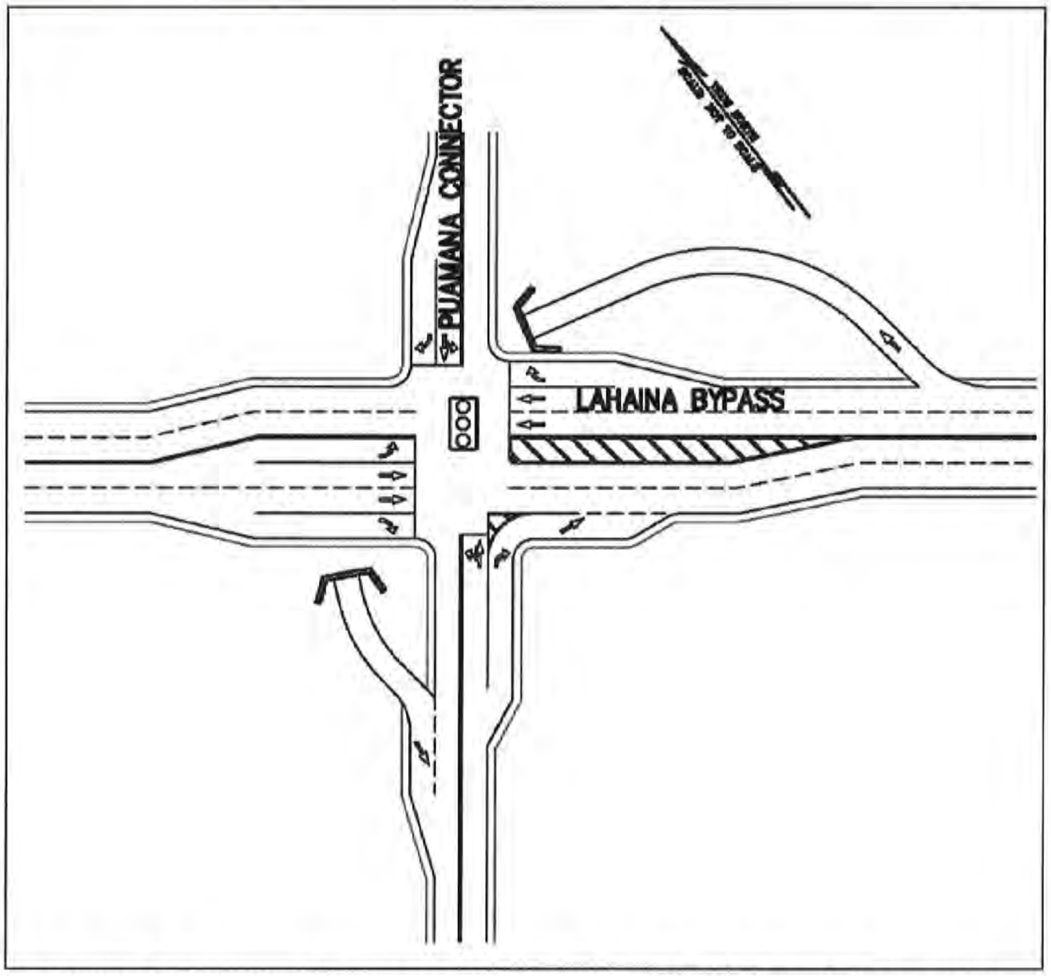


Figure 3: Puamana Connector Intersection – Partial Grade Separation

The partial grade separation alternative is significantly more costly than an at-grade intersection due to the construction of an overpass structure (see Table 5). An underpass was deemed less feasible due to line of sight limitations, resulting in wider structure and radius; drainage costs; lighting and ventilation. Additional ROW would also be required to accommodate the overpass structure.

Table 5: Grade Separation Comparison

Criteria	Standard At-Grade Intersection	Partial Grade Separation
Additional ROW requirements	0	2 acres
Overpass Structure	$0	$7,000,000
Total Estimated Costs	$1,300,000	$10,400,000

ii. Displaced Left Turn

A Displaced Left Turn intersection (see Figure 4, Source: FHWA Office of Operations website) removes some or all left turn movements from the primary intersection, facilitating the movements through signalized intersections upstream of the primary crossing of the two roads. This removes delay resulting from left turn movements at the primary intersection and helps those movements proceed during a time when through-movements are occurring. Potential concerns are with the length of storage needed to handle the queuing left-turn vehicles. This intersection has less ROW takings than a grade-separated interchange but does incur the cost of addition traffic signals and pavement as compared to a standard signalized intersection. These intersections have been used in New York, Maryland, Louisiana, and Utah.

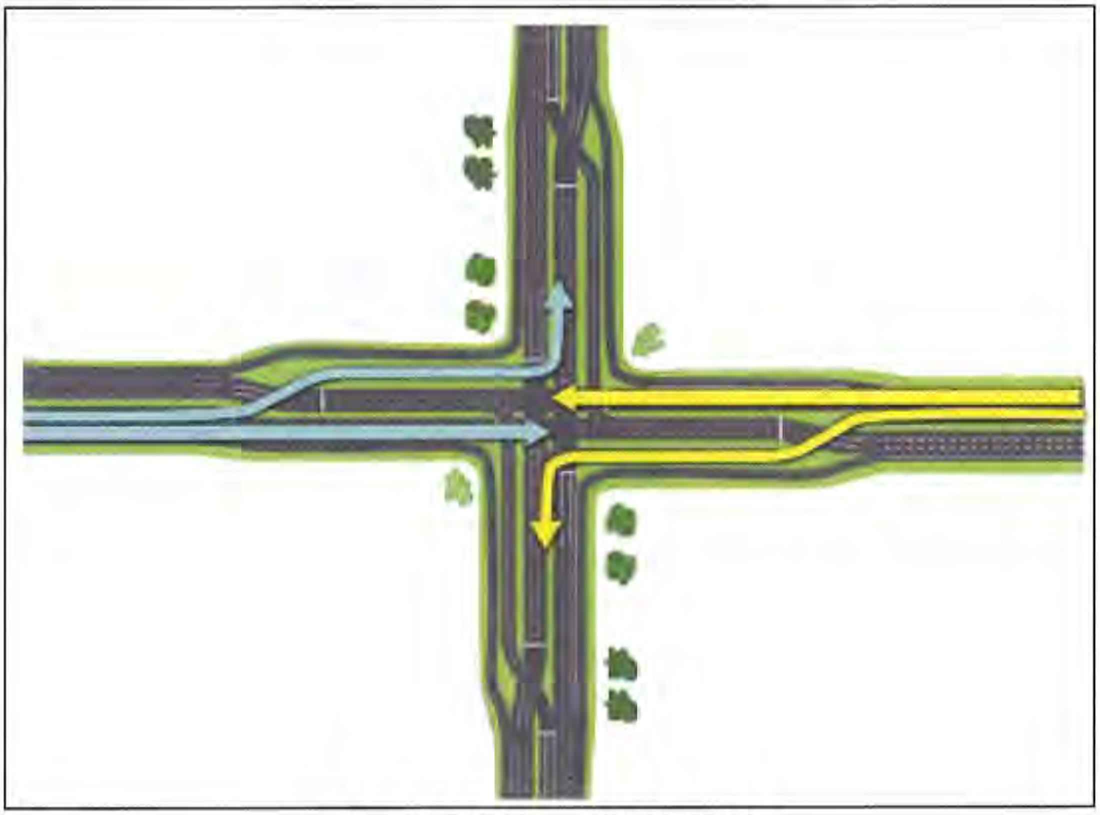


Figure 4: Displaced Left Turn

iii. Jughandle

Signalized Intersections: Informational Guide (FHWA-HRT-04-091) (FHWA, 2004) states that jughandles are typically only considered as a viable alternative at intersections with "low-to-medium" left turns from the major street. While jughandles are able to accommodate one or two lane ramps, a single lane ramp is standard. *Traffic Performance of Three Typical Designs of New Jersey Jughandle Intersections* (FHWA-HRT-07-032) looked at forward and reverse single-lane ramp jughandle (see Figure 5 and 6, Source: *NJDOT Design Manual*) capacity and concluded that the maximum number of vehicles per hour for the left-turn movement was 350 vehicles. At Hokiokio Place in the peak hour for 2035 conditions (33% diversion), the left turn volume is projected in the *TIAR* to be 655 vehicles.

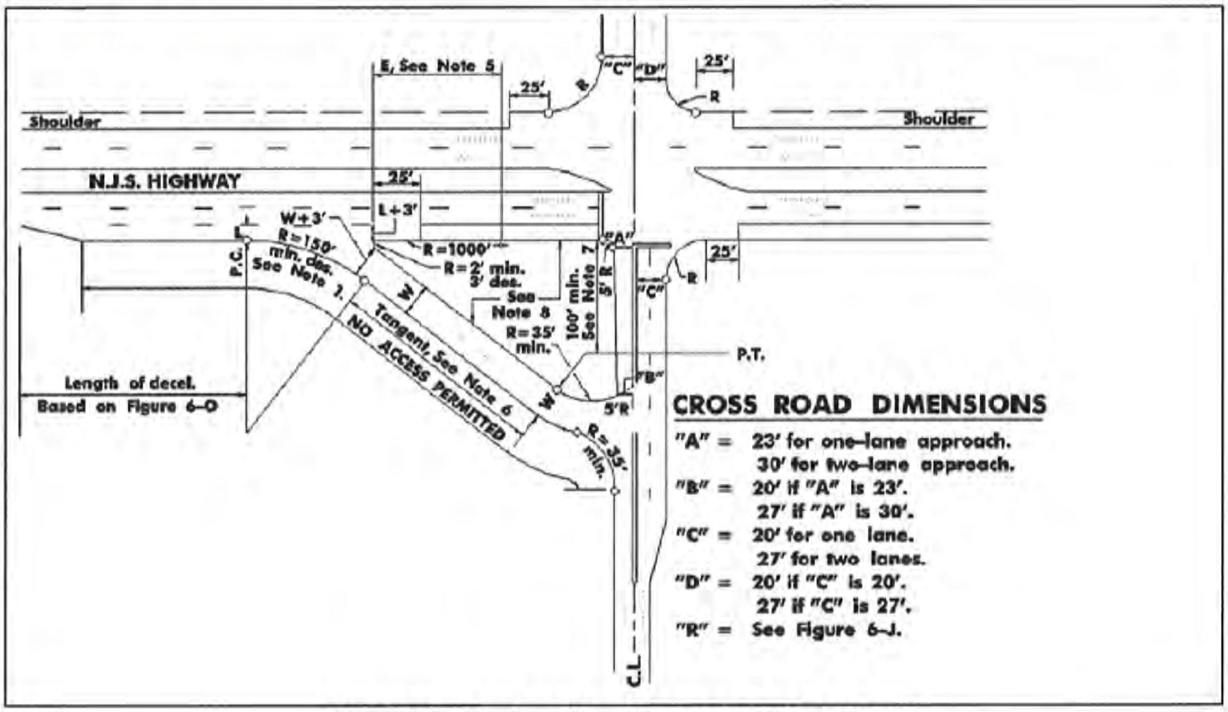


Figure 5: Jughandle - Forward Type Ramp

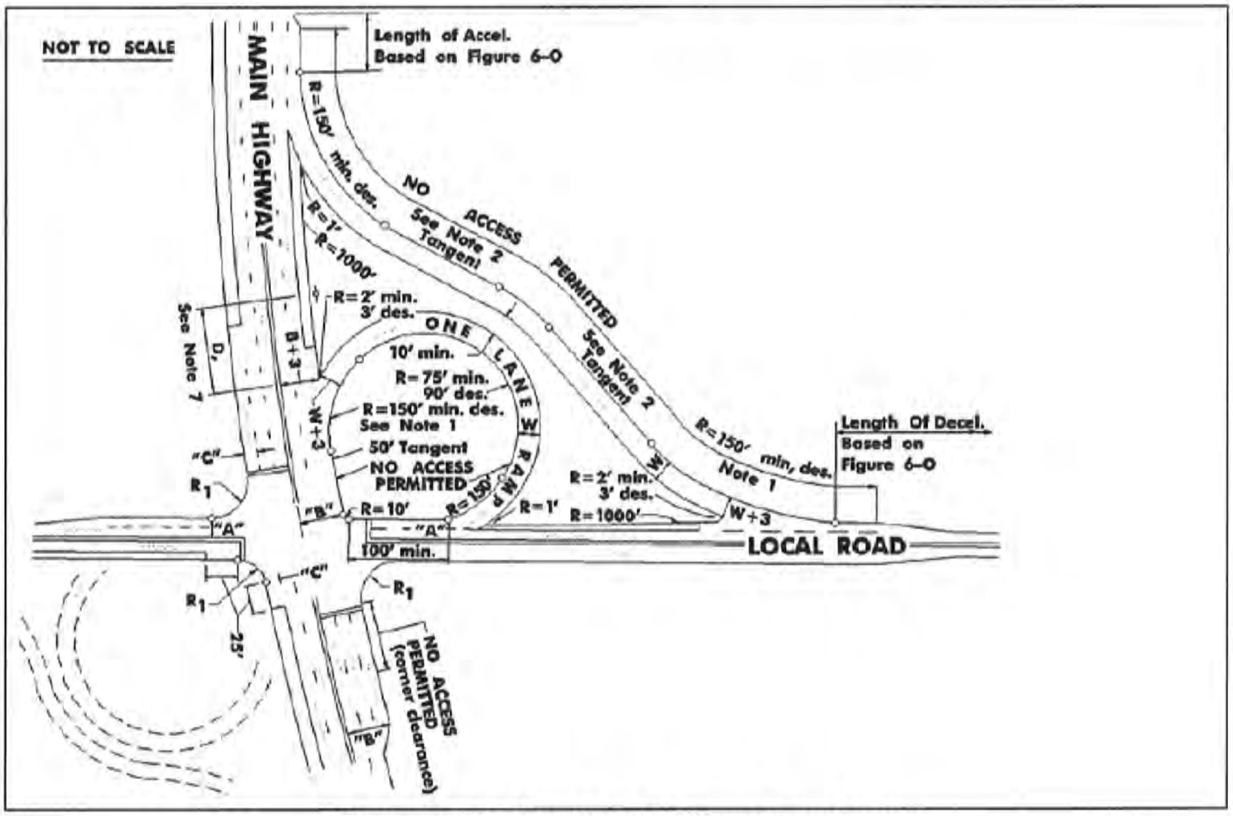


Figure 6: Jughandle - Reverse Type Ramp

A concern with high left turn volumes is that the turning vehicles may queue onto the mainline (Lahaina Bypass) which adds further delay to through-traveling vehicles. There is potential to accommodate this by having a two-lane ramp and adding a second traffic signal at the intersection of the ramp and the minor road (Puamana Connector). This signal would have to be coordinated with the primary Lahaina Bypass traffic signal. Ultimately, FHWA does not recommend using at grade reverse loop intersections for intersections with large left turn demand as there is potential of vehicles to queue through the primary intersection.

Figure 7 shows an aerial photo (Source: GoogleMaps) of the Lahaina Bypass and Hokiokio Place intersection from January 2013, reflecting partial completion of the 1B-1 improvements. Although the ramp length and offset have yet to be defined, based on preliminary estimates, all of Lot 10 would need to be purchased. At present HDOT has only contemplated purchasing the lower portion of Lot 10 for Phase 1B-1. There is also a potential for impacting a portion of Lot 9, depending on the offset of the jughandle. There is a residential dwelling on Lot 9. The gate and entry feature for the Puunoa subdivision would need to be relocated, and an additional section of Hokiokio Place would need to be improved, with a crossing over on the median separated roadway.

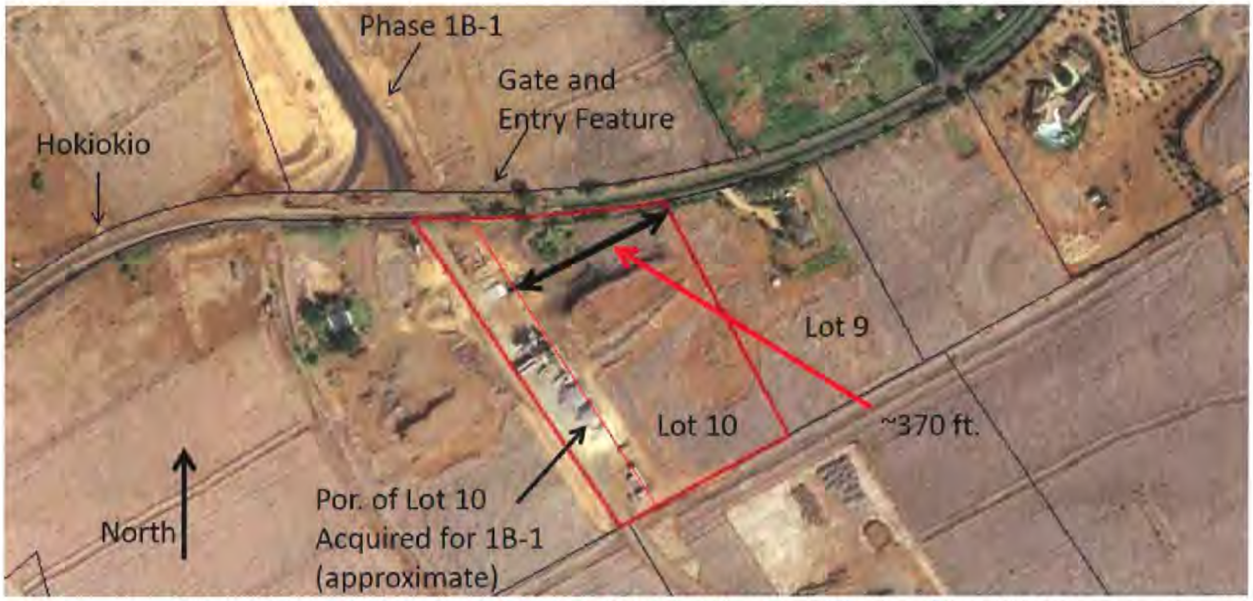


Figure 7: Lahaina Bypass at Hokiokio Place – Existing Conditions

iv. Quadrant Roadway

A Quadrant Roadway intersection (see Figure 8, Source: University of Maryland, An Applied Technology and Traffic Analysis Program website) is a form of jughandle intersection, increases operational efficiency by removing left turns away from the main intersection and allowing a two-phase traffic signal. Drawbacks are the additional ROW needed, which are more than a Displaced Left Turn intersection, cost of additional signals and roadway, and driver confusion.

Figure 8: Quadrant Roadway

Synchro traffic modeling and simulation analysis resulted in a LOS C for both signalized intersections during the AM peak hour and LOS D and LOS C during the PM peak hour (see Appendix C). This was based on a jughandle intersection configuration with a single lane exit and signalized intersection with the ramp and Hokiokio Place. The timing of the two signalized intersections would need to be coordinated.

IV. CONCLUSIONS

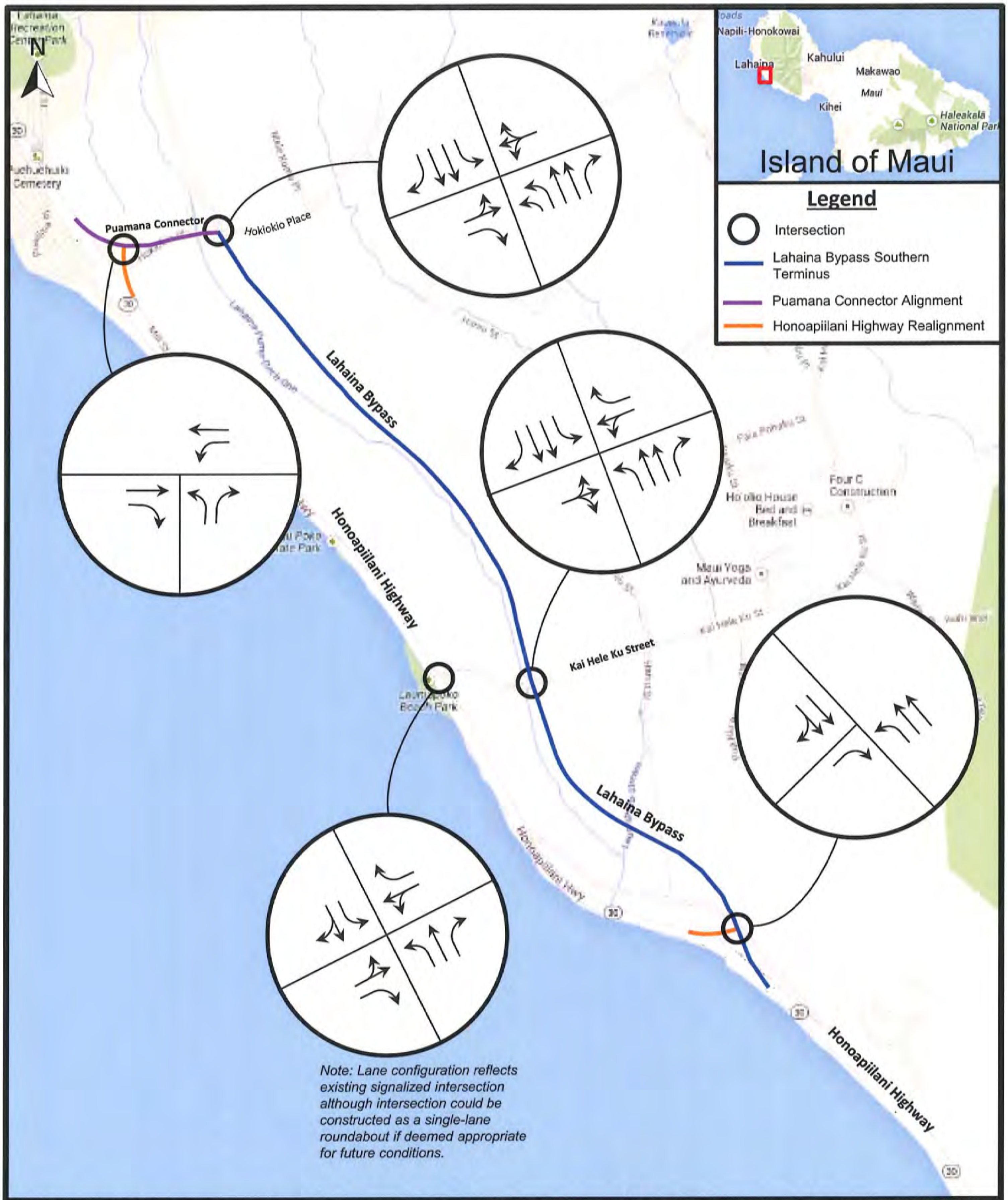
Analysis of the Puamana Connector location considered potential alignment with Punakea Loop or with Hokiokio Place. In conclusion, Hokiokio Place was considered the preferred alignment based on its proximity to Lahaina town and the avoidance of concerns that would come from routing traffic along the shoreline with the Punakea Loop alternative. In addition, it would utilize an existing roadway and intersection as opposed to constructing a new intersection and roadway improvements to provide a new connector between Honoapiilani Highway and Lahaina Bypass. Potential full build plans are for the Puamana Connector to have four travel lanes. Limited right in, right out access should be considered at the Punakea Loop underpass upon future development of the Makila Rural Residential project.

Traffic signal warrants passed for most intersection scenarios. Due to the small minor road volumes, traffic signal warrants did not pass for the intersection of Lahaina Bypass at Puamana Connector (Hokiokio Place) in 2020 and the intersections of Honoapiilani Highway at Puamana Connector, for both Punakea Loop and Hokiokio Place scenarios for the 2035 baseline option. The intersection of Honoapiilani Highway at Kai Hele Ku Street did not pass the vehicular volume traffic signal warrants although the intersection is currently signalized, providing pedestrians a safe crossing between Launiupoko Beach Park and a mauka overflow parking lot. Future traffic control should consider vehicle and pedestrian conflicts at that time and a traffic signal should be retained if pedestrian safety concerns warrant it.

Roundabouts were found to be precluded at intersections along the Lahaina Bypass and Puamana Connector although possible at the intersection of Honoapiilani Highway and Kai Hele Ku Street. Study of alternative designs at the Lahaina Bypass intersections with Kai Hele Ku Street and with the Puamana Connector concluded that all had geometric, operation, or cost constraints that made them not as feasible as a comparable standard at-grade intersection. Therefore, it is suggested that the study intersections be signalized in future conditions with the potential for a roundabout at the intersection of Honoapiilani Highway and Kai Hele Ku Street, depending on the needs at the time.

In conclusion, proposed intersection traffic control for the full build scenario is shown in the following table with lane configurations as shown in Figure 9. Future traffic volumes should be monitored and specific intersection traffic control, lane configuration, storage lengths, and traffic signal timing modified to accommodate needs at that time.

Intersection	Traffic Control
Lahaina Bypass at Puamana Connector	Traffic Signal (when warranted)
Lahaina Bypass at Kai Hele Ku Street	Traffic Signal
Lahaina Bypass at Honoapiilani Hwy	Traffic Signal
Honoapiilani Hwy at Puamana Connector	Traffic Signal
Honoapiilani Hwy at Kai Hele Ku Street	Traffic Signal or Roundabout



Note: Lane configuration reflects existing signalized intersection although intersection could be constructed as a single-lane roundabout if deemed appropriate for future conditions.

Figure 9: Full Build Intersection Lane Configuration

Proposed Relocation of the Southern Terminus of the Lahaina Bypass – Traffic Addendum

SSFM INTERNATIONAL

V. REFERENCES

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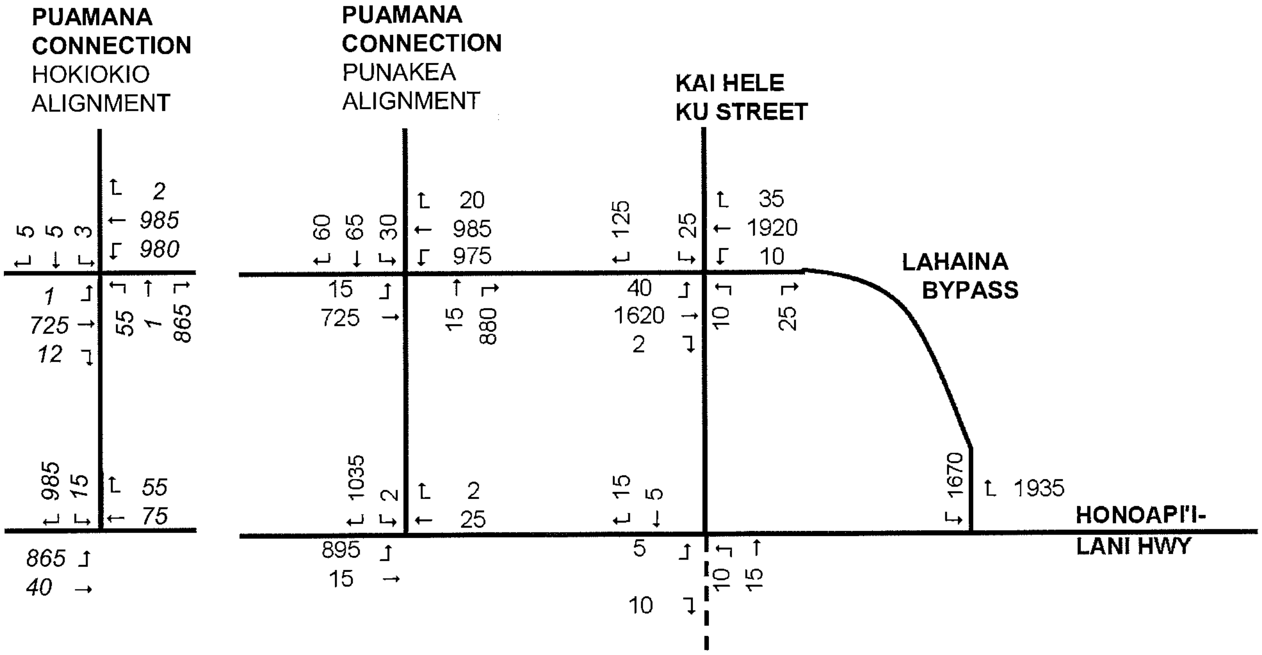
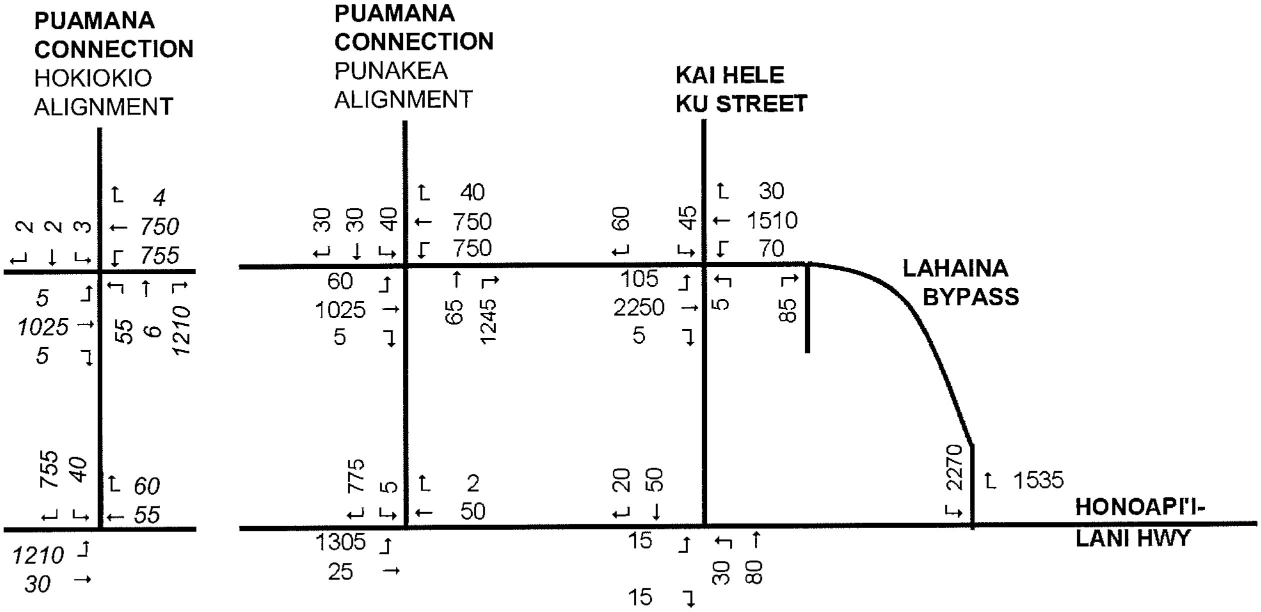
APPENDIX A

Forecasted Intersection Traffic Volumes



AM PEAK HOUR

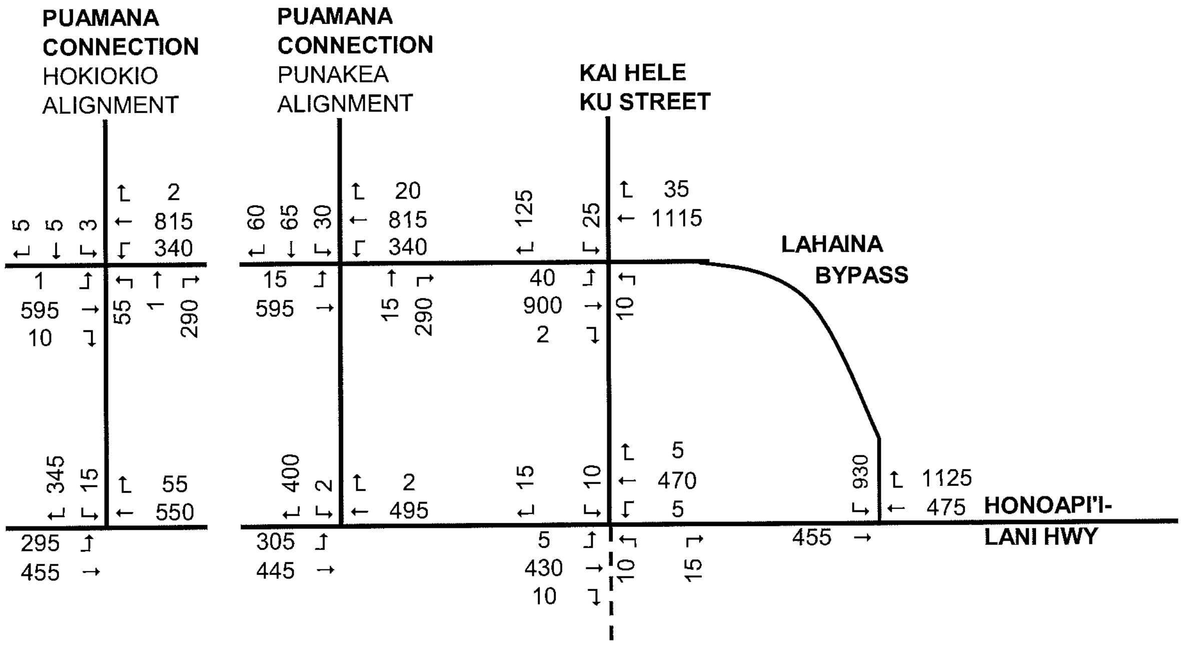


PM PEAK HOUR

NOT TO SCALE

2035 BASELINE TRAFFIC FORECAST W/ MAKILA DEVELOPMENT
FIGURE 4

Source: TIAR for the Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway (SSFM, 2009).
(Note: Volumes in italics were not previously included)



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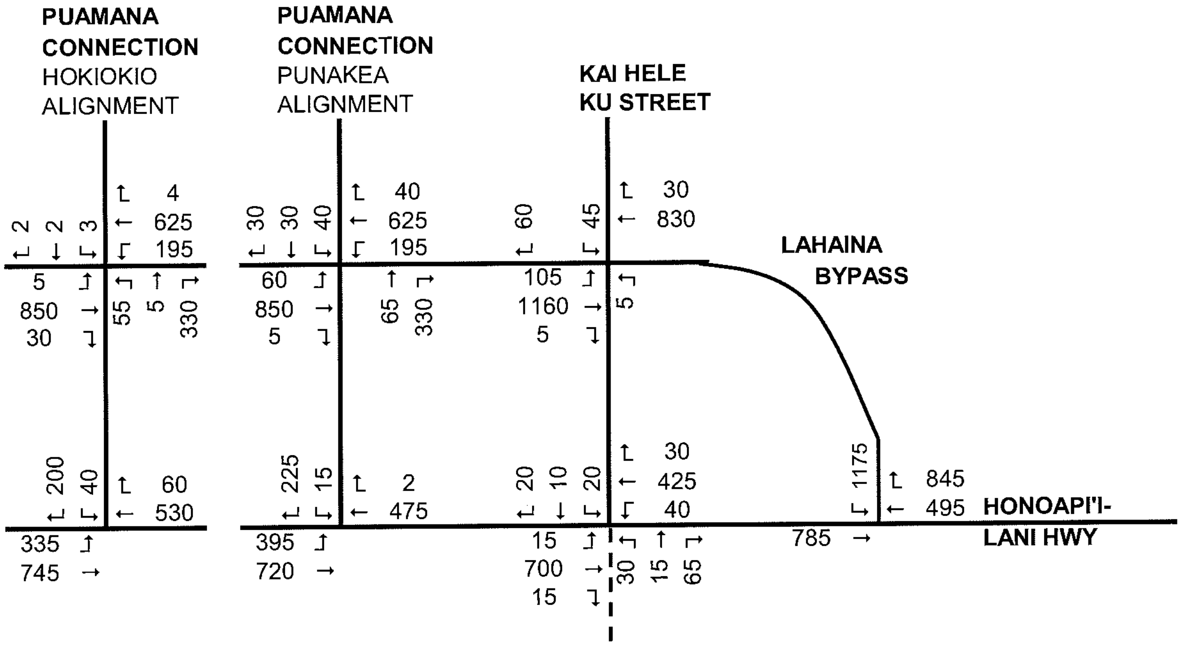
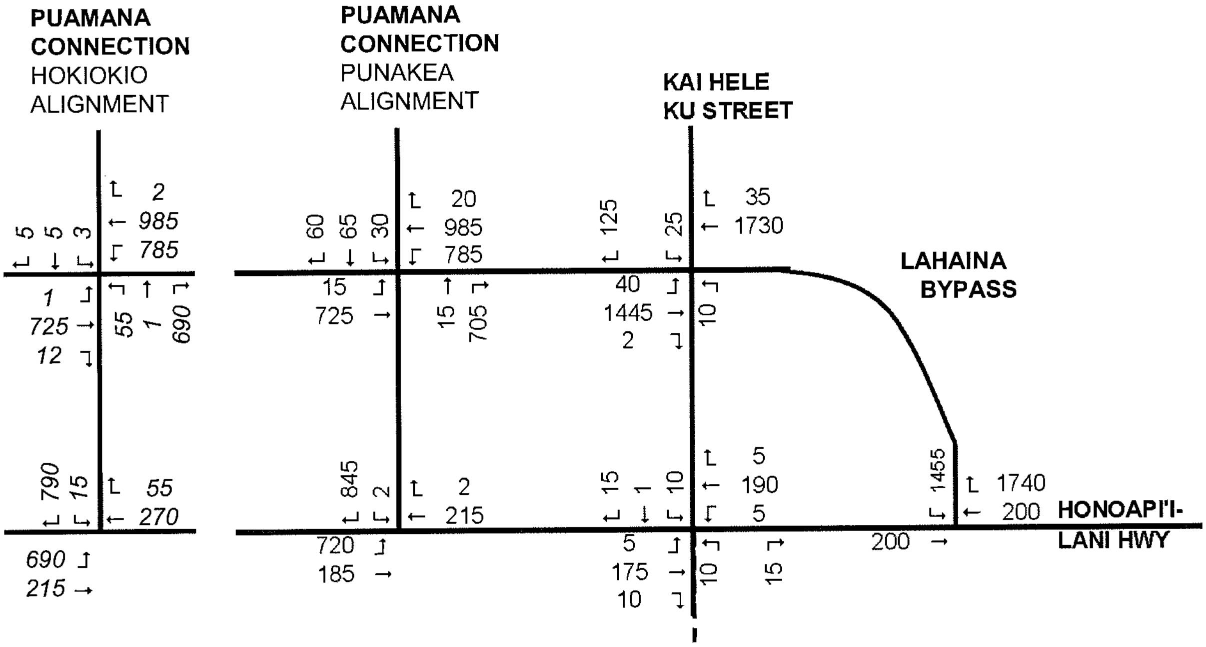


PM PEAK HOUR

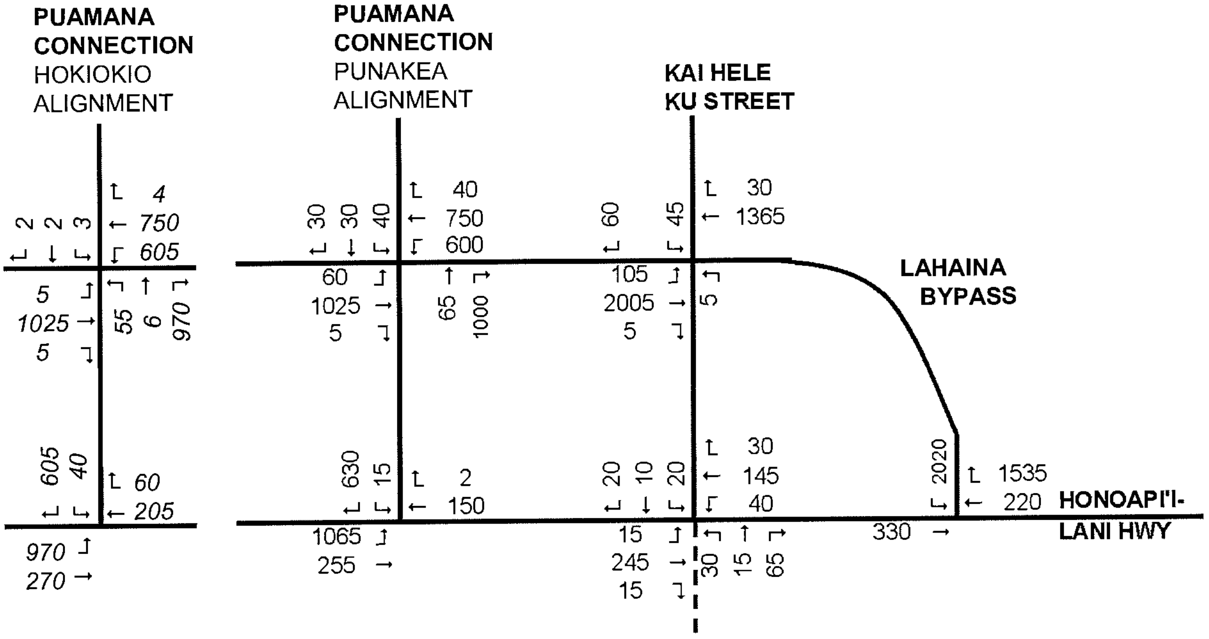
NOT TO SCALE

2020 TRAFFIC ASSIGNMENT ADJUSTED FOR CAPACITY
FIGURE 5

Source: TIAR for the Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway (SSFM, 2009).



AM PEAK HOUR

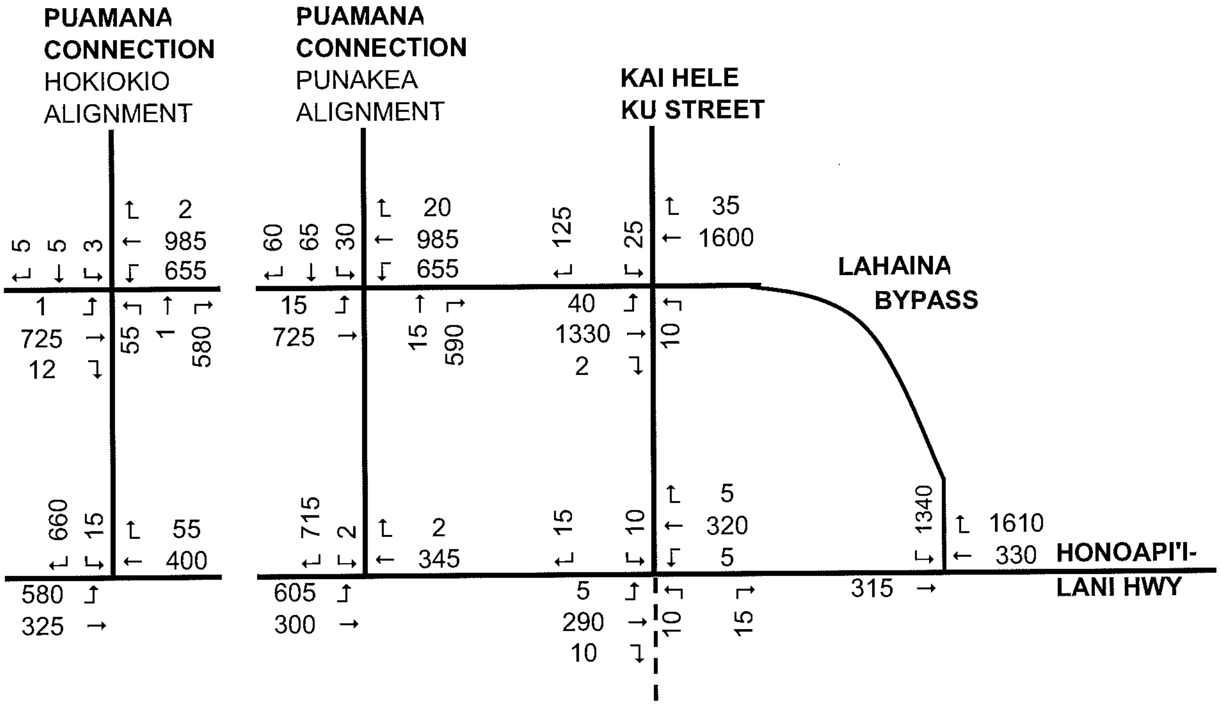


PM PEAK HOUR

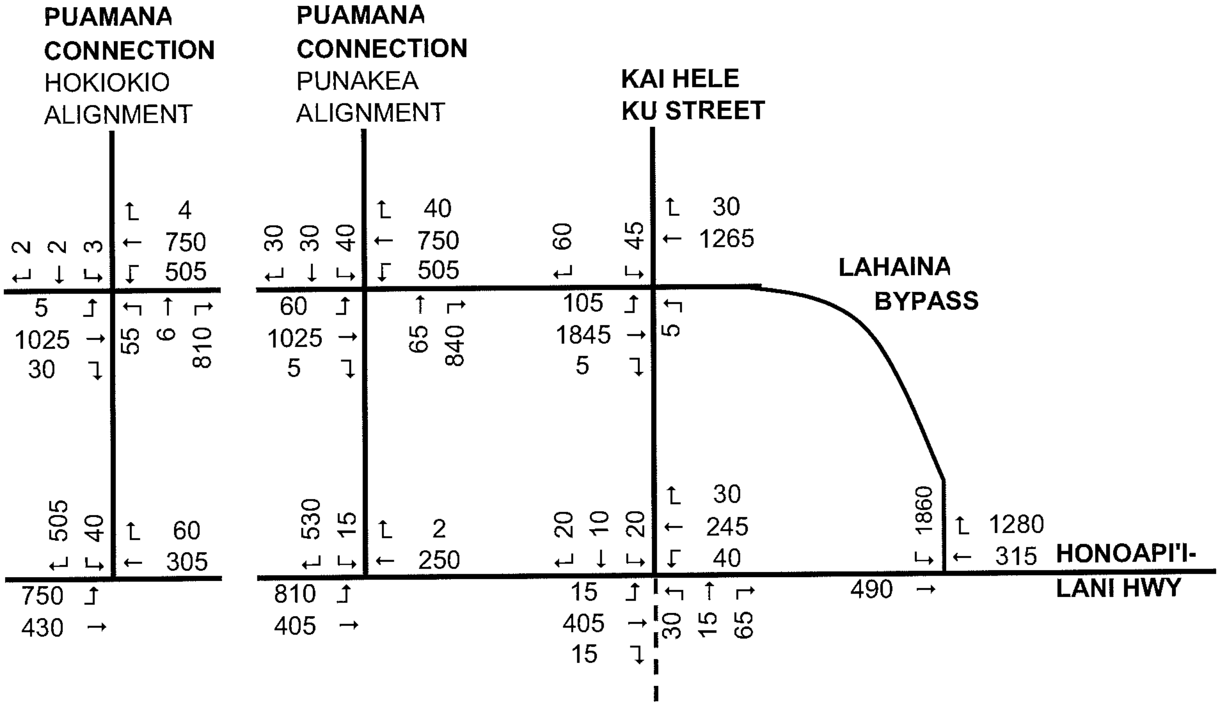
NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 20% DIVERSION
FIGURE 6

Source: TIAR for the Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway (SSFM, 2009).
(Note: Volumes in italics were not previously included)



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 33% DIVERSION
FIGURE 7

Source: TIAR for the Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway (SSFM, 2009).

APPENDIX B
Traffic Signal Warrants

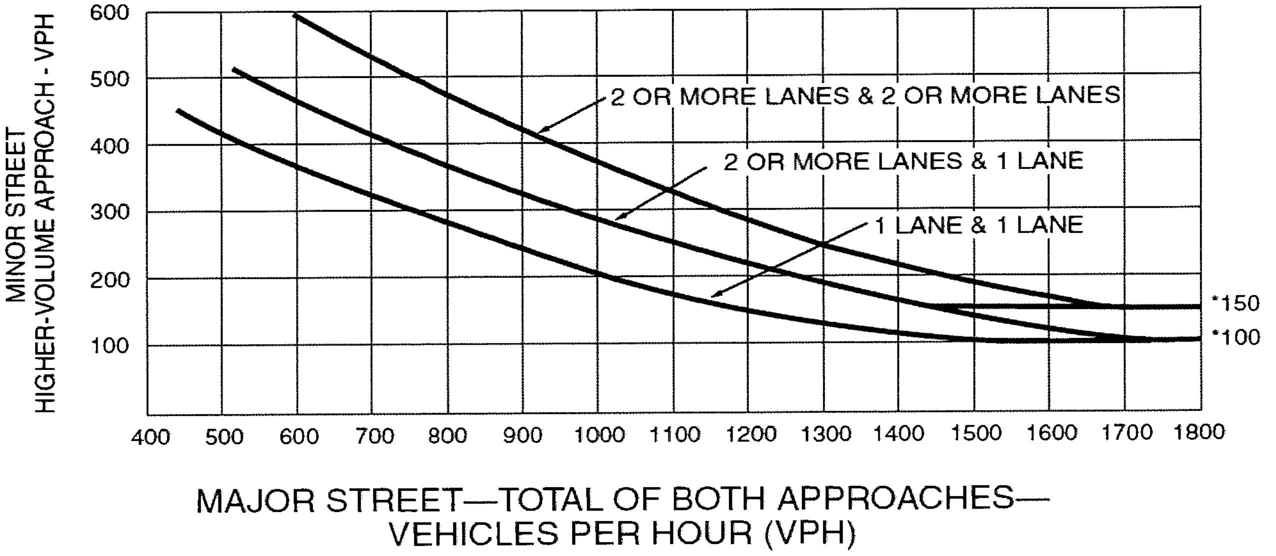
Year 2020 Adjusted

Peak Hour Warrant - Figure 4C-3

Major/Minor Roads	Approach Type	# of Lanes	AM Volume	Pass?	PM Volume	Pass?	Pass?
Lahaina Bypass/	Major	2	1785	Pass	1775	No	**Pass**
Puamana Connector - (Punakea)	Minor	2	155		100		
Lahaina Bypass/	Major	2	606	No	885	No	No
Puamana Connector - (Hokiokio)*	Minor	1	340		195		
Lahaina Bypass/	Major	2	2092	Pass	2130	No	**Pass**
Kai Hele Ku Street	Minor	2	150		105		
Lahaina Bypass/	Major	2	930	Pass	1175	Pass	**Pass**
Honoapiilani Hwy*	Minor	1	475		495		
Honoapiilani Hwy and Puamana Conn/	Major	2	1152	Pass	1355	Pass	**Pass**
Honoapiilani Hwy - (Punakea)	Minor	1	495		475		
Honoapiilani Hwy and Puamana Conn/	Major	2	1110	Pass	1320	Pass	**Pass**
Honoapiilani Hwy - (Hokiokio)	Minor	1	550		530		
Honoapiilani Hwy/	Major	1	925	No	1225	No	No
Kai Hele Ku Street	Minor	1	25		110		

*With a high volumes of left-turn traffic from the major street, the higher of the major-street left-turn volumes is considered as "minor-street" volume and the corresponding single direction of opposing traffic on the major street as the "major street" volume.

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: MUTCD, 2009.

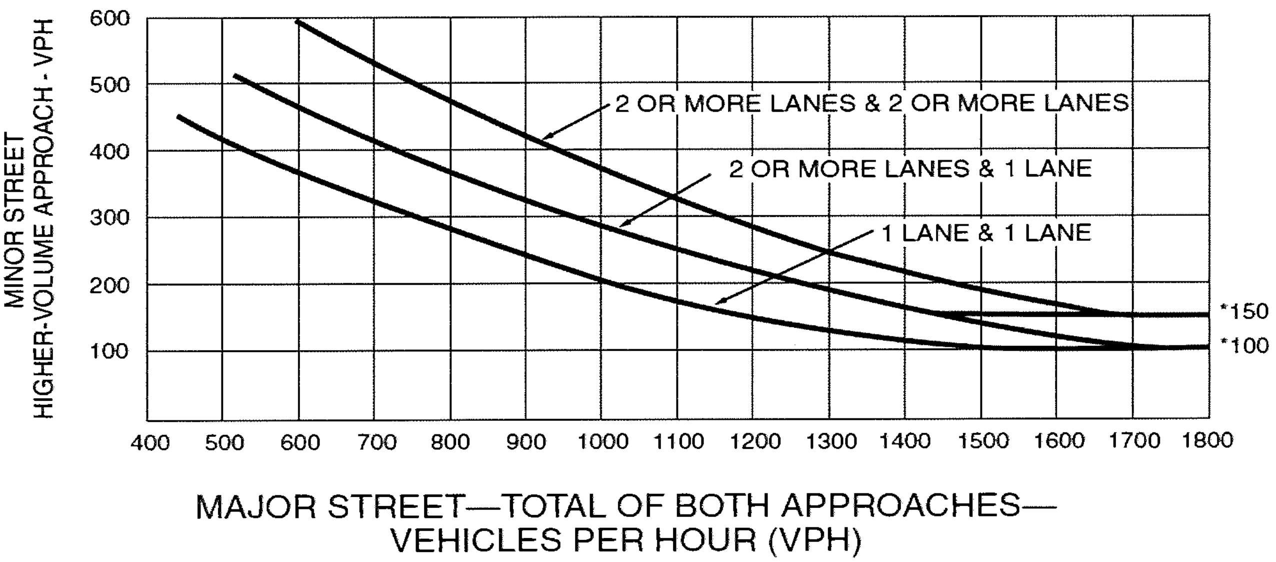
Year 2035 Baseline

Peak Hour Warrant - Figure 4C-3

Major/Minor Roads	Approach Type	# of Lanes	AM Volume	Pass?	PM Volume	Pass?	Pass?
Lahaina Bypass/	Major	2	2720	Pass	2630	No	**Pass**
Puamana Connector - (Punakea)	Minor	2	155		100		
Lahaina Bypass/	Major	2	738	Pass	1035	Pass	**Pass**
Puamana Connector - (Hokiokio)*	Minor	1	980		755		
Lahaina Bypass/	Major	2	3627	Pass	3970	No	**Pass**
Kai Hele Ku Street	Minor	2	150		105		
Lahaina Bypass/	Major	2	3605	No	3805	No	No
Honoapiilani Hwy	Minor	1	0		0		
Honoapiilani Hwy and Puamana Conn/	Major	2	1947	No	2110	No	No
Honoapiilani Hwy - (Punakea)	Minor	1	25		50		
Honoapiilani Hwy and Puamana Conn/	Major	2	1905	No	2035	No	No
Honoapiilani Hwy - (Hokiokio)	Minor	1	75		55		
Honoapiilani Hwy/	Major	1	45	No	180	No	No
Kai Hele Ku Street	Minor	1	15		30		

*With a high volumes of left-turn traffic from the major street, the higher of the major-street left-turn volumes is considered as "minor-street" volume and the corresponding single direction of opposing traffic on the major street as the "major street" volume.

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: MUTCD, 2009.

Proposed Relocation of the Southern Terminus of the Lahaina Bypass - Traffic Addendum
Traffic Signal Warrant Analysis
Year 2035 - 20% Diversion

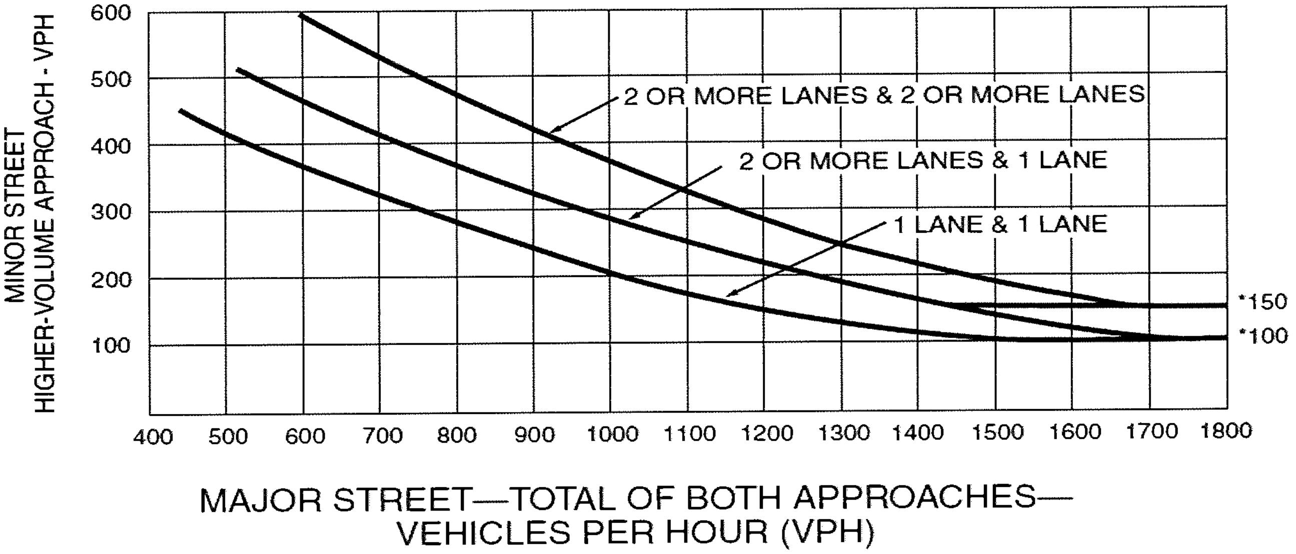
Year 2035 20% Diversion

Peak Hour Warrant - Figure 4C-3

Major/Minor Roads	Approach Type	# of Lanes	AM Volume	Pass?	PM Volume	Pass?	Pass?
Lahaina Bypass/	Major	2	2530	Pass	2480	No	**Pass**
Puamana Connector - (Punakea)	Minor	2	155		100		
Lahaina Bypass/	Major	2	738	Pass	1035	Pass	**Pass**
Puamana Connector - (Hokiokio)*	Minor	1	785		605		
Lahaina Bypass/	Major	2	3252	Pass	3510	No	**Pass**
Kai Hele Ku Street	Minor	2	150		105		
Lahaina Bypass/	Major	2	1455	Pass	2020	Pass	**Pass**
Honoapiilani Hwy*	Minor	1	200		220		
Honoapiilani Hwy and Puamana Conn/	Major	2	1752	Pass	1965	Pass	**Pass**
Honoapiilani Hwy - (Punakea)	Minor	1	215		150		
Honoapiilani Hwy and Puamana Conn/	Major	2	1710	Pass	1885	Pass	**Pass**
Honoapiilani Hwy - (Hokiokio)	Minor	1	270		205		
Honoapiilani Hwy/	Major	1	390	No	490	No	No
Kai Hele Ku Street	Minor	1	26		110		

*With a high volumes of left-turn traffic from the major street, the higher of the major-street left-turn volumes is considered as "minor-street" volume and the corresponding single direction of opposing traffic on the major street as the "major street" volume.

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: MUTCD, 2009.

Proposed Relocation of the Southern Terminus of the Lahaina Bypass - Traffic Addendum
Traffic Signal Warrant Analysis
Year 2035 - 33% Diversion

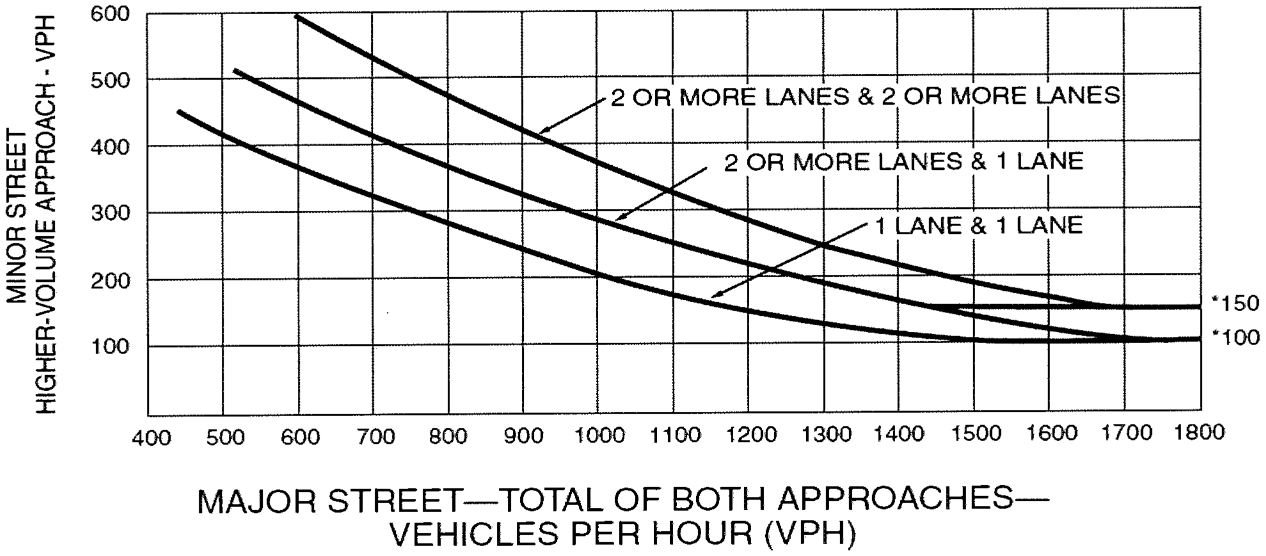
Year 2035 33% Diversion

Peak Hour Warrant - Figure 4C-3

Major/Minor Roads	Approach Type	# of Lanes	AM Volume	Pass?	PM Volume	Pass?	Pass?
Lahaina Bypass/	Major	2	2400	Pass	2385	No	**Pass**
Puamana Connector - (Punakea)	Minor	2	155		100		
Lahaina Bypass/	Major	2	738	Pass	1060	Pass	**Pass**
Puamana Connector - (Hokiokio)*	Minor	1	655		505		
Lahaina Bypass/	Major	2	3007	Pass	3250	No	**Pass**
Kai Hele Ku Street	Minor	2	150		105		
Lahaina Bypass/	Major	2	1340	Pass	1860	Pass	**Pass**
Honoapiilani Hwy*	Minor	1	330		315		
Honoapiilani Hwy and Puamana Conn/	Major	2	1622	Pass	1760	Pass	**Pass**
Honoapiilani Hwy - (Punakea)	Minor	1	345		250		
Honoapiilani Hwy and Puamana Conn/	Major	2	1580	Pass	1725	Pass	**Pass**
Honoapiilani Hwy - (Hokiokio)	Minor	1	400		305		
Honoapiilani Hwy/	Major	1	635	No	750	No	No
Kai Hele Ku Street	Minor	1	25		110		

*With a high volumes of left-turn traffic from the major street, the higher of the major-street left-turn volumes is considered as "minor-street" volume and the corresponding single direction of opposing traffic on the major street as the "major street" volume.

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: MUTCD, 2009.

APPENDIX C

Jughandle Intersection Analysis

HCM Signalized Intersection Capacity Analysis
3: Lahaina Bypass

AM Peak Hour
Year 2035 33% Diversion - Jug Handle

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱		↑↑		↰	↑↑	↱
Volume (vph)	55	1	591	3	662	5	0	986	0	1	723	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	5.0
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	0.95	1.00
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	0.85
Flt Protected		0.95	1.00		1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (prot)		1775	1583		1862	1583		3539		1770	3539	1583
Flt Permitted		0.24	1.00		1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (perm)		441	1583		1862	1583		3539		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	1	642	3	720	5	0	1072	0	1	786	13
RTOR Reduction (vph)	0	0	57	0	0	3	0	0	0	0	0	7
Lane Group Flow (vph)	0	61	585	0	723	2	0	1072	0	1	786	6
Turn Type	Perm	NA	Perm	Perm	NA	Perm		NA		Prot	NA	Perm
Protected Phases		4			8			2		1	6	
Permitted Phases	4		4	8		8						6
Actuated Green, G (s)		56.7	56.7		56.7	56.7		48.0		10.3	63.3	63.3
Effective Green, g (s)		56.7	56.7		56.7	56.7		48.0		10.3	63.3	63.3
Actuated g/C Ratio		0.44	0.44		0.44	0.44		0.37		0.08	0.49	0.49
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	5.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		192	690		812	690		1306		140	1723	770
v/s Ratio Prot								c0.30		0.00	c0.22	
v/s Ratio Perm		0.14	0.37		0.39	0.00						0.00
v/c Ratio		0.32	0.85		0.89	0.00		0.82		0.01	0.46	0.01
Uniform Delay, d1		24.0	32.8		33.8	20.7		37.1		55.1	22.0	17.2
Progression Factor		1.00	1.00		0.31	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2		1.0	9.5		9.6	0.0		5.9		0.1	0.9	0.0
Delay (s)		24.9	42.3		20.0	20.7		43.0		55.2	22.9	17.2
Level of Service		C	D		B	C		D		E	C	B
Approach Delay (s)		40.8			20.0			43.0			22.8	
Approach LOS		D			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	32.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	104.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: Lahaina Bypass Ramp & Puamana Connector

AM Peak Hour
Year 2035 33% Diversion - Jug Handle

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↰	↱
Volume (vph)	2	0	0	14	656	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0			5.0	5.0	5.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	1.00			1.00	0.95	1.00
Satd. Flow (prot)	1863			1863	1770	1583
Flt Permitted	1.00			1.00	0.95	1.00
Satd. Flow (perm)	1863			1863	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	0	0	15	713	2
RTOR Reduction (vph)	0	0	0	0	0	1
Lane Group Flow (vph)	2	0	0	15	713	1
Turn Type	NA			NA	NA	Perm
Protected Phases	4			2	5	
Permitted Phases						5
Actuated Green, G (s)	1.2			46.5	67.3	67.3
Effective Green, g (s)	1.2			46.5	67.3	67.3
Actuated g/C Ratio	0.01			0.36	0.52	0.52
Clearance Time (s)	5.0			5.0	5.0	5.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	17			666	916	819
v/s Ratio Prot	c0.00			c0.01	c0.40	
v/s Ratio Perm						0.00
v/c Ratio	0.12			0.02	0.78	0.00
Uniform Delay, d1	63.9			27.0	25.3	15.1
Progression Factor	0.88			1.00	1.00	1.00
Incremental Delay, d2	3.1			0.1	4.2	0.0
Delay (s)	59.4			27.1	29.6	15.1
Level of Service	E			C	C	B
Approach Delay (s)	59.4			27.1	29.5	
Approach LOS	E			C	C	

Intersection Summary			
HCM 2000 Control Delay	29.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
3: Lahaina Bypass

PM Peak Hour
Year 2035 33% Diversion - Jug Handle

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱		↑↑		↰	↑↑	↱
Volume (vph)	56	6	838	3	506	2	0	751	0	5	1025	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	5.0
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	0.95	1.00
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	0.85
Flt Protected		0.96	1.00		1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (prot)		1783	1583		1862	1583		3539		1770	3539	1583
Flt Permitted		0.53	1.00		1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (perm)		988	1583		1862	1583		3539		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	7	911	3	550	2	0	816	0	5	1114	34
RTOR Reduction (vph)	0	0	34	0	0	1	0	0	0	0	0	14
Lane Group Flow (vph)	0	68	877	0	553	1	0	816	0	5	1114	20
Turn Type	Perm	NA	Perm	Perm	NA	Perm		NA		Prot	NA	Perm
Protected Phases		4			8			2		1	6	
Permitted Phases	4		4	8		8						6
Actuated Green, G (s)		55.0	55.0		55.0	55.0		26.0		4.0	35.0	35.0
Effective Green, g (s)		55.0	55.0		55.0	55.0		26.0		4.0	35.0	35.0
Actuated g/C Ratio		0.55	0.55		0.55	0.55		0.26		0.04	0.35	0.35
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	5.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		543	870		1024	870		920		70	1238	554
v/s Ratio Prot								0.23		0.00	c0.31	
v/s Ratio Perm		0.07	c0.55		0.30	0.00						0.01
v/c Ratio		0.13	1.01		0.54	0.00		0.89		0.07	0.90	0.04
Uniform Delay, d1		10.9	22.5		14.4	10.1		35.6		46.2	30.8	21.4
Progression Factor		1.00	1.00		0.04	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2		0.1	32.4		0.5	0.0		12.4		2.0	10.6	0.1
Delay (s)		11.0	54.9		1.1	10.1		47.9		48.2	41.4	21.5
Level of Service		B	D		A	B		D		D	D	C
Approach Delay (s)		51.9			1.1			47.9			40.9	
Approach LOS		D			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	119.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↰	↱
Volume (vph)	11	0	0	8	503	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0			5.0	5.0	5.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	1.00			1.00	1.00	0.85
Flt Protected	1.00			1.00	0.95	1.00
Satd. Flow (prot)	1863			1863	1770	1583
Flt Permitted	1.00			1.00	0.95	1.00
Satd. Flow (perm)	1863			1863	1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	0	0	9	547	4
RTOR Reduction (vph)	0	0	0	0	0	2
Lane Group Flow (vph)	12	0	0	9	547	2
Turn Type	NA			NA	NA	Perm
Protected Phases	4			2	5	
Permitted Phases						5
Actuated Green, G (s)	1.5			45.1	38.4	38.4
Effective Green, g (s)	1.5			45.1	38.4	38.4
Actuated g/C Ratio	0.02			0.45	0.38	0.38
Clearance Time (s)	5.0			5.0	5.0	5.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	27			840	679	607
v/s Ratio Prot	c0.01			c0.00	c0.31	
v/s Ratio Perm						0.00
v/c Ratio	0.44			0.01	0.81	0.00
Uniform Delay, d1	48.8			15.1	27.5	19.0
Progression Factor	1.25			1.00	1.00	1.00
Incremental Delay, d2	11.2			0.0	6.9	0.0
Delay (s)	72.4			15.2	34.4	19.0
Level of Service	E			B	C	B
Approach Delay (s)	72.4			15.2	34.3	
Approach LOS	E			B	C	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX N.

Engineering Assessment Report

Established 1969

Engineering Assessment for

The Proposed Lahaina Bypass Southern Terminus Relocation Project

Prepared For: Makila Land Company
305 East Wakea Ave., Suite 100
Kahului, Hawaii 96732

ALAN L. UNEMORI
LICENSED PROFESSIONAL ENGINEER
NO. 9354-S

Date: January 2007
Revised: August 2013
Revised: September 2013
Revised: March 2014
Revised: April 2014
Revised: May 2014

WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers – Land Surveyors
Wells Street Professional Center – Suite 403
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Wailuku, Maui, Hawaii 96793

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EXHIBITS

TABLES

PROPOSED LAHAINA BYPASS
Southern Terminus Relocation

A. INTRODUCTION AND BACKGROUND

The Lahaina Bypass Project which extends from Honokowai to Launiupoko obtained its Final EIS Approval on April 2002. Design and construction of Phase I-A between Lahainaluna Road and Keawe Street has been completed. The design and construction of Phase I-B-1 between Lahainaluna Road and Hoki'oki'o Place has also been completed. Design of Phase I-B-2, Hoki`oki`o Place to Honoapiilani Highway, is projected to begin upon approval of the Environmental Assessment (See Figure 1.)

B. PROPOSED ACTION

Portions of the shoreline along the existing Honoapiilani Highway in the vicinity of the Southern Terminus are being undermined by erosion. Numerous other sections of the existing highway are experiencing similar problems. Several sections of the highway have already been realigned and relocated further inland.

One of the objectives of this project is to avoid this recurring problem. The project proposes to move the southern terminus south in order to allow for an additional segment of the Lahaina Bypass to be located further inland away from the shoreline on higher ground. The elevation of the proposed alignment will range between 40 to 120 feet above mean sea level and 800 to 1500 feet mauka or inland of the existing highway. (See Figure 2.)

There are other advantages to a mauka alignment. By keeping through-traffic away from the coastal area, safer coastal recreational opportunities will become available to the public.

C. ENGINEERING ASSESSMENT

1. Roadway Alignments Considered

Three (3) Alternatives were proposed and evaluated by the State Department of Transportation in this Engineering Assessment. All three Alternatives begin at the end of Lahaina Bypass Phase 1-B-1 at Hokiokio Road and terminate at the existing Honoapiilani Highway near Launiupoko Point or the Launiupoko/Olowalu boundary as shown in Figure 1.

Alternative 1 is shown on Exhibit A. It is the lowest of the three Alternatives which ends at a connection to the existing Honoapiilani Highway just south of Launiupoko Beach Park. This is the Bypass alignment shown in the 2002 SEIS and is also known as the "No Action" Alternative. This alternative does not provide a connection point for any future projects to relocate the existing highway further inland, and away from the receding shoreline. Also note that since Alternative 1 approaches Kai Hele Ku Street at a skewed angle, Kai Hele Ku will need to be realigned to cross the highway at a 90 degree angle, and thus requiring acquisition of additional right-of-way from the adjoining parcels.

Alternative 2 is shown on Exhibit B. This is the middle of the three Alternatives which ends at the Launiupoko/Olowalu boundary. An intersection and connector will need to be constructed to connect with the existing Honoapiilani Highway. Alternative 2 also approaches Kai Hele Ku Street at a skewed angle, so Kai Hele Ku Street will need to be realigned. Alternative 2 will also require approximately 777 feet of connector to the existing Honoapiilani Highway at the southern end. The cross-section for the connector is currently expected to consist of a 24' wide travelway with two 8' paved shoulders (40 ft wide pavement), similar to the existing highway roadway section.

Alternative 3 is shown on Exhibit C. This is the alignment which is farthest inland. An intersection and connector will need to be constructed to connect with the existing Honoapiilani Highway. Alternative 3 approaches Kai Hele Ku Street at a perpendicular angle, so Kai Hele Ku Street will not need to be realigned. Alternative 3 will also require approximately 1,006 feet of connector to the existing Honoapiilani Highway at the southern end. The cross-section for the connector is currently expected to consist of a 24' wide travelway with two 8' paved shoulders (40 ft wide pavement).

All three (3) Alternatives were presented to the HDOT for approval. A highway with grade-separated travelways may be considered to reduce the overall earthwork quantities, however, it may also require additional roadside barriers in the median and additional right-of-way acquisition.

2. Infrastructure

a. *Water System*

There are two private water systems in Launiupoko, Launiupoko Irrigation Company Inc. and Launiupoko Water Company Inc. providing non-potable and potable water service to the area, respectively. There are no water lines within the proposed project corridor except for a line along Kai Hele Ku Drive which is being used primarily for irrigation. Since the crossing at the new Kai Hele Ku intersection will be fairly close to present grade, the existing waterline will not be affected.

The existing, source, storage and water distribution systems are located mauka and east of the proposed highway corridor. Therefore, new pipe line sleeve or lines will be installed across the right-of-way to service lands on the makai side before or in conjunction with the highway project.

b. *Wastewater System*

Since the County sewer system does not extend to Launiupoko, individual wastewater system in the form of septic tanks with leach fields or seepage pits are being used for wastewater disposal in the area. Currently there are no dwellings in the vicinity of the proposed highway corridor. Therefore, no wastewater facility will be impacted by the relocated highway.

c. *Electricity*

MECO's main high voltage line that provides power to Lahaina from Central Maui runs along the foot of the West Maui Mountains approximately one mile east, or mauka, of the proposed project corridor. Therefore, this transmission line will not be impacted by the highway realignment project.

There is also an overhead distribution system along Kai Hele Kuu Drive. This line will be undergrounded across the realigned highway corridor.

d. *Drainage*

There are eight (8) contributory drainage areas situated upland (mauka) of the proposed Lahaina Bypass Extension corridor. Seven (7) of these are over 100 acres. Only one is less than 100 acres. (See Figure 3.)

These drainage areas are comprised of the westerly slopes of the West Maui Mountains which are fairly steep and flatter lands that were formulated by the erosion of these steeper slopes. Most of the flatter land were previously used for cultivation of sugar cane. More recently they have been subdivided into smaller agricultural lots with houses built on them.

The drainage concept used and approved by the County to develop the agricultural subdivisions were to maintain the surface runoff to pre-development rates and volumes by retaining the additional runoff generated by the development onsite in retention basins and/or subsurface storage systems. Consequently, the curve numbers and coefficient of permeability used for the highway drainage is based on pre-development conditions. In accordance with the County's "Rules for the Design of Storm Drainage Facilities", for drainage areas greater than 100 acres, and all streams, the NRCS hydrograph method was used. For drainage areas of less than 100 acres, 50-year 1-hour storm and the Rational Method was used to size the drainage structures at all roadway crossings.

A preliminary study of the pre-development and post-development drainage patterns can be found in Appendix B - Preliminary Drainage Report in the Final Environmental Assessment Report.

3. Existing Easements

There are also existing easements that are bifurcated by the proposed bypass alignments. There is an existing Bike Path Easement, which affects Alternatives 2 and 3 only, that ends mauka, from the existing cane haul road to the existing Makila Nui Subdivision. This bike path will be relocated along the proposed Alternative 2 and 3 bypass alignments. See Figure 4 for locations of existing bike path easement and proposed relocated bike path.

There is also an existing Access and Utility Easement that begins at Kai Hele Ku Street, runs parallel to the existing Honoapiilani Highway, then turns in the mauka direction to connect to the existing Makila Nui Subdivision. This easement is bifurcated by the proposed Lahaina Bypass Alternatives 2 and 3 approximately 600 feet north of the bypass terminus. The access to the mauka and makai portions of the existing easements can be maintained via new right-turn-in and right-turn-out driveways off the proposed bypass.

D. RELATIVE COST COMPARISON OF ALTERNATIVES

An order-of-magnitude relative cost estimate for each of the three (3) Alternatives was prepared to aid in the selection of the Preferred Alternative for the Final Environmental Assessment of the Proposed Relocation of the Lahaina Bypass Southern Terminus. These relative cost estimates do not include items which are common to each of the three Alternatives. Common items include, but are not limited to, the drainage culvert structures, the intersection improvements at Hokiokio Road, Punakea loop Extension underpass, and the Detention Basins, which have insufficient information for sizing at this time. Actual cost estimates can be prepared once the Preferred Alternative is selected and designed.

Tables 1, 2 and 3 present the Preliminary Order of Magnitude Relative Cost Estimates for each of Alternatives 1, 2 and 3, respectively. For convenience, a summary of the Preliminary Order of Magnitude Cost Estimates are given below:

Alternative No.	Relative Cost Estimate
1	$20,284,924.50
2	$29,017,050.73
3	$27,990,618.70

It can be seen that Alternative 1 (the "No Action alternative) is relatively the least expensive Alternative as it is also the shortest Alternative.

E. SUMMARY AND CONCLUSION

It is our professional opinion that with appropriate design considerations the proposed realignment project will not have any adverse impact on existing public facilities, downstream properties or the coastal environment. Moving the highway further inland as proposed will provide greater opportunities for coastal recreational activities for public enjoyment as well as eliminate the risk of coastal erosion. Removing through traffic from the coastal recreational areas will also enhance public safety and accessibility to these coastal recreational resources.

Given these considerations and the order of magnitude relative cost estimates, we believe that Alternative 3 should be the Preferred Alternative.

F. REFERENCES

1. *Lahaina Transportation Design Workshop.* January 2007.

2. *Traffic Study by SSFM.*

3. *Soil Survey of Islands of Kauai, Oahu, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

4. *Rules for the Design of Storm Drainage Facilities in the County of Maui.* July 1995. Department of Public Works and Waste Management, County of Maui.

5. *SCS National Engineering Handbook, Section 4 - Hydrology.* 1969. Soil Conservation Service, U.S. Department of Agriculture.

6. *Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43.* 1962. U.S. Department of Commerce, Weather Bureau.

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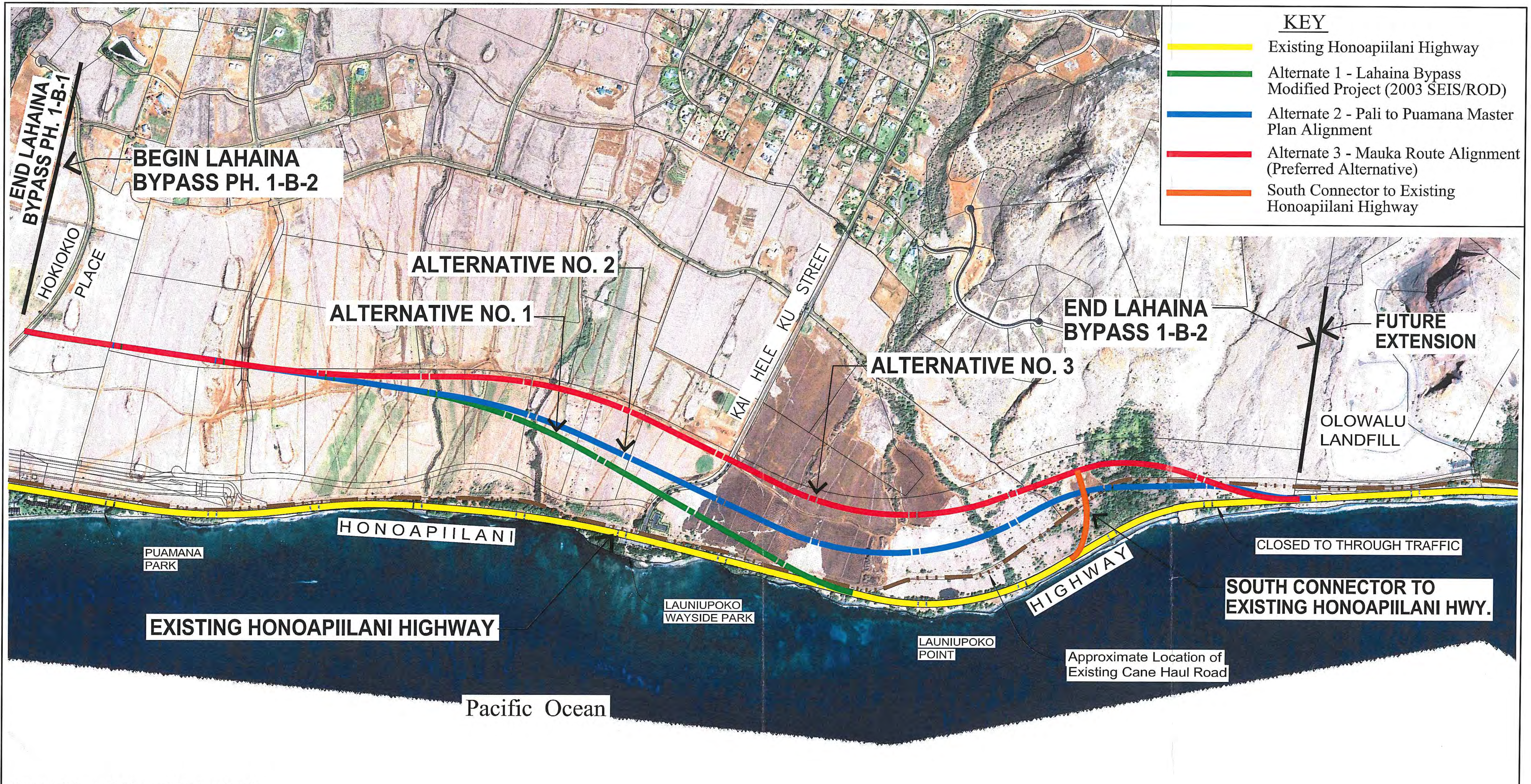
FIGURES

V:\Projdata\04PROJ\04044 – DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Makila Section\exh-terminus location-fig23-00.dwg



Source: Warren S. Unemori Engineering, Inc.

0 1000 2000 3000 4000

Scale: 1 in. = 1000 ft.

Prepared For: State of Hawaii, Department of Transportation

Proposed Lahaina Bypass Southern Terminus Relocation

Alternate Alignment Comparison

FIGURE 1

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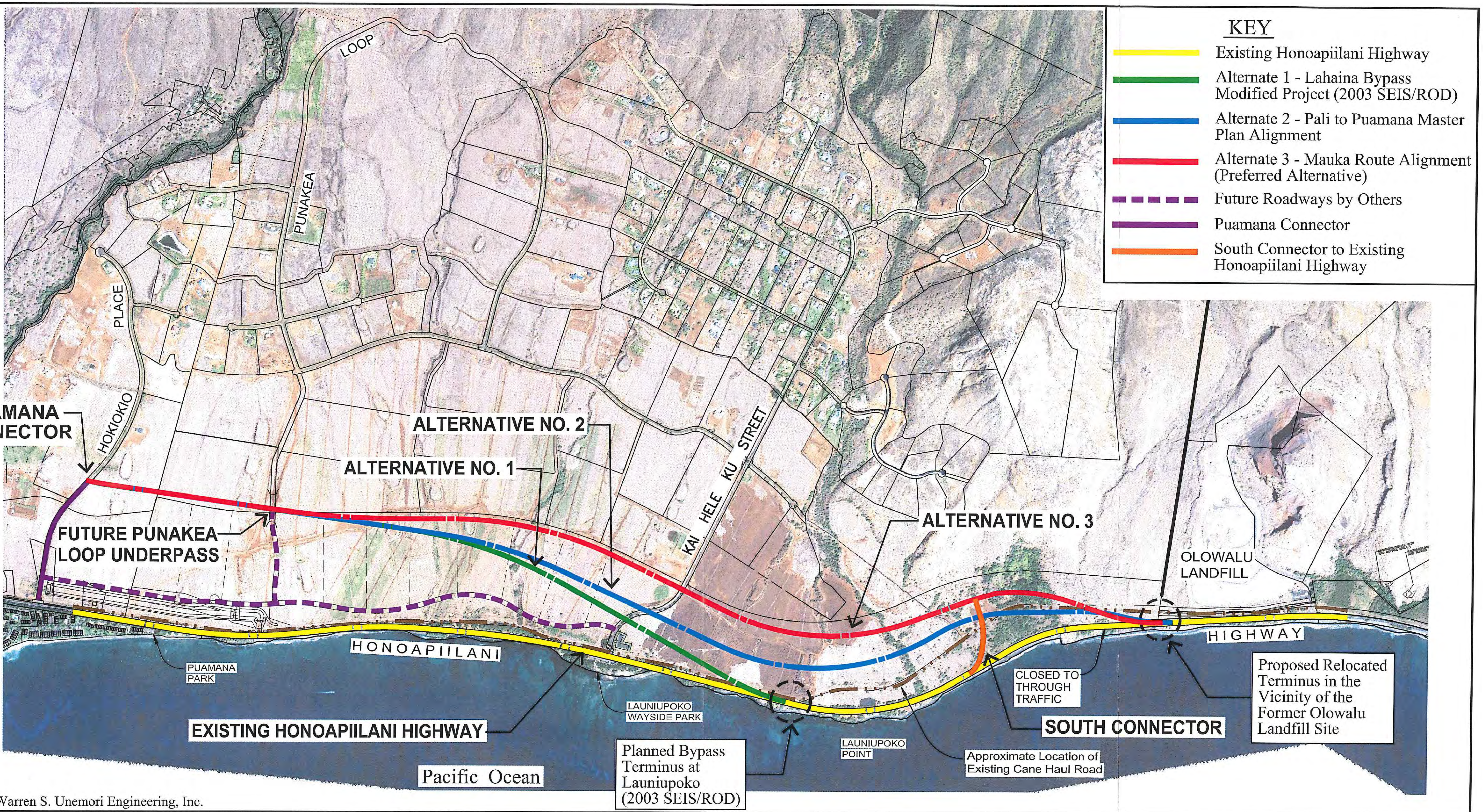


Source: Warren S. Unemori Engineering, Inc.

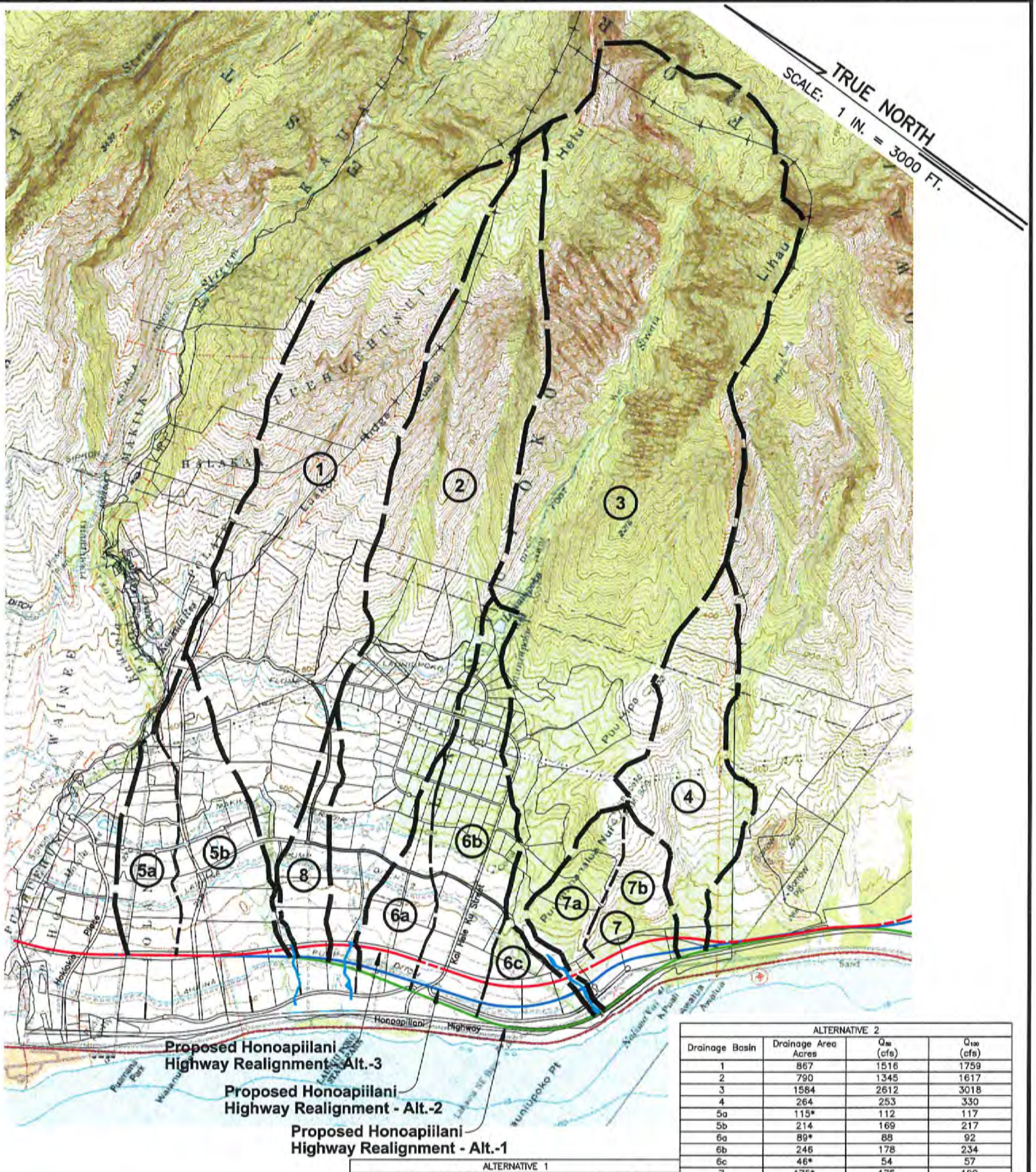
0 1200 2400 3600 4800

Scale: 1 in. = 1200 ft.

Proposed Lahaina Bypass Southern Terminus Relocation

Alternate Alignment Comparison

FIGURE 2



ALTERNATIVE 1			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	169	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

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

ALTERNATIVE 2			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	246	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

ALTERNATIVE 3			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	866	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	168	216
6a	76*	76	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	81*	75	79

DRAIN AREA MAP

FIGURE 3

April 10, 2008

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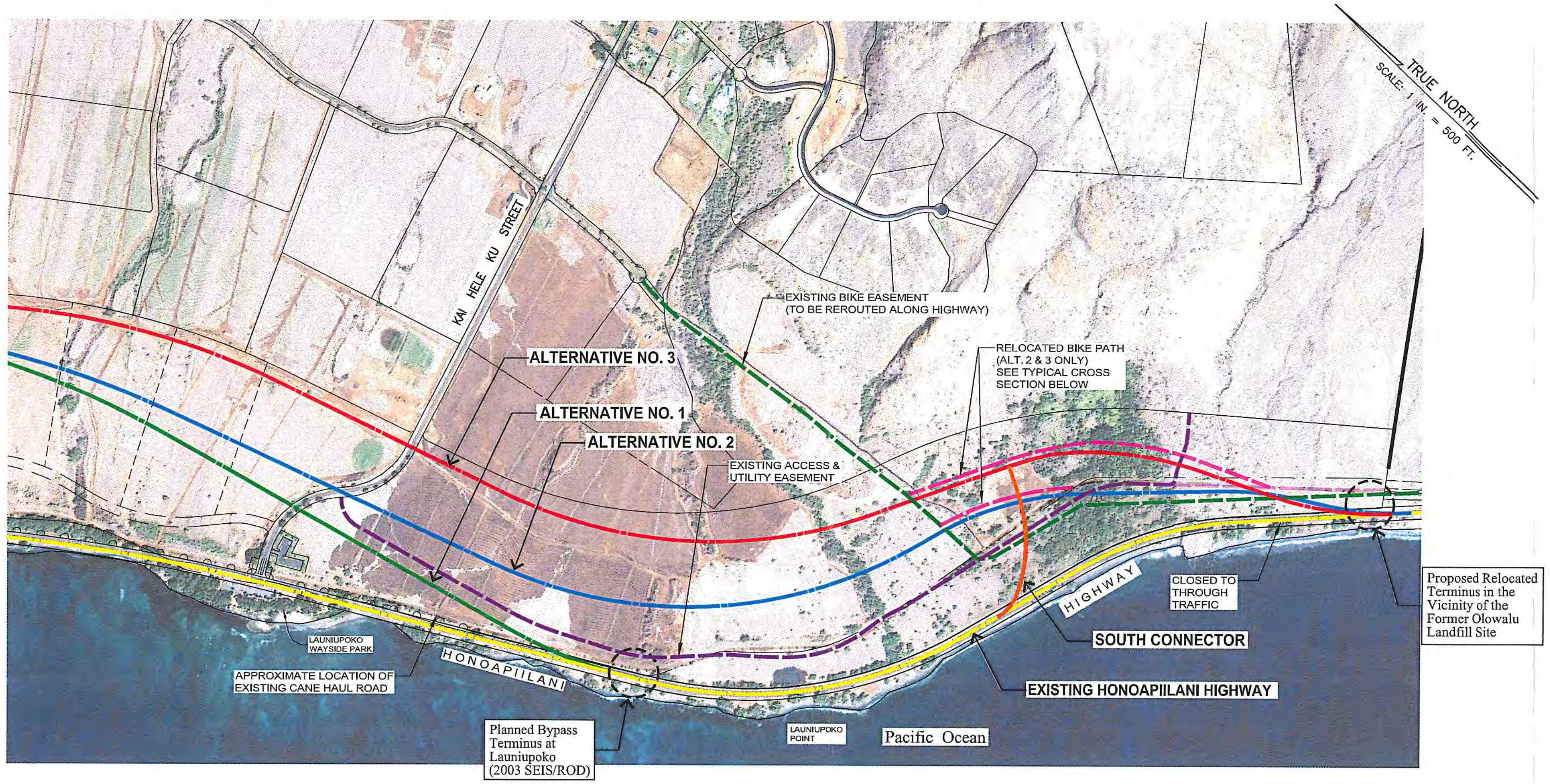
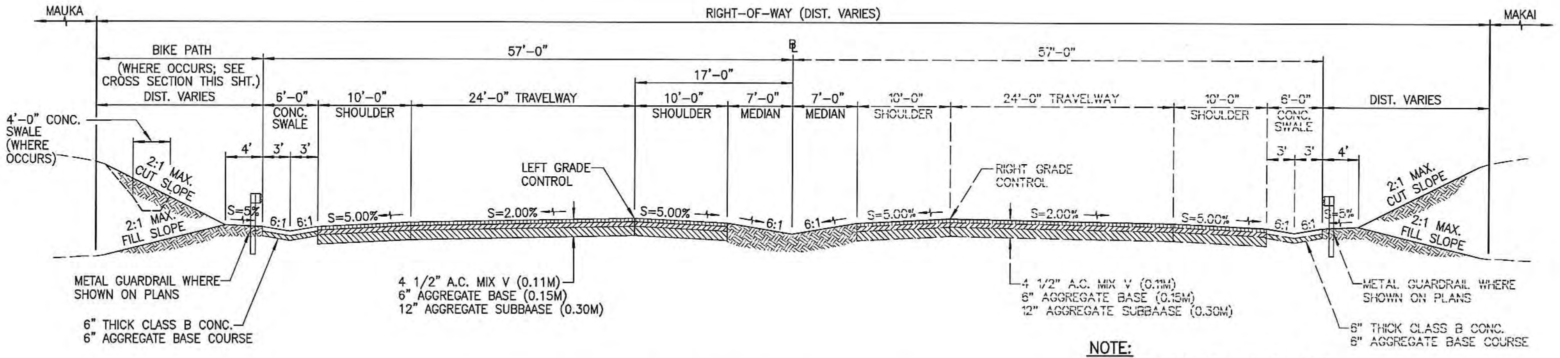


KEY

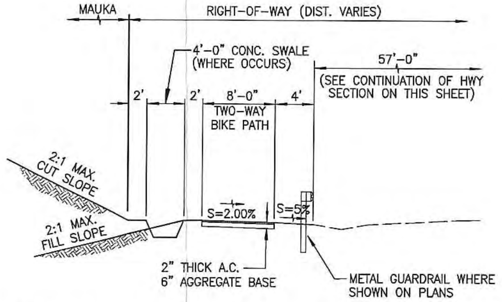
🟨	Existing Honoapiilani Highway
🟩	Alternate 1 - Lahaina Bypass Modified Project (2003 SEIS/ROD)
🟦	Alternate 2 - Pali to Puamana Master Plan Alignment
🟥	Alternate 3 - Mauka Route Alignment (Preferred Alternative)
🟧	South Connector (Alt-2) to Existing Honoapiilani Highway
🟧	South Connector (Alt-3) to Existing Honoapiilani Highway
▬ ▬	Existing Utility & Access Easement
▬ ▬	Existing Bike Path Easement
▬ ▬	Relocated Bike Path
▬ ··· ▬	Existing Cane Haul Road & Access Easement



NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL
RIGHT GRADE CONTROL ELEVATIONS

TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



TYPICAL CROSS SECTION - RELOCATED BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

RELOCATED BIKE PATH EASEMENT

SCALE: 1 IN. = 500 FT.

REDUCED COPY
NOT TO SCALE

FIGURE 4

October 13, 2014

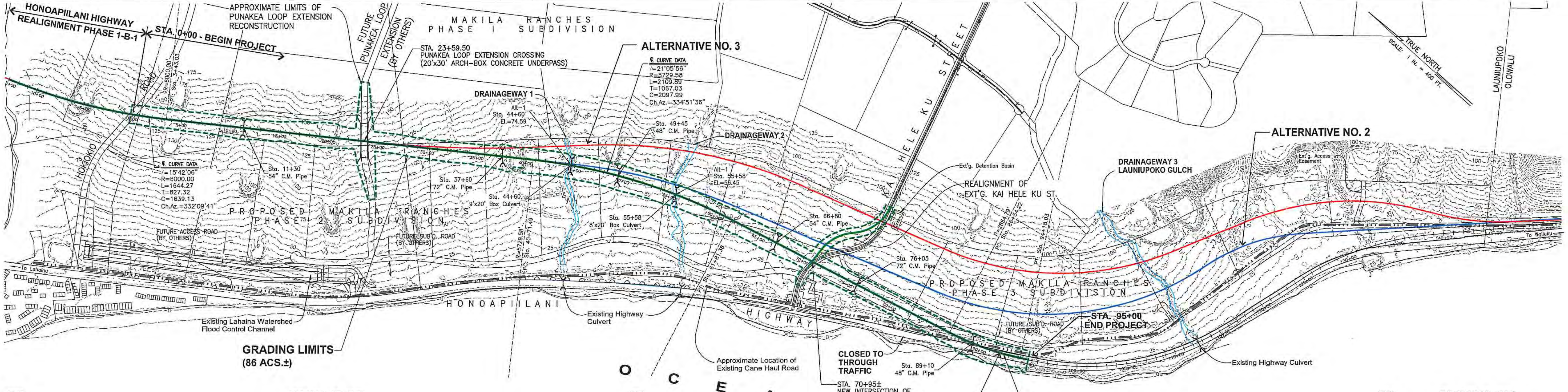
V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Makila Section\exh-relocated bike path esmt-00.dwg

EXHIBITS

A. Profile - Honoapiilani Highway Alternative No. 1

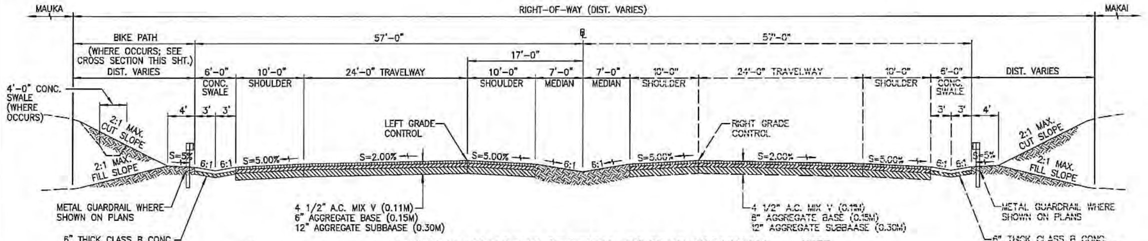
B. Profile - Honoapiilani Highway Alternative No. 2

C. Profile - Honoapiilani Highway Alternative No. 3



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1

SCALE: HORIZ. 1"=400'



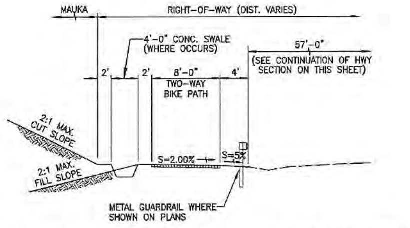
TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL
RIGHT GRADE CONTROL ELEVATIONS

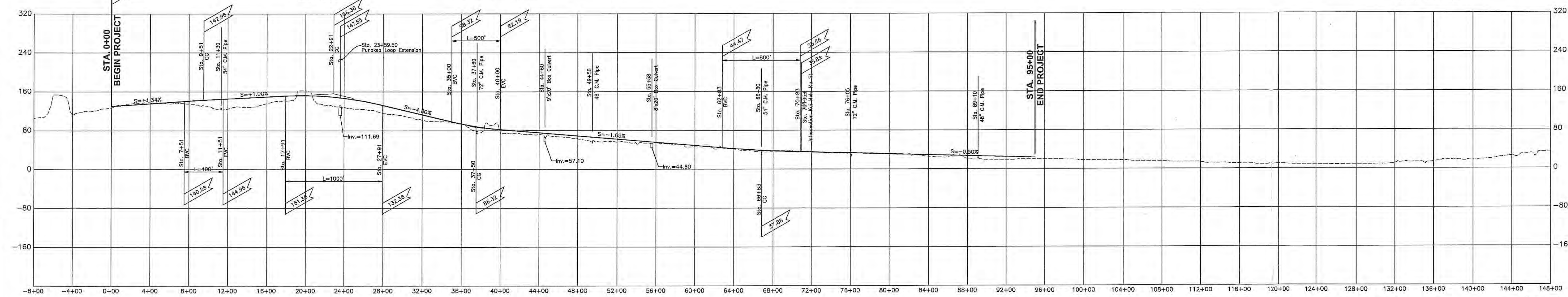
APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 1)

EXCAVATION = 33,239 CU.YD.
EMBANKMENT = 323,541 CU. YD.
HIGHWAY AREA = 52 ACS.±
ROAD RECONSTRUCTION AREA = 7 ACS.±



TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1

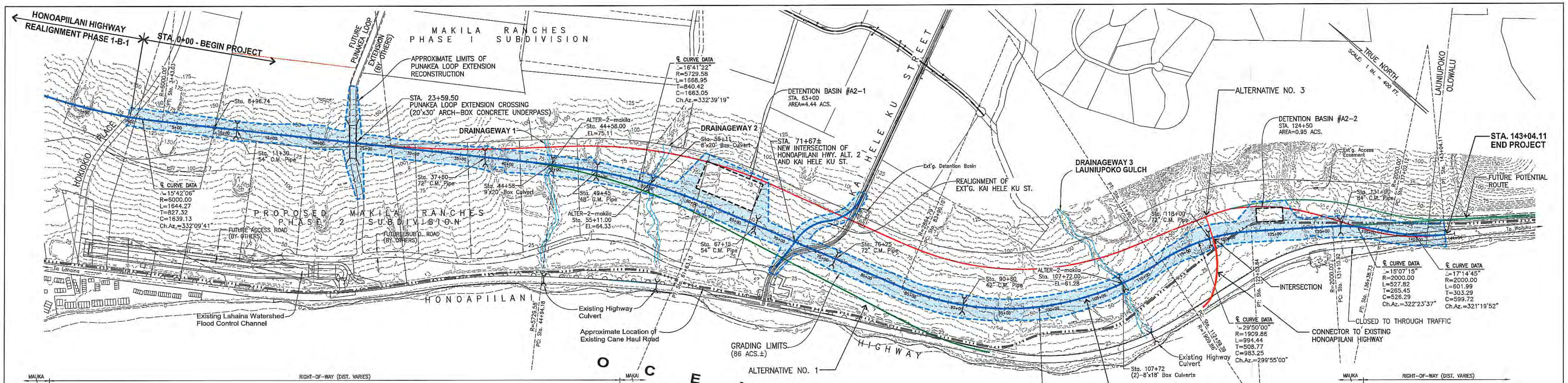
SCALE: HORIZ. 1"=400'
VERT. 1"=80'

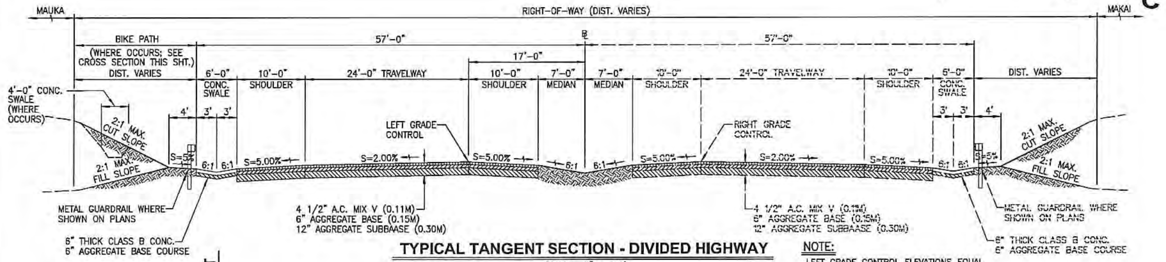
EXHIBIT A

WARREN S. UNEMORI ENGINEERING, INC.

October 16, 2014

V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EA Exhibits-Makila Section\County-Alt-1-400sc-00.dwg





TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

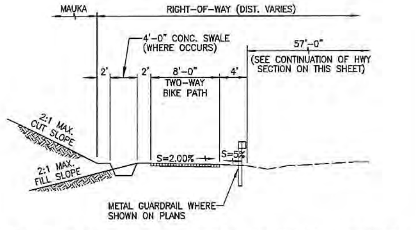
NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL RIGHT GRADE CONTROL ELEVATIONS

PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2

SCALE: HORIZ. 1"=400'

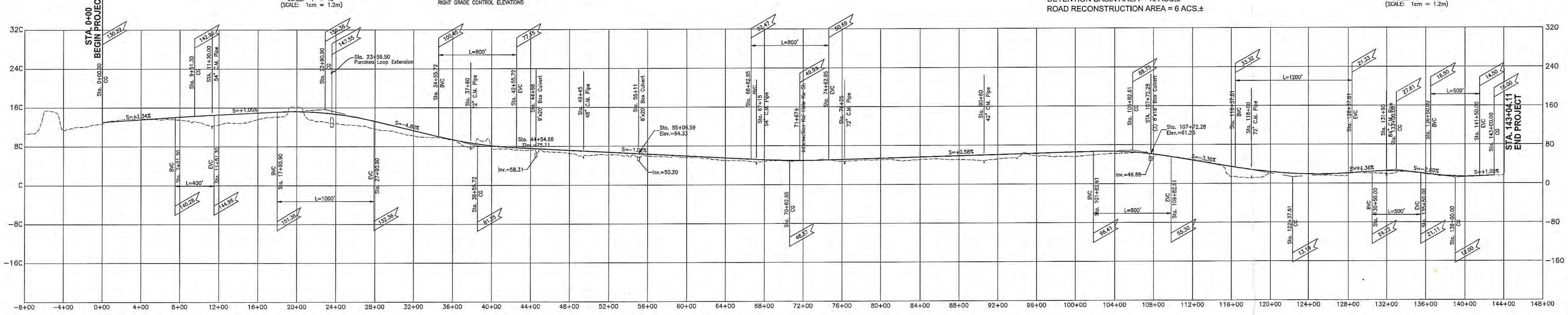
APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 2)

EXCAVATION = 44,200 CU.YD.
EMBANKMENT = 470,500 CU.YD.
HIGHWAY AREA = 70 ACS.±
DETENTION BASIN AREA = 10 ACS.±
ROAD RECONSTRUCTION AREA = 6 ACS.±



TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2

SCALE: HORIZ. 1"=400'
VERT. 1"=80'

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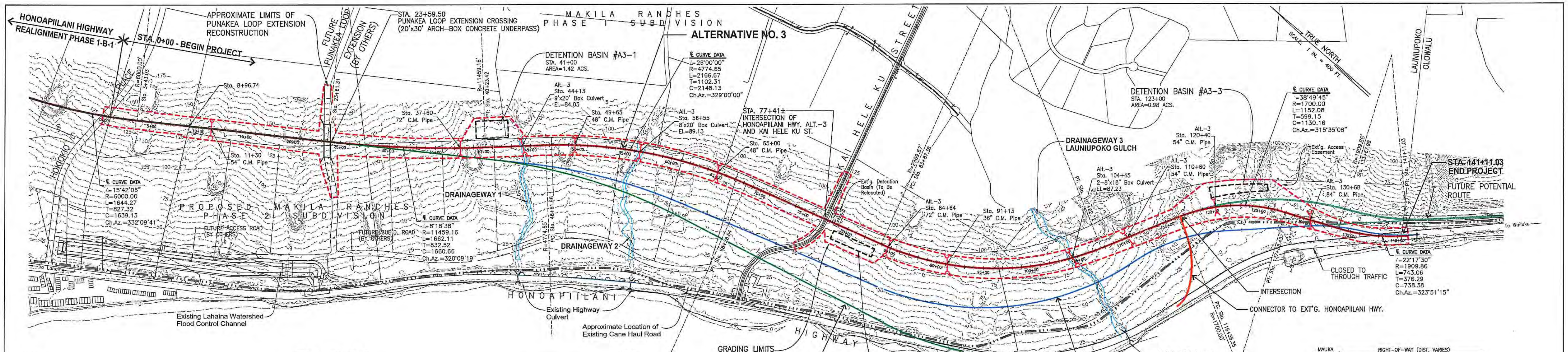
NOT TO SCALE

EXHIBIT B

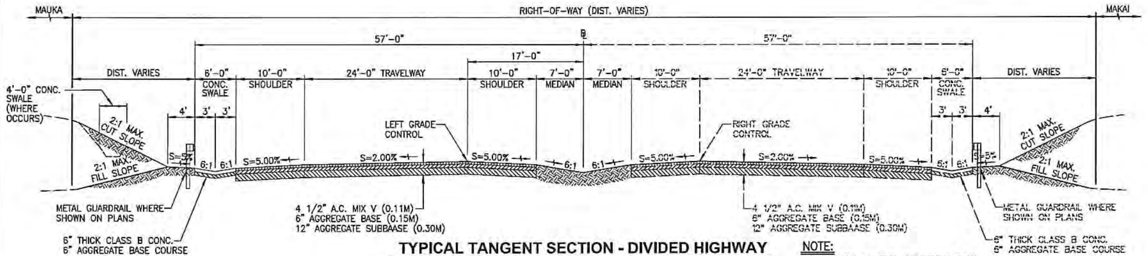
WARREN S. UNEMORI ENGINEERING, INC.

May 20, 2014



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'



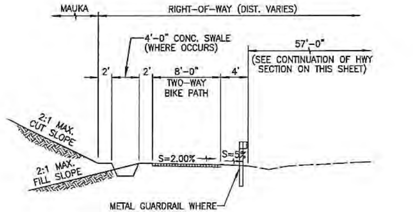
TYPICAL TANGENT SECTION - DIVIDED HIGHWAY

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)

NOTE:
LEFT GRADE CONTROL ELEVATIONS EQUAL RIGHT GRADE CONTROL ELEVATIONS

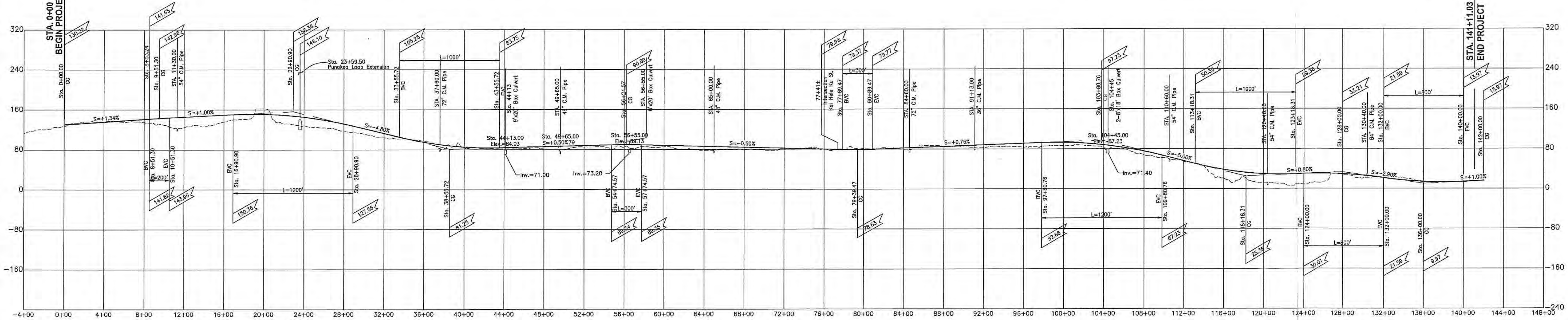
APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 3)

EXCAVATION = 60,900 CU.YD.
EMBANKMENT = 480,200 CU.YD.
HIGHWAY AREA = 67 ACS.±
DETENTION BASIN AREA = 9 ACS.±
ROAD RECONSTRUCTION AREA = 6 ACS.±



TYPICAL CROSS SECTION - BIKE PATH (WHERE OCCURS)

SCALE: 1" = 10'
(SCALE: 1cm = 1.2m)



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3

SCALE: HORIZ. 1"=400'
VERT. 1"=80'

REDUCED COPY
NOT TO SCALE

EXHIBIT C

WARREN S. UNEMORI ENGINEERING, INC.
May 20, 2014

TABLES

TABLE 1 - LAHAINA BYPASS PHASE 1-B-2 PRELIMINARY ORDER OF MAGNITUDE RELATIVE COST ESTIMATE - ALTERNATIVE 1

Description	*Approx. Quantity*	*Unit*	*Unit Price*	*Subtotal*	*Comments*
General Sitework					
Clearing and Grubbing	52	ac.	$ 2,605.00	$ 135,460.00	Based on Exhibit A Quantities
Excavation	33,238	c.y.	$ 15.00	$ 498,570.00	
Embankment	323,540	c.y.	$ 9.00	$ 2,911,860.00	
Dust Abatement and Erosion Control	52	ac.	$ 16,000.00	$ 832,000.00	
			Subtotal - General Site Work:	$ 4,377,890.00	
Roadway (24' wide travelway with 2- 10' paved shoulders)					
44 ft wide 4-1/2" thick AC Mix V	46,445	sq.yd.	$ 65.00	$ 3,018,925.00	Based on Exhibit A Quantities
44 ft wide 6" thick Asphalt Treated Base	46,445	sq.yd.	$ 75.60	$ 3,511,242.00	
44 ft wide 12" thick Aggregate Subbase	46,445	sq.yd.	$ 16.50	$ 766,342.50	
6 ft wide, 6" thick Class B Concrete Swale	9,500	l.f.	$ 78.00	$ 741,000.00	
6 ft wide, 6" thick Aggregate base course beneath Concrete Swale	6,335	sq.yd.	$ 4.00	$ 25,340.00	
Land Acquisition for ROW	52	ac.	$ 134,000.00	$ 6,968,000.00	Based on $2M for 15 ac
			Subtotal - Roadway:	$ 15,030,849.50	
Kai Hele Ku Street Realignment and Signalized Intersection (Alt 1 and 2 only)	1	L.S	$ 876,185.00	$ 876,185.00	Estimated separately
			Subtotal - Realignment and Signalized Intersection:	$ 876,185.00	
			Total, Alternative 1:	$ 20,284,924.50	

TABLE 2 - LAHAINA BYPASS PHASE 1-B-2 PRELIMINARY ORDER OF MAGNITUDE RELATIVE COST ESTIMATE - ALTERNATIVE 2

Description	*Approx. Quantity*	*Unit*	*Unit Price*	*Subtotal*	*Comments*
General Sitework					
Clearing and Grubbing	70	ac.	$ 2,605.00	$ 182,350.00	Based on Exhibit B Quantities
Excavation	44,200	c.y.	$ 15.00	$ 663,000.00	
Embankment	470,500	c.y.	$ 9.00	$ 4,234,500.00	
Dust Abatement and Erosion Control	70	ac.	$ 16,000.00	$ 1,120,000.00	
			Subtotal - General Site Work:	$ 6,199,850.00	
Roadway (24' wide travelway with 2- 10' paved shoulders)					
44 ft wide 4-1/2" thick AC Mix V	69,931	sq.yd.	$ 65.00	$ 4,545,493.33	Based on Exhibit B Quantities
44 ft wide 6" thick Asphalt Treated Base	69,931	sq.yd.	$ 75.60	$ 5,286,758.40	
44 ft wide 12" thick Aggregate Subbase	69,931	sq.yd.	$ 16.50	$ 1,153,856.00	
6 ft wide, 6" thick Class B Concrete Swale	14,304	l.f.	$ 78.00	$ 1,115,712.00	
6 ft wide, 6" thick Aggregate base course beneath Concrete Swale	9,536	sq.yd.	$ 4.00	$ 38,144.00	
Land Acquisition for ROW	70	ac.	$ 134,000.00	$ 9,380,000.00	Based on $2M for 15 ac
			Subtotal - Roadway:	$ 21,519,963.73	
South Connector to Existing Honoapiilani Highway					
40 ft wide 2" thick AC Mix V	3,453	sq.yd.	$ 26.30	$ 90,822.67	Based on Length of 777 l.f.
40 ft wide 5" thick Asphalt Treated Base	3,453	sq.yd.	$ 57.30	$ 197,876.00	
40 ft wide 8" thick Aggregate Subbase	3,453	sq.yd.	$ 10.00	$ 34,533.33	
Land Acquisition for ROW	0.730	ac.	$ 134,000.00	$ 97,820.00	
			Subtotal - South Connector:	$ 421,052.00	
Kai Hele Ku Street Realignment and Signalized Intersection (Alt 1 and 2 only)	1	L.S	$ 876,185.00	$ 876,185.00	Estimated separately
			Subtotal - Realignment and Signalized Intersection:	$ 876,185.00	
			Total - Alternative 2:	$ 29,017,050.73	

Note: Does not include costs for 10 acres of Detention Basin Areas

TABLE 3 - LAHAINA BYPASS PHASE 1-B-2 PRELIMINARY ORDER OF MAGNITUDE RELATIVE COST ESTIMATE - ALTERNATIVE 3

Description	*Approx. Quantity*	*Unit*	*Unit Price*	*Subtotal*	*Comments*
General Sitework					
Clearing and Grubbing	67	ac.	$ 2,605.00	$ 174,535.00	Based on Exhibit C Quantities
Excavation	60,900	c.y.	$ 15.00	$ 913,500.00	
Embankment	480,200	c.y.	$ 9.00	$ 4,321,800.00	
Dust Abatement and Erosion Control	67	ac.	$ 16,000.00	$ 1,072,000.00	
			Subtotal - General Site Work:	$ 6,481,835.00	
Roadway (24' wide travelway with 2- 10' paved shoulders)					
44 ft wide 4-1/2" thick AC Mix V	68,987	sq.yd.	$ 65.00	$ 4,484,155.00	Based on Exhibit C Quantities
44 ft wide 6" thick Asphalt Treated Base	68,987	sq.yd.	$ 75.60	$ 5,215,417.20	
44 ft wide 12" thick Aggregate Subbase	68,987	sq.yd.	$ 16.50	$ 1,138,285.50	
6 ft wide, 6" thick Class B Concrete Swale	14,111	l.f.	$ 78.00	$ 1,100,658.00	
6 ft wide, 6" thick Aggregate base course beneath Concrete Swale	9,407	sq.yd.	$ 4.00	$ 37,628.00	
Land Acquisition for ROW	67	ac.	$ 134,000.00	$ 8,978,000.00	Based on $2M for 15 ac
			Subtotal - Roadway:	$ 20,954,143.70	
South Connector to Existing Honoapiilani Highway					
40 ft wide 2" thick AC Mix V	4,471	sq.yd.	$ 26.30	$ 117,590.22	Based on Length of 1,006 l.f.
40 ft wide 5" thick Asphalt Treated Base	4,471	sq.yd.	$ 57.30	$ 256,194.67	
40 ft wide 8" thick Aggregate Subbase	4,471	sq.yd.	$ 10.00	$ 44,711.11	
Land Acquisition for ROW	1.016	ac.	$ 134,000.00	$ 136,144.00	
			Subtotal - South Connector:	$ 554,640.00	
			Total - Alternative 3:	$ 27,990,618.70	

Note: Does not include costs for 9 acres of Detention Basin Areas

APPENDIX O.

April 26, 2007 Public Scoping Meeting Summary and June 12, 2012 Sign-In Sheet

APRIL 26, 2007
PUBLIC SCOPING MEETING

Public Scoping Meeting
for
Proposed Relocation of Lahaina Bypass Southern Terminus

April 26, 2007
Lahaina Civic Center

SUMMARY OF COMMENTS RECEIVED

A public scoping meeting on the proposed relocation of Lahaina Bypass Southern Terminus was held for the purpose of receiving input for the preparation of the Draft Environmental Assessment for the project. Representing the Department of Transportation were Brennon Morioka, Deputy Director; Fred Cajigal, Maui District Highway Engineer; and Wayne Kawahara, Project Civil Engineer. The list of attendees is attached to this summary.

The following is a summary of questions and comments offered and responses provided.

1. **Bob Pure**:

   a. Comment concerning timing of phases
   Brennan Morioka:
   - Explained phasing of Bypass
   - General design and construction time frame is 2 years for Phase IA
   - Phase IB-2 to follow immediately after construction of Phase IB-1 is completed

2. **Joe Pluta, West Maui Taxpayers Association, West Maui Improvement Foundation**:

   a. Noted that implementation timing is critical

   b. Asked about recent legislation pertaining to SDOT being exempted for certain regulatory requirements
   Brennan Morioka: Legislation is being considered to allow SDOT to be exempt from SMA permitting requirements in the event of an emergency (acts of Mother Nature). Example, if shoreline erosion requires roadway relocation, SDOT would be exempt from SMA process as long as project improvements remain in the right-of-way. If Federal monies are involved, federal legislation governs.

   c. How can we get FEMA involved to facilitate implementation of the Bypass?
   B. Morioka: SDOT does not typically work with FEMA in terms of facilitating project implementation. SDOT's cooperating federal agency is FHWA.

   d. Is FHWA involved in these discussions (regarding this project)?
   B. Morioka: Meetings are held every other week with FHWA.

e. Asked whether there would be further delays in conjunction with this proposal.
B. Morioka: No further delays. The point of this proposal is to move forward. This project in no way will change the (original Lahaina Bypass) Record of Decision causing delay. It will not impact the schedule, except to possibly accelerate the implementation of the broader regional highway planning effort.

f. Inquired about the possibility of extending the Bypass further south to Ma`alaea.
B. Morioka: Explained the permitting process and that Ma`alaea to Launiupoko venture would be a larger project. Explained the EA versus EIS process. SDOT understands that the Ma`alaea extension encompasses broader issues which requires the preparation of an EIS. SDOT will be working to establish a task force for the Ma`alaea to Launiupoko segment in the EIS process.

g. Expressed belief that getting stuck at the Pali and the back up will be a problem. The problem is getting passed that portion of the highway "bottleneck".

3. **Norm Bezane**:

a. Questioned representations made by SDOT regarding start of construction dates for Phase IA.
B. Morioka: Explained the awarding of contracts and further explained the Bypass timeline.

b. Explained his familiarity with RFPs and indicated his understanding is that the Bypass was planned to start in January. Noted last month's DOT representations regarding construction starting in July. At this meeting, it is being represented that construction will start in August. Wants to emphasize that SDOT should meet deadlines and dates.
B. Morioka: After summarizing the project schedule, explained that this is the reason for public involvement. That is to keep the public apprised of status and to keep SDOT accountable.

4. **Fred Schwettmann**:

a. Requested comment on specific issues for consensus building and building in a timely fashion.
B. Morioka: With respect to the Ma`alaea to Launiupoko study, explained EIS process and that EIS process takes longer (5 years) than the EA process. Must ensure that SDOT is providing what the community wants. When conflicting views are received, it is difficult for government to move forward because it is unclear what the community wants. This leads to further delays. Further explained the vulnerability of a project because it is subject to challenge in the courts, which results in the judge making a decision about whether to proceed or not. Once the project is challenged in court, the 5-year timeframe is no longer applicable. Public's questions and comments become part of a formal document to justify the project. If

there is only opposition to a project (at public forums), it is difficult to move a project forward. Building consensus to get people to support a project is the most important thing the community can do to help the process. This is the third meeting (on the Bypass) in the past week and there has been good turn out for these meetings. Engaging the public is part of the consensus building process.

b. Explained his understanding of consensus building, however, inquired whether there are any contingency plans in case of problems. Asked what SDOT thought the potential problems might be; particularly those that would end up in court.
B. Morioka: Some issues which may be a source of concern include cultural sensitivity, environmental impacts (flora, fauna), different routes having community impacts, and impacts on view planes. Explained that this is what the environmental review process is for; it is meant to identify alternatives and options so that when questions are raised, they can be responded to. The project is opened to litigation when questions are not addressed properly.

5. **Joe Pluta**:

a. Expressed support for this project (southern terminus relocation) and commended everyone. Questioned the need to use federal monies. Inquired about the possibility of using State funds and getting reimbursed by the federal government later, or seeking use of private funds. Questioned the economic loss of a road closure should delays be caused an emergency. Wondered about the economic impact due to such an event.
B. Morioka: There are limitations to funding. Federal appropriations end in 2010. In addition, there are limited State funds. SDOT does advance construction monies in a few instances; however, there are limitations because it is difficult to leverage future monies for federal projects.

b. Expressed that we have to start thinking "outside of the box".
B. Morioka: Explained that by 2009 the State will start running out of federal highway funds. Cannot solely rely on federal monies and existing state funding. Public-private partnerships is an avenue which needs to be explored. SDOT will be entering into a number of public-private partnerships and some private entities are being asked to pay for some of it now.

6. **George Laverson**:

a. Has a different perspective from everyone else. Current drive is breathtaking and world class. Hate to see it ruined. He understands the Bypass project, but why Bypass the coast? Can we fix the shore instead of moving the whole highway?
B. Morioka: Explained that this is the type of comments SDOT needs to hear. With respect to the Ma`alaea to Launiupoko project, the EIS process will look at different routes and alternatives. There has been a determination of capacity need 25 years out. How it will be met is not determined (roadway, bikeway, employee subsidized shuttles). Thus, roadways are not the only alternatives being looked at. There is

also the "no-build" scenario to be considered.

7. **Mike Foley**:
   a. Supports the project, but wants to caution everyone that the County and State have the lands zoned for Agriculture in the project vicinity. Moving the highway as proposed would provide opportunity for other development (residential and commercial) instead of recreation and open space. Six months ago the property owner applied for subdivision (into approximately twenty 15-acre lots). Would like to know the status of the subdivision and whether or not the properties are for sale or will be for sale.
   B. Morioka: Explained right-of-way acquisition objectives of the SDOT and that the State tries to acquire property with the least amount of money as possible, or have the lands dedicated to the DOT.

   Rory Frampton, Makila Land Co.: Makila Land owns parcels of land affected by the southern terminus relocation. The subdivision would not increase the cost of the land. Preliminary subdivision approval has been secured, with final subdivision approval being worked on. The alignment recommended has been set aside as a "no build" zone on the subdivision map so it can be transferred to SDOT. Makila wants to work with SDOT and provide the land to the State at no cost.

8. **Hans Michel**:
   a. Thinks the idea of the southern terminus relocation is excellent and public has been ready for regional improvements for many months and years. Questioned the location of the alignment in relation to the "proposed storm drainage channel" (blue line on map exhibit board) and rubbish dump. Expressed concern about drainage.
   B. Morioka: Explained that 2 culvert structures are to be addressed in the design of the southern terminus relocation.

   b. Asked what happens to existing road after the Bypass is completed; does it get turned over to the County and when will that take place?
   B. Morioka: It is typical that the older portion of the road is turned over to the County in a progressive manner, once the Bypass is built.

   c. Requested clarification of funding for Phase IB.
   B. Morioka: $40 million is appropriated for Phase IB (includes Phases IB-1 and IB-2). The $40 million takes us to the end of Phase IB. This proposed southern terminus relocation project is important because it adds significant mileage to the Bypass, gives us more road in a shorter period of time, and saves money. Phase IB-1 will start construction in beginning of 2009.

   d. Commented on the relationship between the drainage channel and the alignment. If there is a big flood the Bypass will be damaged. He would like to see the flood channel mauka of the Bypass but now understands that the monies have lapsed for the flood channel.

9. **Gene Moore**:
   a. Questioned communication between other agencies during construction of multiple projects. Is there coordination between the project managers?
   B. Morioka; Yes. Coordination will be undertaken between multiple projects. All traffic controls will be working in concert with each other.

10. **Hans Michel**:
    a. Expressed concern at the Lahainaluna Road-Honoapi`ilani Highway intersection and the problems of large trucks and semi-trailers navigating the turns.
    B. Morioka: Lahainaluna Road intersection will be improved as part of the Honoapi`ilani Highway widening project to allow for safe turning movements.

    b. Asked about mass transit from Kapalua to the Pali and beyond. Can government acquire land now for future transportation plans. Expressed need that some kind of easement be set aside now for future mass transit.
    B. Morioka: This kind of issue can be addressed through the General Plan and Community Plans. These are the things that need to be addressed before you can reserve lands. In addition to the County General Plan and Community Plans, the SDOT is working on a long-range plan for Maui County (transportation specific).

The meeting was adjourned with no further questions or comments.

Page 1 of 6

LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
SCOPING MEETING

Date: **Thursday, April 26, 2007**
Time: **6:00 p.m. - 8:00 p.m.**
Location: **Lahaina Civic Center - Social Hall**

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
Brennon Morioka	DOT	689 Punchbowl St Honolulu HI 96813	Ph: 587-2156 FAX: Email: brennon.morioka@hawaii.gov
Rory Frampton	Makila Land Co.	33 Lono Ave, Suite 450 Kahului, 96790	Ph: 298-4956 FAX: Email: rorymakilaland.com
Claudine San Nicolas	MAUI NEWS	100 Mahalani St Wailuku HI 96793	Ph: 242-6341 FAX: Email: claudine@mauinews.com
Bob Pure BOB PURE	LBN	2960 Keka'a Drive, Unit C303 Lahaina HI 96761	Ph: 661-3307 FAX: Email: bobdi@hawaii.rr.com
William Soares	ME	37 KUA PLACE	Ph: 667-9140 FAX: Email:
JOSEPH PLUTA	WMTA	PO BOX 10338 LAHAINA, HI 96761	Ph: 661-7990 FAX: 661-7992 Email: PLUTA@MAUI.NET
Kumu Kalani Kapu	Manowaipele 'O Ko'oko	P.O. Box 1683 Lah. HI 96761	Ph: 344-3419 FAX: Email: Valleyislefire@HI Tel.Net

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Page 2 of 6

LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
SCOPING MEETING

Date: **Thursday, April 26, 2007**
Time: **6:00 p.m. - 8:00 p.m.**
Location: **Lahaina Civic Center - Social Hall**

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
Kathleen Aoki	Long Range Planning	250 S. High St Wailuku, HI 96793	Ph: 270-5529 FAX: Email: Kathleen.aoki@co.maui.hi.us
Ferdinand Cajigal	SDOT - Hwy	650 Palapala Drive Kahului, HI 96732	Ph: 873-3535 FAX: Email:
John McKelvey	Just Me.	837 Kai Hele Ku 96761	Ph: 662-0131 FAX: - 0132 Email:
Jennifer Dory	Lahaina Bypass Now	505 Front St. Ste. 202 Lahaina 96761	Ph: 870-0117 FAX: Email: info@lahainabypassnow.com
Bill Frampton	OLOWALU TOWN, LLC	2073 Wells St Wailuku, HI 96793	Ph: FAX: Email:
Joshua Dean Dean	West Maui Land Co	808 Olowalu Village Rd Lahaina	Ph: FAX: Email: joshua@westmauiland.com
Pete Martin		540A STABLE RD PAIA, HI 96779	Ph: FAX: pkm@ Email: mauinet

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LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
SCOPING MEETING

Date: **Thursday, April 26, 2007**
Time: **6:00 p.m. - 8:00 p.m.**
Location: **Lahaina Civic Center - Social Hall**

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
George & Judy Lavenson		50 Puu Anoano #2801 Lahaina, HI 96761	Ph: 667-9300 FAX: 661-0040 Email: GLAVENSON@AOL.com
Fred & Sandra Schwettmann Schwettmann		85 ~~[illegible]~~ Lauawa Pl. Lahaina, HI 96761	Ph: 661-3401 FAX: Email: fschwett@earthlink.net
Donna Soares		P.O. Box 817 Lahaina 96767	Ph: 661-8748 FAX: 661-5871 Email:
Norm Bezaire			Ph: FAX: Email:
Mac Lowson		PO Box 613 Lahaina 96767	Ph: FAX: Email:
Theo Morrison	Lahainabypassnow	505 Front St. #202 Lahaina, HI 96761	Ph: 667-5150 FAX: Email: theo@lahainabypass now.com
David Ferguson	Lahaina Bypass Now	PoBox 11837 Lahaina 96761	Ph: 661-8795 FAX: Email: dave@mchawaii.com

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LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
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Date: Thursday, April 26, 2007
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Location: Lahaina Civic Center - Social Hall

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
Gene Moore		43 Pololtina Lane #5 Lahaina	Ph: 669-6156 FAX: Email:
Neal Shinyama	Maui Electric	210 Kamehameha Av. Kah 96733	Ph: 808 871-2364 FAX: Email:
Heidi Bigelow	West Maui Land Co.	33 Lono Ave. Suite 450 Kahului, HI 96732	Ph: 808 877 4202 FAX: Email:
Mona Stevenson	Maui Community College	310 Kaahumanu Kahului, HI 96732	Ph: FAX: Email: monastev@hawaii.edu
MIKE WHITE	KAANAPALI BEACH HOTEL	2525 KAANAPALI PKWY LAHAINA, HI 96761	Ph: FAX: Email: MWHITE@KBHMAUI.com
John Seebart		c/o KHYC 280 YACHT CLUB WAY REDONDO BCH CA 90277	Ph: FAX: Email: jseebart@pobox.com
KARL BOSSERT	MLP	1200 KONE KAHULUI	Ph: FAX: Email: KBOSSERT@MLPMAUI.com

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LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
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SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
Hans Michel		1404 Olona PL Lahaina	Ph: 667.7693 FAX: Email:
LEILANI PULMANO	LAHAINA BYPASS NOW	1000 KAPALUA DRIVE LAHAINA, HI 96761	Ph: 665-5460 FAX: Email: lpulmano@hlpmaui.com
Toby Hay		45 Kai Ala Drive Lahaina, Hi	Ph: 280-6125 FAX: Email:
CLAIRE Paisson		152 PUAKUKUI PL LAHAINA 96761	Ph: 667-7022 FAX: — Email: —
Debbie Martin		590 A Old Stable Rd Paia HI 96779	Ph: 871-5924 FAX: Email:
	Maui Chamber of Commerce	313 Ano St Kahului HI 96732	Ph: 871-7711 FAX: Email: DANIEL@MAUICHAMBER.CO
MIKE FOLEY		128 PUALU PLACE NAPILI	Ph: 669-8184 FAX: Email: PETE155@Aol.Com

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Howard Hanzawa	KDC		Ph: FAX: Email:
GEORGE KAYA	Gov's Liaison	2264 Aupuni St, Ste Wailuku, HI 96793	Ph: 243-5798 FAX: 243-5049 Email: george.kaya@hawaii.gov
Laurie Lowson	Resident	POB 11494 96761 6494	Ph: FAX: Email: Laurie@Lowson.com
KIRK HUNT	HUNT CONSTRUCTION	1328 KAHOMA ST	Ph: 808 385-8395 FAX: 808 661-8079 Email: KIRKNUCES@HAWAII.RR.COM
			Ph: FAX: Email:

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JUNE 12, 2012
PUBLIC MEETING

Page 1 of 7

PUBLIC MEETING FOR PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Date: **Tuesday, June 12, 2012**
Time: **5:30 p.m. - 7:30 p.m.**
Location: **Kaunoa West Maui Senior Center**

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
May Fujiwara	~~N/A~~ LBN	P.O. Box 1086 Lahaina, HI 96767	Ph: (808) 661-4208 Email: fujiwaramitsu@aol.com
Anita Yamafuji		801 S. Hopoe PL Lahaina HI	Ph: 667-5763 Email:
Nanea Kalani	The Maui News		Ph: Email: Nkalani@mauinews.com
Lynn McFarlane		167 Awaiku St Lahaina 96761	Ph: Email: LynnRossGary@msn.com
DIANE + Bob PURE	LBN	2560 Kekaa Dr. @-303	Ph: 661-3307 Email: bobdi@HAWAII.rr.com
Emi Fukuzawa Murata		79 Waikulu Pl Lahaina 96761	Ph: Email:
Roger Joslin		P.O. 1610 Lahaina	Ph: 344-4882 Email: rogerjoslin@aol.com

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SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
KIYOSHI MURATA		79 WAI KULU PL LAHAINA HI 96761	Ph: Email: KIYOSHI.MURATA@GMAIL.COM
JOAN MCKELVEY		537 KAI HELE KU ST. LAHAINA 96761	Ph: Email:
Don Lehman	West Maui Taxpayers	131 Kualapa Pl LAHAINA, HI 96761	Ph: Email: delehman@EARTHLINK.NET
Mark Roberts		3066 Mana Hope Pl Kihei	Ph: 808 280-4663 Email: Robertson218@yahoo.com
Mary Jorgensen	Maui County Dept of Planning Long Range	250 South High St. Wailuku, HI 96793	Ph: 808-270-8241 Email: mary.Jorgensen@mauicounty.gov
Larry Okada	—	388 Aki St	Ph: 268-3517 Email:
Kathleen Aoki	Planning Dept	250 S. High St Wailuku, HI 96793	Ph: 270-5529 Email: Kathleen.aoki@mauicounty.gov

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
Rep McKelvey			Ph: Email:
BARRY AOKI		761 PAUWALU ST LAHAINA, HI 96761	Ph: 264-7496 Email:
Joe Pueschel		960 Front St Lahaina HI 96761	Ph: 280-3458 Email: joseph.pueschel@gmail.com
Judy Lauridsen		22 Huapala Pl Lahaina, HI	Ph: 667-0870 Email:
Donna Kretsch		60E Huapala Pl Lah HI 96761	Ph: 385-0360 Email:
Katherine Monroe		PO Box 1566 Lahaina 96767	Ph: 808 385-9463 Email:
John Monroe		PO Box 1566 Lahaina 96767	Ph: 808-385-9463 Email:

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PUBLIC MEETING FOR PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
Bo Petty		PO BOX 1172 Lahaina 96767	Ph: Email:
Lorne Shandro		#5 Pua Niu Way.	Ph: Email: LORNESHANDRO@TELUS.NET.
Noelle DuBois			Ph: Email:
Janet Mann		100 Punakea Lp Lahaina HI 96761	Ph: Email: jmann@hawaiiantel.net
ANITA WHITE	QUAM PROPERTIES/REALTOR	LAHAINA PO BOX 3086	Ph: Email: ANITA@AVIATORAGENT.COM
RICHARD HOEHN	PRIVATE LANDOWNER	390 PUALOA NANI PL. KIHEI	Ph: 276-5454 Email: RHOEHN808@GMAIL.COM
Vonnie Pietsch	"	304 Hokiokio Pl Lahaina	Ph: 250 7150 Email: ronniep@hawaii.rr.com

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PUBLIC MEETING FOR PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
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Ilich Kato		80 Hanui St Lahaina HI 96761	Ph: 661-0998 Email:
Sandra Braun		455 Hokiokio Pl Lah	Ph: 661-9088 Email:
Kevin Brown		120 Puunoa	Ph: 661 1616 Email:
Danny & Lynn LaTendre		12 Wai Kulu Pl. Lahaina, H	Ph: 214-9670 Email: lmgl06@gmail.com
Roz Baker	State Senate		Ph: Email: senbaker@capitol.hawaii.gov

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
R. Nishikawa	—	153 Fleming Rd Lahaina 96761	Ph: 870 6478 Email: mauinosh@yahoo.com
C. Sutherland		PO Box 446	Ph: 205-8086 Email:
E. KALUA	OFFICE OF THE MAYOR	200 S HIGH ST. WAILUKU HI 96793	Ph: 463-3122 Email: ZEKE.KALUA@MAUICOUNTY.GOV
S. Allen Merle		200 Puanui	Ph: 949-973-0007 Email: omwao@cox.net
			Ph: Email:
			Ph: Email:
			Ph: Email:

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE & E-MAIL
Alan Arakawa	County of Maui	200 S. High St Wailuku Maui	Ph: 281-0354 Email:
Randy Clark		752 Hookahua Pl	Ph: 281-0493 Email: rclark808@gmail
DAVE MINAMI	Resident & WML	390 PUNAKEA LOOP 96761	Ph: 357-3984 Email: dave@westmauiland.com
JAMIE Dulebohn	Resident	39 Puaa Niu Way	Ph: Email: jamie.dulebohn@gmail.com
Bill Frampton	Olowalu Town, LLC	2035 Main Street #1 Wailuku, HI 96793	Ph: Email: bill@fwmaui.com
			Ph: Email:
			Ph: Email:

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