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Mayor

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Director

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Deputy Director

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FILE COPY

AUG 08 2014

GLEN A. UENO, P.E., P.L.S.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

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

July 21, 2014

'14 JUL 28 P3:27

Jessica Wooley, Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813

Dear Ms. Wooley:

SUBJECT: FINAL ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS AT TMK NOS. (2)3-5-002:014 (POR.), 018 (POR.), 888 (POR.); (2)3-5-027:021 (POR.); (2)3-6-002:003 (POR.); AND (2) 3-8-005:999 (POR.), WAILUKU, MAUI, HAWAII

With this letter, the County of Maui, Department of Public Works hereby transmits the Final Environmental Assessment (FEA) and Finding of No Significant Impact (FEA-FONSI) for the Proposed Waiale Road Extension and East Waiko Road Improvements situated at TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), 888 (por.); (2) 3-5-027:021 (por.); (2) 3-6-002:003 (por.); and (2) 3-8-005:999 (por.), in the Wailuku District on the island of Maui for publication in the next available edition of the Environmental Notice.

The County of Maui, Department Public Works has included copies of public comments and the corresponding responses from the application that were received during the 30-day public comment period on the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI)

Enclosed is a completed OEQC Publication Form, two copies of the FEA-FONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Department of Public Works, Nolly Yagin, P.E., at (808) 270-7745.

Very truly yours,

David Goode
Director of Public Works

DG/CY:gq(ED14-0977)
Enclosures

cc: Mich Hirano, AICP, Munekiyo & Hiraga, Inc. (w/out enclosures)
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AGENCY ACTIONS
SECTION 343-5(B), HRS
PUBLICATION FORM (FEBRUARY 2013 REVISION)

Project Name: Proposed Waiale Road Extension and East Waiko Road Improvements
Island: Maui
District: Wailuku
TMK Nos.: (2) 3-5-002:014 (por.), 018 (por.); (2) 3-5-027:021 (por.); (2) 3-6-002:003 (por.); and (2) 3-8-005:999 (por.)
Permits: Construction Permits (Grubbing, Grading and Work to Perform on County/State Highway); Section 404 Department of Army Permit (stream crossing only); Section 401 Water Quality Certification (stream crossing only); Coastal Zone Management Consistency Determination, Stream Channel Alteration Permit, (stream crossing); National Pollutant Discharge Elimination System (NPDES) Permit; and Community Noise Permit, as applicable.
Proposing/Determination Agency: County of Maui, Department of Public Works, 200 South High Street, Wailuku, Hawaii 96793, Contact: Nolly Yagin, P.E., Telephone: (808) 270-7745
Accepting Authority:
(for EIS submittals only)
Consultant: Munekiyo & Hiraga, Inc., 305 High Street, Suite 104, Wailuku, Hawaii 96793, Contact: Mitsuru "Mich" Hirano, Senior Vice President, Telephone: (808) 244-2015

Status (check one only):

__DEA-AFNSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day comment period ensues upon publication in the periodic bulletin.
_X_FEA-FONSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__FEA-EISPN	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day consultation period ensues upon publication in the periodic bulletin.
__Act 172-12 EISPN	Submit the proposing agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov). NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
__DEIS	The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.
__FEIS	The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__ Section 11-200-23 Determination	The accepting authority simultaneously transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the proposing agency. No comment period ensues upon publication in the periodic bulletin.
__Section 11-200-27 Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously

accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.

__Withdrawal (explain)

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page):

The County of Maui, Department of Public Works (DPW) proposes to construct the Waiale Road Extension, which extends Waiale Road from its current terminus at East Waiko Road southward to Honoapiilani Highway. The proposed extension is approximately 8,600 lineal feet (ft.) in length within an 80-ft. right-of-way and will be designed with two (2) 12-ft. travel lanes, 6-ft. shoulders, 6-ft. grass swales, and a 10-ft. bike/pedestrian path on the west side of the roadway. The Waiale Road Extension will be funded by the County of Maui. In addition, DPW proposes to improve East Waiko Road from the intersection at Waiale Road to Kuihelani Highway. The East Waiko Road Improvements are approximately 4,600 lineal feet in length within the existing 60-ft. right-of-way and include upgrading the existing pavement section to two (2) 12-ft. travel lanes, 6-ft. shoulders, and asphalt concrete (AC) swales. The extension of Waiale Road was recognized by the County as a long range strategy to improve traffic flow within and around Waikapu Village and provide an alternative route between Kahului and Wailuku. The purpose and need of the East Waiko Road Improvements are to improve the roadway conditions in order to facilitate increased safety and use of this route. The East Waiko Road Improvements will be funded by the County of Maui.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
PRESIDENT

KARLYNN FUKUDA
EXECUTIVE VICE PRESIDENT

GWEN OHASHI HIRAGA
SENIOR VICE PRESIDENT

MITSURU "MICH" HIRANO
SENIOR VICE PRESIDENT

MARK ALEXANDER ROY
VICE PRESIDENT

TO: Jessica Wooley, Director
Office of Environmental Quality Control
State of Hawaii
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

DATE: July 25, 2014

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements TMK (2)3-5-002:014 (por.), 018 (por.), and 888 (por.), TMK (2)3-5-027:021 (por.), TMK (2) 3-6-002:003 (por.), and TMK (2)3-8-005:999 (por.)

Enclosed is/are:

Copies	Date	Description
Orig.	7/21/14	Transmittal Letter from Department of Public Works
2 + 1 (CD)	July 2014	Final Environmental Assessment (EA)
1	----	OEQC Publication Form with Project Summary

	For your information	**For your use**
X	**For necessary action**	**As requested**
	For your review	**For your signature**
	For your files	**Returning**

REMARKS: The attached documents are provided for publication in the next OEQC Bulletin on August 8, 2014.

Should you have any questions, please do not hesitate to call me at (808) 244-2015.

Signed:
Mitsuru "Mich" Hirano, AICP
Senior Vice President

MH:yp
Copy to: David Goode, Department of Public Works (w/enclosures (one (1) copy of Final EA)

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305 High St., Suite 104 Wailuku, Hawaii 96793
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Final Environmental Assessment

PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS

TMK (2)3-5-002:014 (por.), 018 (por.), and 888 (por.), TMK (2)3-5-027:021 (por.), TMK (2)3-6-002:003 (por.), and TMK (2)3-8-005:999 (por.)

Prepared for:

County of Maui,
Department of Public Works

Approving Agency:

County of Maui,
Department of Public Works

July 2014

MUNEKIYO HIRAGA, INC.

CONTENTS

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LIST OF FIGURES

LIST OF APPENDICES

LIST OF TABLES

ABBREVIATIONS

44 CFR	Title 44 Code of Federal Regualtions
AC	Asphalt Concrete
ADT	Average Daily Traffic
ADWF	Average Dry Weather Flow
AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawaii
AMSL	Above Mean Sea Level
ATA	Austin, Tsutsumi & Associates, Inc.
AWSC	All-way Stop Controlled
BMPs	Best Management Practices
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CIA	Cultural Impact Assessment
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	Decibels
DOE	State of Hawaii, Department of Education
DPW	County of Maui, Department of Public Works
DWS	County of Maui, Department of Water Supply
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
GPD	Gallons per Day
HAR	Hawaii Administrative Rules
HDOH	State of Hawaii, Department of Health
HOV	High Occupancy Vehicle
HRS	Hawaii Revised Statutes
HSA	Hawaii Stream Assessment
HSG	Hydrologic Soil Group
HSTP	Hawaii Statewide Transportation Plan
IcB	Iao Clay
JaC	Jaucas Sand
Leq	Equivalent Hourly Sound Level
LOS	Level of Service
LSB	Land Study Bureau
MGD	Million Gallons Per Day
MIP	Maui Island Plan

MLRLTP	Maui Long Range Land Transportation Plan
MPD	Maui Police Department
MPH	Miles Per Hour
MSAT	Mobile Source Air Toxics
MTP	Maui Tropical Plantation
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
PpA	Pulehu Silt Loam
PrB	Pulehu Cobbly Silt Loam
PtA	Pulehu Cobbly Clay Loam, 0 to 3 percent slopes
PtB	Pulehu Cobbly Clay Loam, 3 to 7 percent slopes
PZUE	Puuone Sand
RGB	Rural Growth Boundary
SCS	Scientific Consultant Services, Inc.
SDOT	State of Hawaii, Department of Transportation
SHPD	State Historic Preservation Division
SHPO	State Historic Preservation Officer
SMA	Special Management Area
SRB	Small Town Boundary
STIP	Hawaii Statewide Transportation Improvement Program
TAZ	Traffic Analysis Zones
TIAR	Traffic Impact Assessment Report
TMK	Tax Map Key
TSM	Transportation System Management
UGB	Urban Growth Boundary
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WKWWRF	Wailuku-Kahului Wastewater Reclamation Facility

Executive Summary

Project Name:	Proposed Waiale Road Extension and East Waiko Road Improvements
Type of Document:	Final Environmental Assessment
Legal Authority:	Chapter 343, Hawaii Revised Statutes
Agency Determination:	Finding of No Significant Impact (FONSI)
Applicable Environmental Assessment review "trigger":	Use of State land and funds Use of County land and funds
Location:	Island of Maui Waikapu TMK (2)3-5-002:014 (por.), 018 (por.), and 888 (por.), TMK (2)3-5-027:021 (por.), TMK (2)3-6-002:003 (por.), and TMK (2)3-8-005:999 (por.)
Applicant:	County of Maui Department of Public Works 200 South High Street Wailuku, Hawaii 96793 Contact: David Goode, Director Phone: (808) 270-7845
Approving Agency:	County of Maui Department of Public Works 200 South High Street Wailuku, Hawaii 96793 Contact: David Goode, Director Phone: (808) 270-7845
Consultant:	Munekiyo & Hiraga, Inc. 305 High Street, Suite 104 Wailuku, Hawaii 96793 Contact: Mich Hirano, AICP Phone: (808) 244-2015

Project Overview: The County of Maui, Department of Public Works (DPW) proposes to construct the Waiale Road Extension, which extends Waiale Road from its current terminus at East Waiko Road southward to Honoapiilani Highway. The proposed extension is approximately 8,600 lineal feet (ft.) in length within an 80-ft. right-of-way and will be designed with two (2) 12-ft. travel lanes, 6-ft. shoulders, 6-ft. grass swales, and a 10-ft. bike/pedestrian path on the west side of the roadway, as well as associated drainage improvements and landscaping. The Waiale Road Extension will be funded by the County of Maui, the State of Hawaii, and the Federal Highway Administration. In addition, DPW proposes to improve East Waiko Road from the intersection at Waiale Road to Kuihelani Highway. The East Waiko Road Improvements are approximately 4,600 lineal feet in length within the existing 60-ft. right-of-way and include upgrading the existing pavement section to two (2) 12-ft. travel lanes, 6-ft. shoulders, and asphalt concrete (AC) swales along with drainage improvements. The East Waiko Road Improvements will be funded by the County of Maui, the State of Hawaii, and the Federal Highway Administration.

The proposed Waiale Road Extension and East Waiko Road improvements together make up the "proposed project". The extension of Waiale Road was recognized as a long range transportation strategy by the County of Maui, to improve traffic flow within and around Waikapu Village and provide an alternate route between Kahului and Wailuku. The purpose and need of the East Waiko Road Improvements are to improve roadway conditions in order to facilitate increased safety and use of this route.

The lands underlying the project area consist of State, County, and privately owned parcels. The use of State or County lands and/or funds are triggers for an environmental assessment pursuant to Chapter 343, Hawaii Revised Statutes (HRS). An Environmental Assessment (EA) has been prepared for the project in accordance with Chapter 343, HRS, and Title 11, Chapter 200 Hawaii Administrative Rules (HAR), Environmental Impact Statement Rules. This EA documents the project's technical characteristics and environmental impacts, and advances findings and conclusions relative to the significance of the project.

Alternatives: The following alternatives for the project were addressed in the EA.

No Action Alternative: This alternative would maintain the existing roadways conditions. This alternative would not meet the need to improve traffic flow within and around Waikapu Village nor provide an alternate route between Kahului and Wailuku. Further, it would not fulfill the long-term traffic management strategy as identified in Maui Long Range Transportation plan.

Deferred Action Alternative: This alternative would defer the proposed project until a later time. The impacts identified would be similar as the proposed project, with the exception of potentially higher costs due to price escalation. Equally important, the "deferred action" alternative may require further alignment studies if the land for the roadway corridor for Waiale Road Extension is not secured. As such, the preferred alternative is to move forward with the proposed project as described.

Transportation System Management (TSM) Alternative: This alternative includes ridesharing, fringe parking, and High-Occupancy Vehicle (HOV) lanes. TSM programs are one (1) component of the overall long-term transportation strategy to reduce projected traffic increases. TSM programs on Maui are gaining in popularity, but are underutilized. These programs do not reduce or eliminate the need for new roadways to meet Maui's long-term traffic management strategy.

Mass Transit Alternative: This alternative includes Maui County's Maui Bus system. Although the Maui Bus system continues to increase mass transit ridership, it is still in its infancy and does not reduce or eliminate the need for new roadways to meet Maui's long-term traffic management strategy.

Terminus Alternatives: Four (4) terminus alternatives for Waiale Road Extension were evaluated in the EA.

(1) Old Quarry Road Terminus (Preferred Terminus)

The proposed project terminus meets the project purpose and need. From a long-term planning perspective, using the Maui Island Plan's (MIP) Small Town Boundary (STB) for this area, the proposed terminus provides an appropriate roadway route and a "hard" edge for the STB in this area.

Old Quarry Road terminus location was deemed the best alternative as an appropriate route because the alignment would follow the STB and bypass the proposed Waikapu Tropical Plantation's internal roadway network. This alignment would have limited access (one roadway intersection) along the Waiale Road Extension to

Honoapiilani Highway. This limited access would provide for optimal traffic free flow efficiency and would meet the purpose and need of the project.

(2) **<u>Kuihelani Highway and Honoapiilani Highway Terminus</u>**

This alternative would extend Waiale Road to the intersection of Kuihelani Highway and Honoapiilani Highway. This alternative was eliminated early on from further analysis mainly because of the location of this alternative terminus. The terminus would fall outside of the area of influence for Waiale Road Extension, and thus outside of the purpose and need for the project. This terminus alternative will not generate new traffic; rather, it will provide an alternate access to Honoapiilani Highway, while ultimately not changing the overall traffic demand at the intersection of Honoapiilani Highway and Kuihelani Highway.

In addition, adding another approach to the existing intersection of Honoapiilani Highway and Kuihelani Highway would require:

(a) Honoapiilani Highway, Waiale Road Extension, and Kuihelani Highway to intersect at extremely acute angles. Intersections with acute angles - especially between major arterials - are not recommended per American Association of State Highway and Transportation Officials; or

(b) A realignment of Honoapiilani Highway to orient it in an east-west alignment to create right angles between the four (4) approaches. This would require right-of-way acquisition, and for Honoapiilani Highway's north-south through traffic to become less-efficient turning movements.

Furthermore, the Planning Department recommended that the Waiale Road Extension alignment follow the STB of the MIP to provide a "hard" edge to the STB. Again, this alternative was eliminated early on from further analysis.

(3) **<u>King Kamehameha/Kahili Golf Courses Terminus</u>**: This alternative terminus depicts a longer Waiale Road Extension which would significantly increase cost without a corresponding benefit to the traffic turning movements and/or traffic volume as compared to the preferred Old Quarry Road terminus. Additionally, this terminus did not follow the STB in the MIP. The Planning Department recommended that the Waiale Road Extension alignment follow the STB to provide a "hard" edge to the STB. As such, this alternative terminus was not recommended as the preferred alternative.

(4) **Maui Tropical Plantation Terminus:** This alignment depicts a much shorter Waiale Road Extension which would significantly decrease cost but would also increase traffic congestion as compared to the preferred Old Quarry Road terminus.

This alignment would be utilized as an internal roadway for the future planned development called Waikapu Tropical Plantation. As such, this alignment would decrease the efficiency of the connection to Honoapiilani Highway and increase turning movement volumes. Additionally, internal roadways that connect to this portion of the Waiale Road Extension would further decrease traffic operational efficiencies. It would also contribute to potential pedestrian conflicts. The improved Maui Tropical Plantation terminus intersection configuration would operate at Level of Service (LOS) F. LOS is a performance measure to describe conditions of traffic flow at intersections. Values range from LOS A (minimal delay) to LOS F (congested) and traffic would be at overcapacity on some of its movements (The Highway Capacity Manual Special Report 209, 2000).

For the reasons stated above, the Maui Tropical Plantation terminus and alignment was not recommended as the preferred alternative.

Impacts and Mitigations:

Surrounding Land Uses: The proposed project is compatible with the surrounding land uses. As such, it is not anticipated to have an adverse impact on surrounding land uses.

Climate: The proposed project is not anticipated to have an adverse impact on the climate of the surrounding area.

Agricultural Land: The proposed alignment for the Waiale Road Extension encompasses lands that have been defined as "Prime" and moderately productive soils. The use of 16 acres of agricultural lands for the proposed Waiale Road Extension is not anticipated to adversely impact agricultural productivity in this region.

The proposed East Waiko Road Improvements will not adversely impact agricultural productivity for this area since the improvements will be confined within the existing right-of-way.

<u>Topography and Soils Characteristics</u>: The Waiale Road Extension vertical roadway profile will not significantly alter topographic and soils conditions.

Special care will be taken on the East Waiko Road Improvements area when widening the existing 20 feet width of asphalt concrete (AC) to 36 feet width due to the loose sandy soils within this area. Best Management Practices to prevent erosion will be incorporated during construction to minimize soil loss, such as periodic water spraying of the disturbed soils and a dust screen. Also, an 8-inch thick ingress/egress gravel access way will be constructed near the entrance of the project site to minimize the tracking of onsite soils by construction vehicles onto existing roadways. Additionally, a water basin will be implemented during construction to contain process water. Geotechnical soil investigation will be carried out during the design phase of the project to determine the roadway design and geotechnical mitigation measure for pavement stability. As such, the proposed project is not anticipated to adversely impact topographic and soils conditions.

<u>Flood and Tsunami Hazards</u>: There is no practical alternative to avoid crossing the Waikapu Stream. As such, the crossing can be mitigated by a bridge design which will not interfere with the natural flow of the Waikapu Stream and allow a crossing. The bridge will be designed to accommodate a 100-year, 24-hour storm event. To address the portion of the existing East Waiko Road right-of-way within Flood Zone AE, during the design phase of the proposed project, the existing berm may need to be raised to contain the flow within the Waikapu Stream. As such, the proposed project is not anticipated to adversely affect adjacent or downstream properties from flooding.

The project area is located inland and outside the tsunami inundation zone.

<u>Streams and Wetlands</u>: None of the aquatic species observed within Waikapu Stream are listed as threatened or endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act. Any changes to the stream will be designed to accommodate diadromous life cycle of native fish and invertebrates. The bridge will be designed to allow the natural flow of the stream to continue to occur. Best Management Practices during construction will be implemented to prevent water quality degradation. Streams and wetlands are not anticipated to be adversely affected by the proposed project.

Flora and Fauna: No federally listed endangered or threatened plant species were found in the project area, nor were any species found that are candidates for such status. No significant adverse impact on botanical resources are anticipated as a result of the project.

No federally listed endangered or threatened fauna species were found in the project area, nor were any species found that are candidates for such status. Additionally, no native fauna were observed during the field survey. Nonetheless, it was recommended that any street lights be shielded to direct the light downward as young birds are easily confused by bright lights. Street lights are not proposed for the roadway except at intersections and at these locations, the lights will be directed downward and fully shielded. Furthermore, any temporary lighting used during construction work during the night, if deemed necessary, will be shielded and directed downward. Given the above mitigation measures, flora and fauna resources are not anticipated to be adversely impacted by the proposed project.

Archaeological Resources: One (1) site was documented within the project area, SIHP No. 50-80-04-6668, which consisted of a historic era boulder terrace located on the south bank of the Waikapu Stream in the area under the proposed bridge crossing. No additional archaeological mitigation is required for this site, allowing for removal, if necessary. Archaeological monitoring was recommended for any ground disturbing activities from the project construction along East Waiko Road because of the potential for sand deposits. Additionally, if any inadvertent discoveries of cultural materials and/or burials are found during construction, all work in the immediate area of the find will cease and the State Historic Preservation Division (SHPD) will be notified to conduct an assessment and recommend mitigative measures. State of Hawaii, Department of Land and Natural Resources, SHPD has approved the Archaeological Inventory Survey and a monitoring plan will be submitted and approved prior to construction.

Cultural Impact: Based on historical and cultural research, it is reasonable to conclude that the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access or other customary activities will not be affected by the proposed project.

Air Quality: The implementation of the proposed project will result in temporary construction-related air impacts. Mitigation measures will involve utilization of dust barriers, water wagons and/or sprinklers to control dust. In regards to the long-term use of the roadways, the proposed project is not anticipated to have a long-term adverse impact on air quality parameters.

Noise: Traffic noise levels generated by the proposed project are not expected to exceed the noise abatement levels set forth by State Department of Transportation (SDOT) within the project construction area. Therefore, noise mitigation measures are not anticipated to be required for the proposed project.

Noise levels may be temporarily affected by construction-related activities. Mitigation measures include proper equipment and vehicle maintenance, equipment mufflers or other noise attenuating equipment may also be employed. Heavy noise-generating construction activities will be restricted to hours between 7:00 a.m. and 6:00 p.m. from Monday through Friday, excluding holidays. If such construction activities are to occur outside of these hours, the surrounding community will be notified.

Scenic and Open Space Resources: The project is not part of a designated scenic view corridor and will not affect views from inland vantage points. Additionally, the proposed project will not affect open space resources.

Chemicals and Hazardous Materials: The proposed Waiale Road Extension and East Waiko Road Improvements will not require the use or storage of chemicals or hazardous materials during the use of the roadways. Use of fertilizers within the landscaped area along the roadway will be in a manner consistent with best management landscape practices. With such practices, there are no anticipated adverse effects on groundwater resources attributed to fertilizer use.

Beach and Mountain Access: No traditional Hawaiian access corridors were identified in the Cultural Impact Assessment for the project. No adverse impacts to beach and mountain access are anticipated by the proposed project.

Population: The proposed project does not generate population. However, it will benefit the community by developing and improving transportation infrastructure to support anticipated long-term population growth.

Economy: In the short term, the proposed project will provide construction and construction-related employment, thus benefitting the local economy. The estimated cost of construction is $17.3 million.

In the long term, the proposed project will improve the existing roadway network that will support both traffic and economic growth.

Police and Fire Protection: The proposed project will not affect the service area nor require additional personnel for these services.

Medical Services: The proposed project will benefit medical services by providing a more efficient roadway network for these services.

Solid Waste: The contribution of construction waste will be minimized through implementation of a solid waste management plan. With these solid waste management measures, there are no anticipated adverse impacts to the County's solid waste collection or capacity.

Recreational Resources: The proposed project does not generate population. The proposed project is not located within proximity to any park or recreational resources. Therefore, it is not anticipated to adversely impact recreational resources. The proposed project will be beneficial to the community since a bike/pedestrian path will be included as part of the Waiale Road Extension project.

Schools: The proposed project is not anticipated to adversely impact school enrollments and facility requirements since it does not generate population.

Roadways: The proposed East Waiko Road Improvement project will improve capacity along this roadway. The proposed Waiale Road Extension will:

1. Increase the viability of Waiale Road as an alternate route to Honoapiilani Highway and Kuihelani Highway through the Waikapu area;

2. Improve regional access to Honoapiilani Highway and Kuihelani Highway for existing and future growth within the Waikapu and Wailuku areas; and

3. Reduce turning movements to and from Honoapiilani Highway from Kuikahi Drive and East Waiko Road, which otherwise serve as the only means of accessing Honoapiilani Highway within this area.

Currently, traffic within the project area runs relatively smoothly. Needed improvements at the intersections around the project area will meet projected traffic conditions.

Ultimately, the proposed project will improve the roadway network within and around Waikapu.

Water: Landscaping along the proposed Waiale Road Extension will require water resources of approximately 6,000 to 10,000 gallons per day. Water will be provided by the private development of non-potable sources in conjunction with the nearby proposed Waikapu Country Town project. Based on the limited amount of water required for landscaping and the use of non-potable water sources, the proposed project is not anticipated to adversely impact potable well production or potable water source supply.

Wastewater: There will be no impact to wastewater since there will be no need for the project to connect to wastewater facilities.

Drainage: The off-site drainage areas that sheet flow across the project area will be intercepted by ditches and the collected runoff will pass under the roadway culverts. Additionally, the use of retention/detention basins for the proposed project will capture the increase in stormwater runoff that the project is estimated to generate. Furthermore, the Waikapu bridge will be designed to meet a 100-year 24-hour storm event. Stormwater runoff is not anticipated to have an adverse impact on the adjacent and downstream properties.

Electrical Systems: Traffic signals, when warranted, and street lights will be installed at the intersections of Waiale Road Extension and Honoapiilani Highway and at East Waiko Road and Waiale Road Extension. Coordination with Maui Electric Company, Ltd. will be undertaken, as required, to ensure timely delivery of utility services for the proposed project.

Cumulative and Secondary Impacts: The Maui County General Plan and MIP process identifies future growth to occur within Maui County to the year 2030. And, as such, infrastructure, including transportation infrastructure, will need to meet the expected growth. Over time, the proposed project will accommodate the expected growth in this region. The proposed project will have a positive impact by improving the roadway network within and around Waikapu.

Permits and Approvals: The following permits and approvals will be required prior to implementation of the project:

1. **<u>Federal Government</u>**

   U.S. Department of Army Permit, Section 404

   National Environmental Policy Act (NEPA)

   Section 106, National Historic Preservation Act

2. **<u>State of Hawaii</u>**

   Coastal Zone Management Consistency Determination, as applicable

   Chapter 343, Hawaii Revised Statutes, Environmental Review

   Section 401, Water Quality Certification, as applicable

   National Pollutant Discharge Elimination System (NPDES) Permit

   Commission on Water Resource Management, Stream Channel Alteration Permit

   Community Noise Permit, as applicable

3. **<u>County of Maui</u>**

   Subdivision Approval

   Grading Permits

   Special Flood Hazard Area Development Permit, as applicable

Work to Perform on County Roads

Construction Permits

Finding of No Significant Impact: In accordance with Chapter 343, HRS, and Chapter 200 (Title 11), HAR, the County of Maui, Department of Public Works has reviewed the Final EA document and determined a Finding of No Significant Impact (FONSI). A summary of the FONSI assessment is provided in **Table ES-1.**

Table ES-1. Summary Assessment of Project Impacts in Comparison to Significance Criteria

Criteria (from HAR 1-200-12(b))	**Significant**
Involves an irrevocable commitment to loss or destruction of any natural or cultural resource	No
Curtails the beneficial uses of the environment	No
Conflicts with the State's long-term environmental policies or goals and guidelines expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders	No
Substantially affects the economic or social welfare of the community or State	No
Substantially affects public health	No
Involves substantial secondary impacts	No
Involves substantial degradation of environmental quality	No
Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions	No
Substantially affects a rare, threatened or endangered species, or its habitat	No
Detrimentally affects air or water quality or ambient noise levels	No
Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a floodplain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, freshwater, or coastal waters	No
Substantially affects scenic vistas and viewplanes identified in county or state plans or studies	No
Requires substantial energy consumption	No
Notes: "No" means the project impact as it pertains to the criterion is considered to be not significant and therefore, an EA is the appropriate environmental review document, as provided in HRS Chapter 343. "Yes" means the project impact as it pertains to the criterion is considered to be significant and, therefore, an environmental impact statement would be the appropriate review document under HRS Chapter 343.	

I. PROJECT OVERVIEW

I. PROJECT OVERVIEW

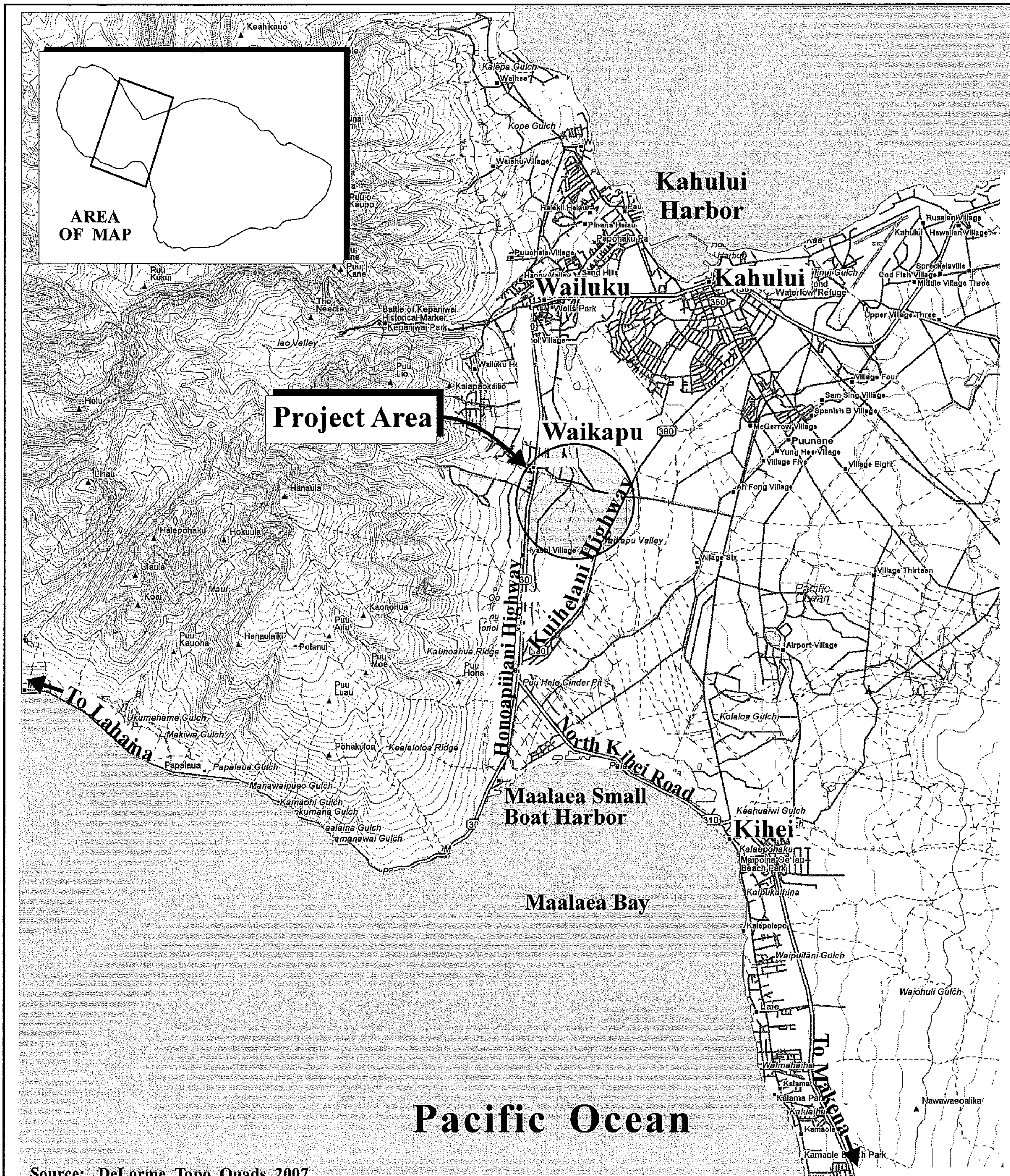
A. PROPERTY LOCATION, EXISTING USE, AND LAND OWNERSHIP

The County of Maui, Department of Public Works (DPW) proposes to extend Waiale Road from its current terminus at East Waiko Road southward to Honoapiilani Highway. The proposed Waiale Road Extension is intended to provide a bypass to route traffic around Waikapu Village and mitigate increase in traffic within and around this residential community. In addition, DPW proposes to improve East Waiko Road which will involve upgrading the existing pavement section, re-striping and drainage improvements.

The proposed Waiale Road Extension and East Waiko Road Improvements are located in the Waikapu region of the island of Maui, Hawaii. See **Figure 1**. The proposed Waiale Road Extension will start at the Waiale Road and East Waiko Road intersection and extend in a southerly direction for a distance of approximately 8,600 lineal feet and connect to Honoapiilani Highway around the Old Quarry Road intersection. See **Figure 2**. The proposed East Waiko Road Improvements will start at the Waiale Road and East Waiko Road intersection and extend eastward to Kuihelani Highway. Improvements along this section of East Waiko Road will extend approximately 4,600 lineal feet. Refer to **Figure 2**.

The proposed Waiale Road Extension alignment traverses over the Waikapu Stream and existing sugar cane fields. The majority of the lands required for the proposed Waiale Road Extension are owned by Waiale 905 Partners, LLC, while a sliver of land between East Waiko Road and the Waikapu Stream is owned by Waiko Baseyard, LLC. The County of Maui owns the majority of land along the East Waiko Road right-of-way. However, small portions of land along East Waiko Road are owned by Spencer Homes, Inc. and Waiko Baseyard, LLC. See **Figure 3** and **Table 1**. The portions of the roadway route for both Waiale Road and East Waiko Road that are privately owned will be acquired by the County of Maui.

The proposed Waiale Road Extension and East Waiko Road Improvements project, herein, are collectively called the "project".



Source: DeLorme Topo Quads 2007

Figure 1 Proposed Waiale Road Extension and East Waiko Road Improvements

Regional Location Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

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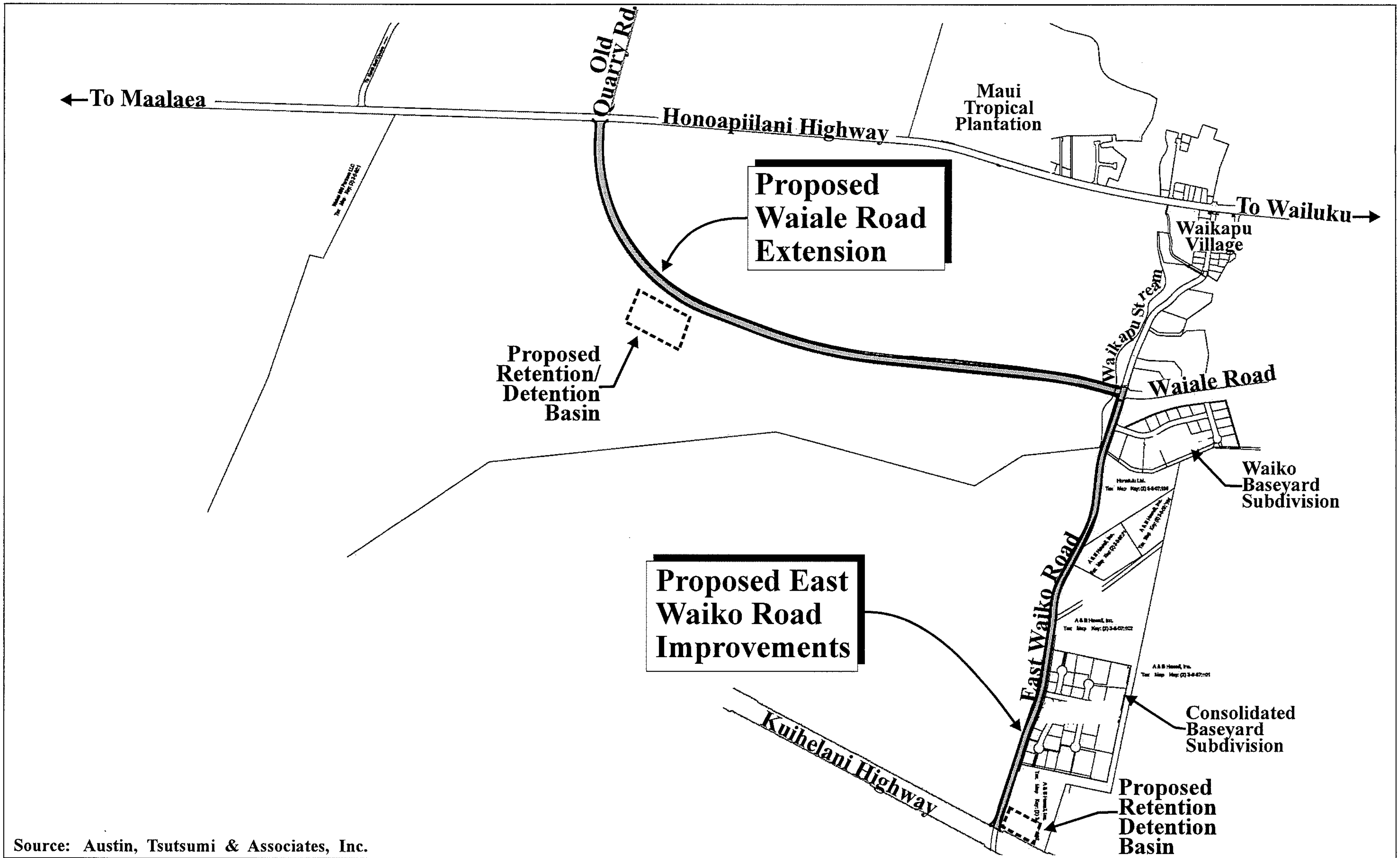


Source: Austin, Tsutsumi & Associates, Inc.

Figure 2

Proposed Waiale Road Extension and East Waiko Road Improvements

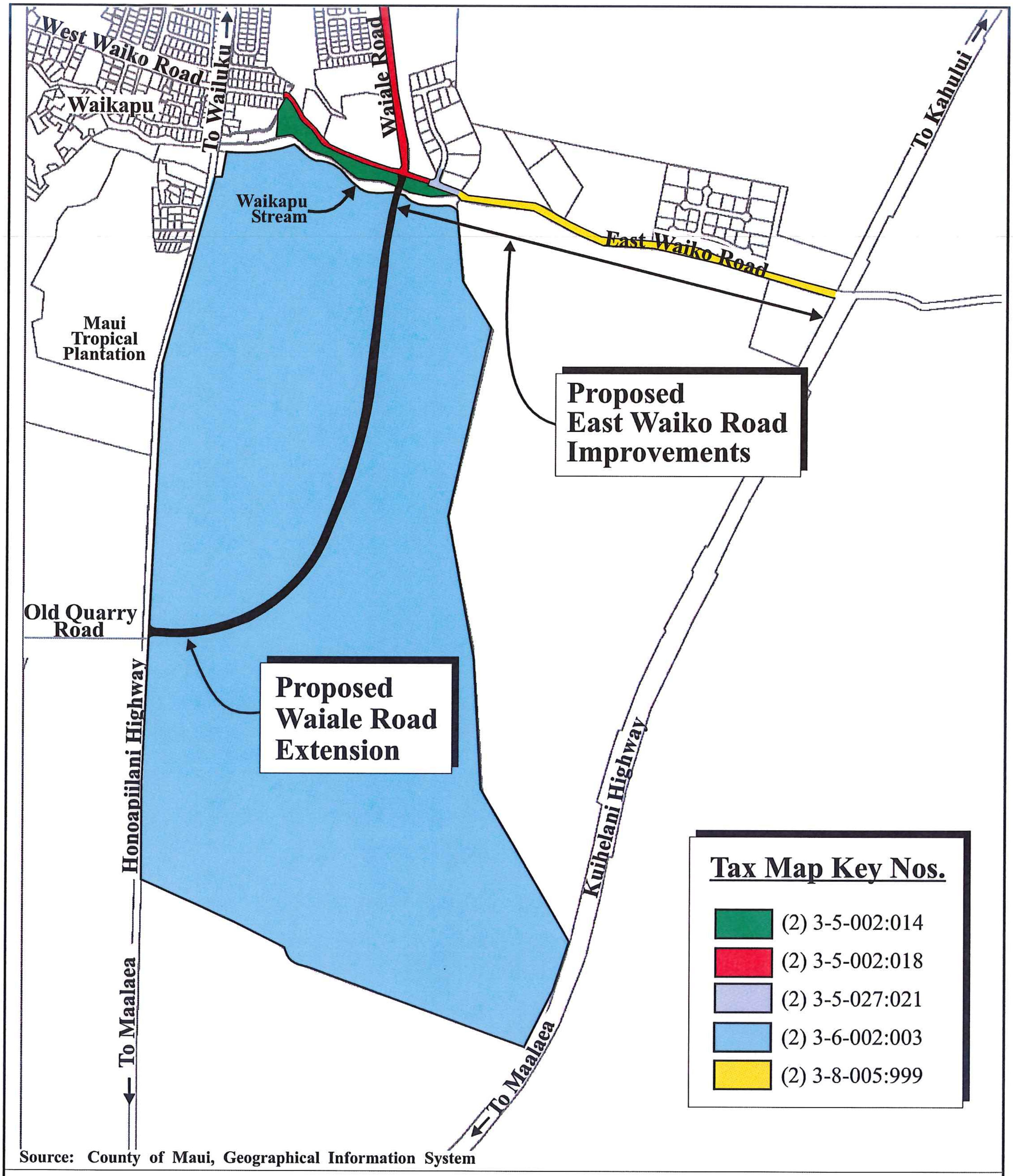
Site Plan

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\siteplan



Source: County of Maui, Geographical Information System

Figure 3 Proposed Waiale Road Extension and East Waiko Road Improvements
Tax Map Key Parcel Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\TMK Map

Table 1. Summary of Existing Land Ownership and Use

TMK	Area	Existing Use	Landowner
(2) 3-5-002:014	5.073 acres	Fallow land	Waiko Baseyard, LLC
(2) 3-5-002:018	14.128 acres	East Waiko Road	Spencer Homes, Inc.
(2) 3-5-027:021	81,604 sq. ft.	East Waiko Road	Waiko Baseyard, LLC
(2) 3-6-002:003	621.4 acres	Sugar cane fields	Waiale 905 Partners LLC
(2) 3-8-005:999	5.5 acres	East Waiko Road	County of Maui

B. PROJECT PURPOSE AND NEED

The need for the Waiale Road Extension was identified in the Maui Long Range Land Transportation Plan (MLRLTP) in 1997 by the State of Hawaii, Department of Transportation (SDOT) in conjunction with the County of Maui. The MLRLTP serves as a:

> *"guide for the development of the major surface transportation facilities ... to be implemented within the County of Maui ... of an integrated inter-modal transportation system that facilitates the efficient movement of people and goods"*.

The extension of Waiale Road was recognized as a long-range (to the Year 2020) strategy to improve traffic flow within and around Waikapu Village and provide an alternate route between the urban areas of Kahului and Wailuku. Specifically, the need for the Waiale Road Extension will be to:

1. Increase the viability of Waiale Road as an alternate route to Honoapiilani Highway and Kuihelani Highway through the Waikapu area;

2. Improve regional access to Honoapiilani Highway and Kuihelani Highway for existing and future regional growth within the Waikapu and Wailuku areas; and

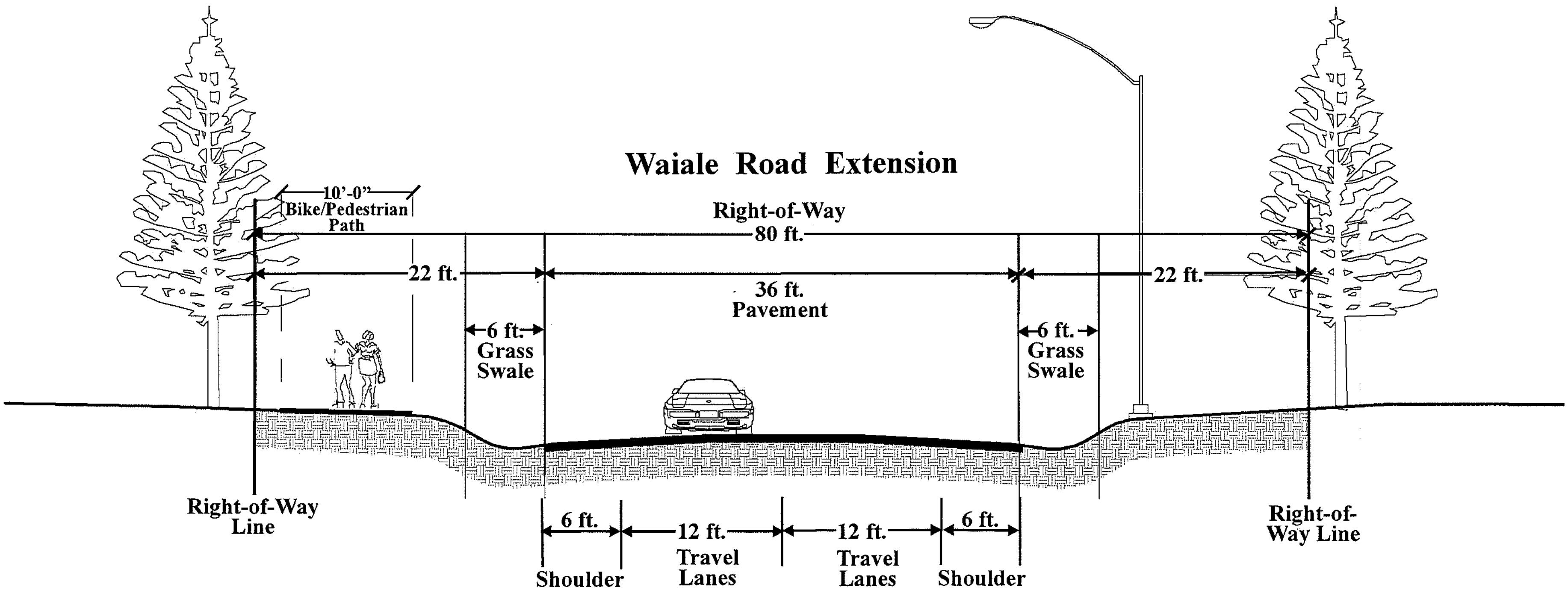
3. Reduce turning movements to and from Honoapiilani Highway from Kuikahi Drive and East Waiko Road, which otherwise are the only means of accessing Honoapiilani Highway within the area.

The need for the East Waiko Road Improvements was identified in the County of Maui's Capital Improvement Projects Report in the 2011 fiscal year County of Maui Budget. The Capital Improvement Projects Report identifies projects that are planned for implementation within the County of Maui. The purpose of the East Waiko Road Improvements is to improve the roadway conditions along East Waiko Road in order to facilitate increase safety and use of this route.

C. PROPOSED ACTION

Waiale Road is a major north-south collector street with a striped double yellow median that provides access from Waikapu Village to the southern areas in Wailuku. Waiale Road is proposed to be extended from the current terminus of Waiale Road and East Waiko Road in a southerly direction for a distance of approximately 8,600 lineal feet and connect to Honoapiilani Highway, near Old Quarry Road. Refer to **Figure 2**. The extended roadway would divert existing traffic on East Waiko Road away from Waikapu Village. The County of Maui right-of-way for this asphalt concrete (AC) roadway is anticipated to be 80 feet wide with two (2) 12-ft. travel lanes, 6-ft. shoulders, 6-ft. grass swales, and a 10-ft. bike/pedestrian path on the west side of the roadway. Landscaping and drainage improvements will also be done as part of the proposed action. See **Figure 4**. The proposed Waiale Road Extension will cross over a portion of the Waikapu Stream. The bridge crossing will be designed to minimize any alterations to the natural stream bed. See **Figure 5**. A traffic light, when warranted, will be installed at the terminus of the Waiale Road Extension with Honoapiilani Highway.

East Waiko Road is a major street with a striped double yellow median that provides an alternate route through Wailuku. East Waiko Road is proposed to be improved within the existing 60-ft. right-of-way with a maximum pavement width of 36 ft. These improvements will start at the Waiale Road and East Waiko Road intersection and head east to Kuihelani Highway for a distance of approximately 4,600 linear feet. Improvements include upgrading the existing pavement section and re-striping the roadway to provide two (2) 12-ft. travel lanes, 6-ft. shoulders and 6-ft. AC swales for drainage on both sides of the road. See **Figure 6**.



Source: Chris Hart & Partners, Inc.

Figure 4

Proposed Waiale Road Extension and East Waiko Road Improvements

Waiale Road Extension Typical Roadway Section

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

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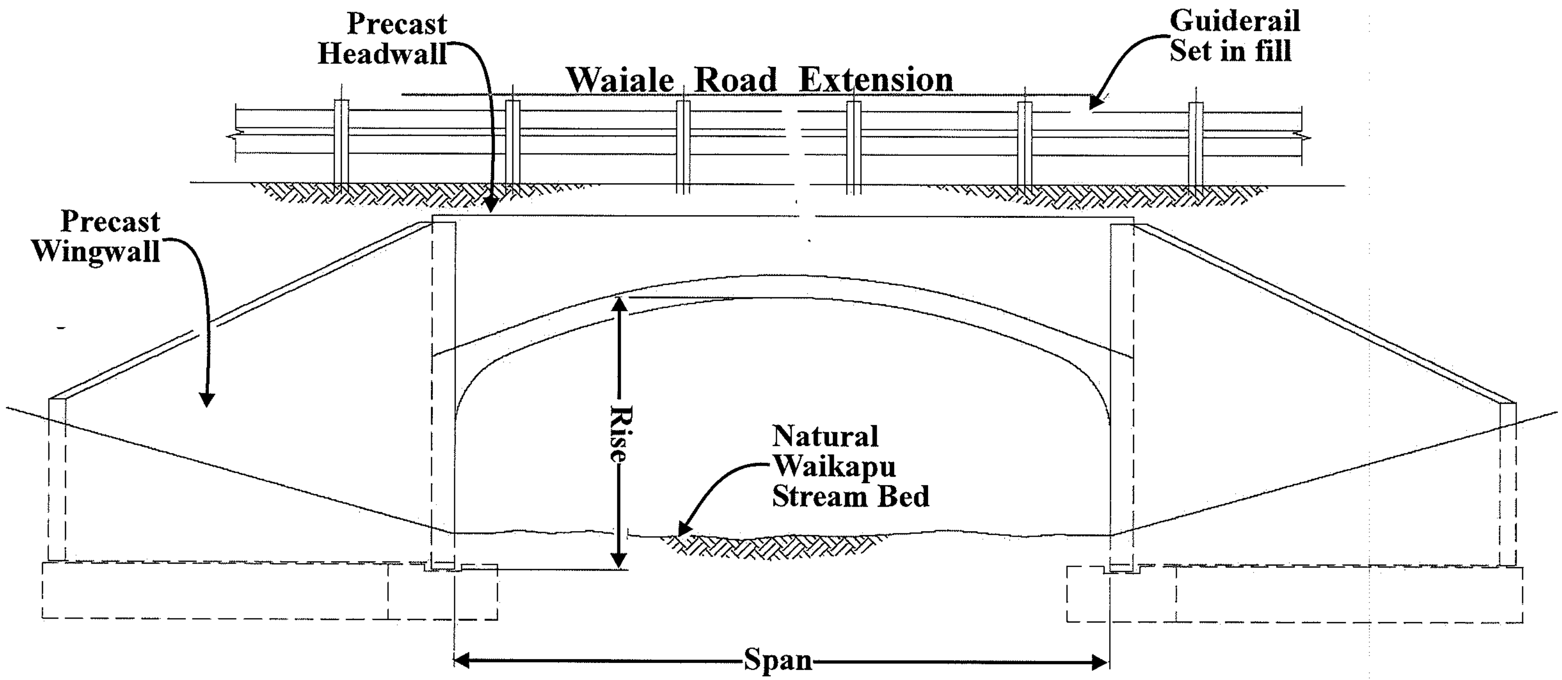


Source: Con Span Bridge Systems

Figure 5

Proposed Waiale Road Extension and East Waiko Road Improvements

Schematic Waikapu Bridge Section

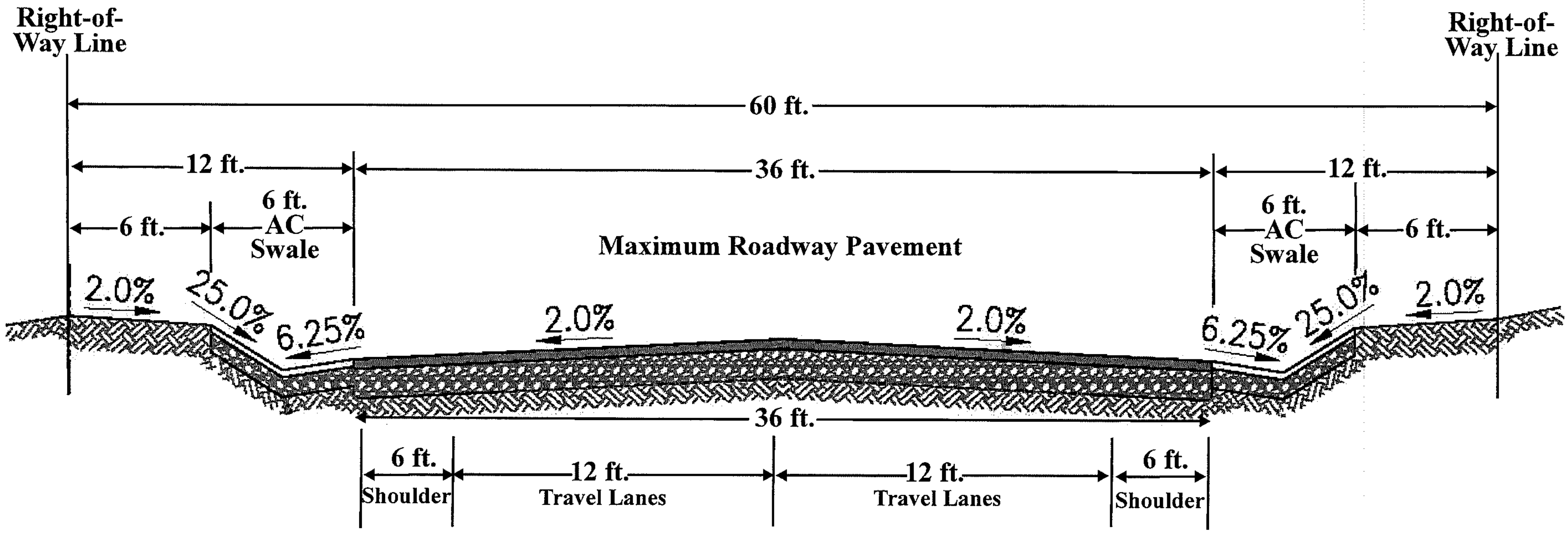
NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\schematic

East Waiko Road Improvements



Source: Austin, Tsutsumi & Associates, Inc.

Figure 6

Proposed Waiale Road Extension and East Waiko Road Improvements

East Waiko Road Typical Roadway Section

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\waikotypicalsection

D. PROJECT COSTS AND IMPLEMENTATION

The cost of the proposed Waiale Road Extension and East Waiko Road Improvements project as reflected in the County of Maui Capital Improvement Program is estimated to be $17.3 million. Project construction is expected to take 24 to 36 months to complete upon receipt of necessary regulatory and construction approvals.

E. CHAPTER 343, HAWAII REVISED STATUTES (HRS) REQUIREMENTS

The County of Maui, Department of Public Works (DPW) is proposing this project to meet transportation objectives as identified in the 1997 Maui Long Range Land Transportation Plan. The requirements of Chapter 343, Hawaii Revised Statutes (HRS) are triggered with the use of County lands and funds. In addition, the intersection of Honoapiilani Highway and the proposed Waiale Road Extension will be completed in coordination with the State of Hawaii, Department of Transportation (SDOT), thus requiring the use of State lands and funds, which is also a trigger for HRS Chapter 343.

Therefore, an Environmental Assessment (EA) has been prepared pursuant to Title 11, Chapter 200, Hawaii Administrative Rules (HAR), Environmental Impact Statement Rules. This EA evaluates potential environmental and socio-economic impacts and associated mitigative measures.

II. ALTERNATIVES TO THE PROPOSED ACTION

II. ALTERNATIVES TO THE PROPOSED ACTION

The following alternatives have been evaluated as part of the process of selecting a preferred alternative for the proposed project:

A. NO ACTION ALTERNATIVE

The "no action" alternative would maintain the existing roadway conditions which involves Waiale Road terminating at East Waiko Road and East Waiko Road being maintained in its current state. Without the proposed project, impacts identified in the later sections of this EA document would not occur. Nor would the proposed project benefits occur. The purpose and benefit of the project is to provide improved traffic flow within and around Waikapu Village and provide an alternative route between the urban areas of Kahului and Wailuku. The proposed Waiale Road Extension project was identified in the 1997 Maui Long Range Land Transportation Plan as a long-term traffic management strategy. The "no action" alternative would not fulfill the long-term traffic management strategy for Wailuku-Waikapu area; and for this reason the "no action" alternative was rejected.

B. DEFERRED ACTION ALTERNATIVE

The "deferred action" alternative would defer the proposed project to a later time. The impacts identified in following Chapters of the EA would be similar to the proposed project with the exception of potentially higher costs due, in part, to price escalation. Equally as important, the "deferred action" alternative may require further alignment studies if the land for roadway corridor for the Waiale Road Extension is not secured. Small town/urban development as noted in the Maui Island Plan (MIP), which identifies future urban growth areas, is planned around the project area. The roadway route should be protected prior to the urbanization of the surrounding area to ensure proper roadway alignment and siting. For these reasons, deferring project implementation would result in higher costs and, thus, this alternative was rejected.

C. TRANSPORTATION SYSTEM MANAGEMENT (TSM) ALTERNATIVES

TSM programs can include ridesharing, fringe parking, High-Occupancy Vehicle (HOV) lanes, and traffic signal timing optimization. The following TSM programs currently exist in Maui:

- **Ridesharing:** Vanpool Hawaii, Inc. (VPSI, Inc.) operated as a ridesharing service that was performed as part of a contract between State Department of Transportation (SDOT) and VPSI, Inc. The program provided drivers with vans or SUV's, but required participants to collectively pay a fee of $65.00 per month plus gasoline and parking fees. Participants could either form their own van pools or be matched with suitable (by location) ride sharers. However, Vanpool Hawaii has ceased its program on the island of Maui.

- **Fringe Parking (Park and Ride/Pool Lots):** Currently, there is a Park and Ride lot located at· the southwest corner of the intersection of Puunene Avenue/Kuihelani Highway/Dairy Road and at the intersection of Honoapiilani Highway and North Kihei Road. The MIP recommends the allocation of $8 million towards the creation of new transit hub/park-n-ride facilities in Maalaea and in Central Maui (County of Maui, Maui Island Plan, December 2012). The Central Maui Transit Hub is located at the Queen Kaahumanu Center in Kahului.

- **HOV Lanes:** Currently there are no HOV lanes within the County of Maui, because Maui has no freeways. HOV lanes would not be constructed on Honoapiilani Highway in the vicinity of the project area because it is a single lane in either direction. Kuihelani Highway would also not be ideal for HOV lanes because of its left-turn lanes.

TSM programs are one (1) component of the overall long-term transportation strategy. Although TSM programs exist in Maui, and are gaining in popularity, these programs are underutilized. The programs above do not reduce or eliminate the need for new roadways to meet Maui's long-term transportation strategy.

D. MASS TRANSIT ALTERNATIVE

Maui County currently works with Roberts Hawaii to operate the Maui Bus, which serves the major areas of the island and offers a headway (time between successive buses) of either 60 or 90 minutes. The bus fare is $1.00 per person, with monthly passes also available for $45.00 for general boarding or $30.00 for students and senior citizens.

Maui County, as part of its Public Transit Program, plans to expand the number of routes, increase the fleet size, and reduce the headways of the vehicles. As a result, the County projects that the number of fixed route boardings will increase from 1,765,516 in 2009. In 2010, there were 2,348,135 boardings, an increase of 33 percent from 2009. This would equate to approximately 16.5 annual boardings per capita.

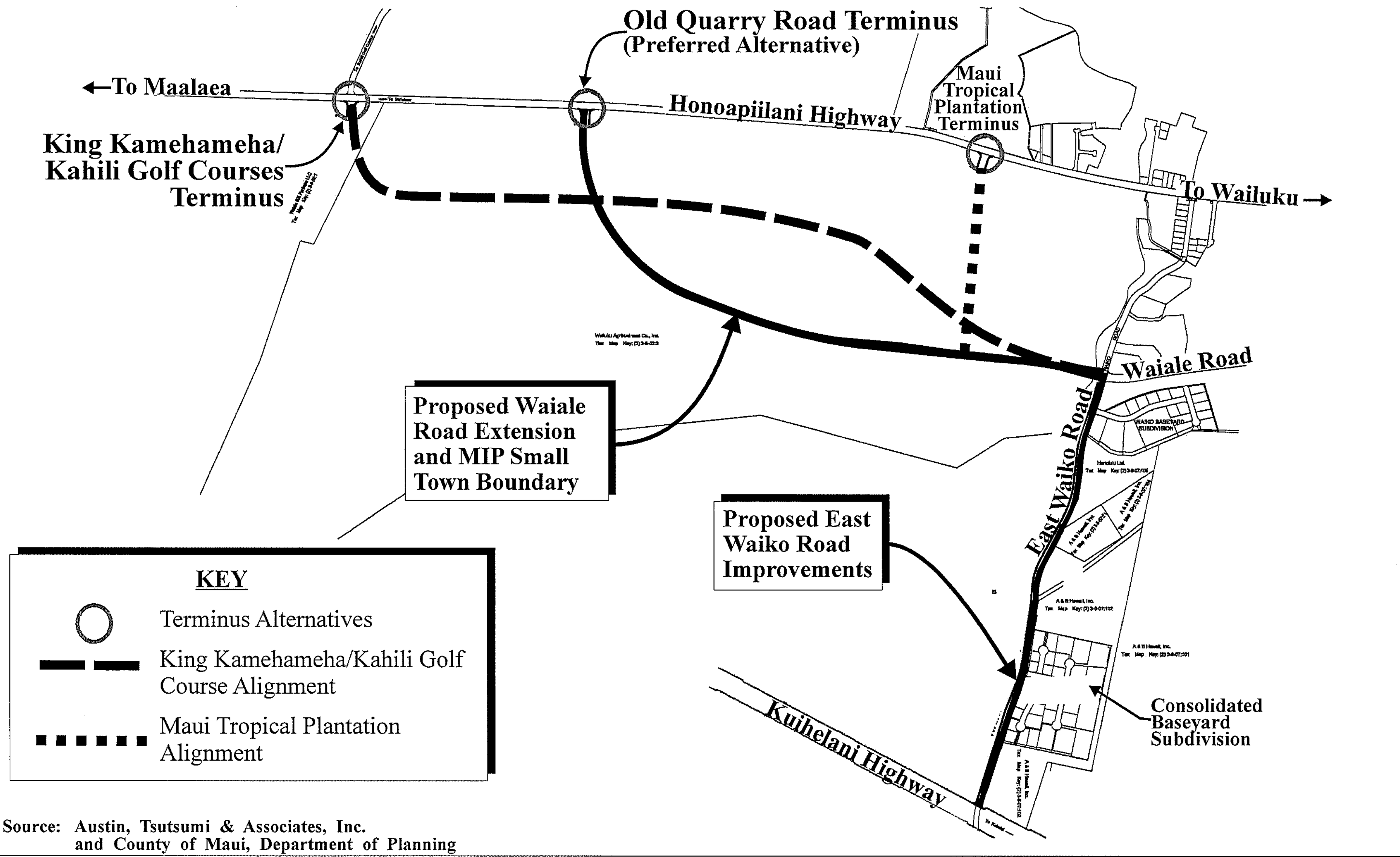
Although mass transit ridership continues to increase annually, mass transit is still in its infancy stage in Maui County. The potential for increasing ridership to take mass transit to the next level is constrained by the low demand for mass transit, number of available busses, and reduction of headway for routes. This alternative is similar to the TSM Alternative, in that it is one (1) component of the overall long-term transportation strategy for Maui County. The Mass Transit Alternative does not reduce or eliminate the need for new roadways to meet Maui's long-term transportation strategy.

E. HONOAPIILANI HIGHWAY TERMINUS ALTERNATIVES

In examining the location of the Waiale Road terminus at Honoapiilani Highway, four (4) terminal options were considered: (1) Kuihelani Highway and Honoapiilani Highway intersection near Maalaea; (2) King Kamehameha/Kahili Golf Courses intersection; (3) Maui Tropical Plantation intersection; and (4) Old Quarry Road terminus. See **Figure 7**.

1. Old Quarry Road Terminus (Preferred Terminus)

The Old Quarry Road Terminus, as described in Chapter 1, establishes a roadway route which terminates in the vicinity of the Old Quarry Road. The proposed project terminus meets the project purpose and need. From a long-term planning perspective, the proposed terminus provides an appropriate roadway route in accordance with the MIP Small Town Boundary (STB) for this area. The TIAR and the Roadways Section found in **Appendix "A"** and Chapter III.D.1. of this EA provides further details on the traffic impacts to existing and future roadways.



Source: Austin, Tsutsumi & Associates, Inc.
and County of Maui, Department of Planning

Figure 7

Proposed Waiale Road Extension and East Waiko Road Improvements

Alternative Terminus Locations

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\terminuslocation

The Old Quarry Road Terminus was deemed the preferred alternative as the traffic flow would follow the STB and bypass the proposed Waikapu Tropical Plantation's internal roadway network. This alignment would have limited access (one roadway intersection) along the Waiale Road Extension to Honoapiilani Highway. This limited access would provide for optimal traffic flow efficiency by minimizing congestion and would meet the purpose and need of the project to:

1. Increase the viability of Waiale Road as an alternate route to Honoapiilani Highway and Kuihelani Highway through the Waikapu area;

2. Improve regional traffic access to Honoapiilani Highway and Kuihelani Highway for existing and future growth within the Waikapu and Wailuku areas; and

3. Reduce traffic turning movements to and from Honoapiilani Highway from Kuikahi Drive and East Waiko Road, which would otherwise serve as the only means of accessing Honoapiilani Highway within the area.

2. Kuihelani Highway/Honoapiilani Highway Intersection Terminus

This alternative involves extending Waiale Road to the Kuihelani Highway/Honoapiilani Highway intersection in the vicinity of Maalaea. This alternative was eliminated early on from further analysis mainly because the location of this alternative terminus would fall outside the area of influence of the Waiale Road Extension.

This alternative road alignment will not generate "new" traffic; rather, it will provide an alternate access to Honoapiilani Highway, and does not change the overall traffic demand at the intersection of Honoapiilani Highway and Kuihelani Highway.

In addition, adding another approach to the existing intersection of Honoapiilani Highway and Kuihelani Highway would require:

(a) Honoapiilani Highway, Waiale Road Extension, and Kuihelani Highway to intersect at extremely acute angles. Intersections with acute angles - especially between major arterials - are not recommended per American Association of State Highway and Transportation Officials; or

(b) A realignment of Honoapiilani Highway to orient it in an east-west alignment to create right angles between the four (4) approaches. This would require right-of-way acquisition, and for Honoapiilani Highway's north-south through traffic to become less-efficient turning movements.

Furthermore, the Planning Department recommended that Waiale Road Extension alignment follow the STB to provide a "hard" edge to the STB. This alternative would be contrary to Planning Department's recommendation. It would not contain the STB area.

Given the reasons stated above, this terminus alternative was eliminated early on from further analysis.

3. <u>King Kamehameha/Kahili Golf Courses Terminus</u>

The Honoapiilani Highway and King Kamehameha/Kahili Golf Courses intersection alternative for the terminus of Waiale Road Extension was identified as a possible terminus location since it is an existing SDOT intersection along Honoapiilani Highway. The terminus location would meet the purpose and need of the project but after further analysis was not determined to be the preferred terminus location.

The alignment of the right-of-way, as shown in **Figure 7**, depicts a longer Waiale Road Extension which would significantly increase cost without a corresponding benefit to traffic turning movements and/or traffic volume as compared to the Old Quarry Road terminus (Preferred Alternative). Secondly, and in consultation with the County of Maui, Department of Planning, Long Range Division (Long Range Division), the proposed alignment was recommended to follow the MIP STB. The Long Range Division wanted to provide a "hard" edge to the STB. The area between the Waiale Road Extension and Honoapiilani Highway would be identified within the MIP as a location for future urban/rural small town growth. The STB provides for an area to develop a master planned community with the Waiale Road Extension as the appropriate boundary designated as the edge of the STB. This alignment was determined by Long Range Division to be too narrow of a land area from Honoapiilani Highway to this alignment for a master planned community that would allow for a mixed-use design. Therefore, in consultation with the DPW and Long Range Division, this alternative was not deemed ideal and rejected from further study due to the STB alignment in this area.

4. Maui Tropical Plantation Terminus

The Honoapiilani Highway and Maui Tropical Plantation intersection alternative for the terminus of Waiale Road Extension was identified as a possible terminus location since it is an existing SDOT intersection and identified as the terminus location for Waiale Road Extension in the Hawaii Statewide Transportation Improvement Program. The terminus location would meet the purpose and need of the project but after further analysis was not determined to be the preferred terminus location.

The alignment of the right-of-way, as shown in **Figure 7**, depicts a much shorter Waiale Road Extension which would decrease cost but would also increase traffic congestion as compared to the Old Quarry Road terminus (Preferred Alternative). The access to Honoapiilani Highway would bifurcate the proposed Waikapu Tropical Plantation development and become part of an internal roadway network for the Waikapu Tropical Plantation project which would decrease the efficiency of Waiale Road Extension to Honoapiilani Highway by increasing traffic turning movements. See Traffic Impact Assessment (**Appendix "A"**). Additionally, internal roadways that would connect to this portion of the Waiale Road Extension would further decrease the traffic flow. Also, the proposed Waikapu Tropical Plantation is intended to be a walkable and livable master planned community that would include residential, commercial, recreational, and public uses, all of which would generate internal pedestrian traffic that would need to cross the Waiale Road Extension. These potential pedestrian conflicts would cause safety concerns along this stretch of the Waiale Road Extension. Specifically, this alternative would result in the following:

1. Increased traffic turning movements at the Maui Tropical Plantation and Honoapiilani Highway intersection;

2. Longer roadway crossings for pedestrians across increased traffic on the portion of Waiale Road Extension that becomes an internal roadway for the proposed Waikapu Tropical Plantation; and

3. Potential for backups on Honoapiilani Highway from Waiale Road Extension internal connections from the proposed Waikapu Tropical Plantation roadways.

In addition, the intersection configuration would require an additional westbound left-turn lane (dual) lane to accommodate the increase in traffic. As a result, an additional receiving lane would be necessary in the southbound direction along Honoapiilani Highway. The heavy northbound right-turn volume would create the need for a "dedicated" northbound right-turn. See Figure 36 of the Traffic Impact Assessment Report (**Appendix "A"**) for intersection configuration. Even with these intersection configuration improvements, the intersection would operate at LOS F and would be overcapacity on some of its movements.

For the reasons stated above, the Maui Tropical Plantation terminus and alignment was not recommended as the preferred alternative.

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

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

A. PHYSICAL SETTING

1. Surrounding Land Uses

a. Existing Conditions

The project area is located in the vicinity of Waikapu Village in the Central Maui region. Originally developed as a sugar plantation town, Waikapu Village today is primarily a single-family residential community with limited areas for commercial businesses along Honoapiilani Highway. From a regional perspective, Wailuku is located north of the project area, while Kahului is located northeast of the project area. Refer to **Figure 1**. In addition to residential neighborhoods and commercial area, the Waikapu Village area also includes the Waikapu Community Center and the industrial areas along East Waiko Road. East Waiko Road connects Honoapiilani Highway with Kuihelani Highway. Additionally, agricultural lands mainly cultivated in sugar cane surround the project area.

Kuihelani Highway is located east of the project area, and is a State of Hawaii four-lane divided highway. It provides regional access from Kahului to West Maui via Honoapiilani Highway. Honoapiilani Highway is located west of the project area and is also a State of Hawaii two-lane highway in the project vicinity. It provides regional access from Wailuku through Waikapu to West Maui.

Future planned uses to the southeast of the proposed Waiale extension include the Central Maui Regional Park, Community Park and County facility area as planned open space areas. To the northwest of the Waiale Road extension is a proposed master planned expansion of the Waikapu Tropical Plantation, a urban/rural self sufficient small town.

b. **Potential Impacts and Mitigation Measures**

The proposed Waiale Road Extension and East Waiko Road Improvements are compatible with the surrounding land uses. See photos of the surrounding area in **Appendix "B"**. The existing Waiale Road forms a T-intersection at East Waiko Road which connects Honoapiilani Highway and Kuihelani Highway. East Waiko Road travels through the residential neighborhood of Waikapu Village. The extension will allow regional traffic to bypass the residential areas of Waikapu Village. This bypass route will keep the character of the neighborhood roadway network at a neighborhood scale and mitigate traffic impacts to Waikapu Village resulting from surrounding urban development.

Furthermore, the Waiale Road Extension has been identified as a long-term surface transportation solution in the 1997 Maui Long Range Land Transportation Plan. The plans for proposed transportation projects have been developed in consideration of the surrounding and future land uses.

It is noted that the alignment for Waiale Road Extension has been established in consideration of the Maui Island Plan Small Town Boundary Map, approved by County Council in December 2012.

The improvements to East Waiko Road will occur within the existing right-of-way. The improvements to East Waiko Road will provide better access to the industrial areas of Waikapu and continue to allow pass-through traffic to Kahului. It will continue to provide an alternate roadway from Kahului to Wailuku via Kuihelani Highway/East Waiko Road/Waiale Road and relieve traffic from Kaahumanu Avenue.

For reasons discussed above, the proposed project is compatible with the surrounding uses.

2. **Climate**

a. **Existing Conditions**

Like most areas of Hawaii, the climate in Waikapu is relatively uniform year-round. Characteristic of Maui's climate, the project area experiences mild and uniform temperatures, moderate humidity and relatively consistent northeasterly tradewinds. This stability is attributed to its tropical latitude, relative to the Pacific anticyclone and storm tracts, and the surrounding ocean currents. Variations in climate among the different regions in Maui, are largely due to local terrain.

In the region, August is the warmest month with an average daily high temperature of 79 degrees Fahrenheit (measured at Kahului Airport), while the coolest month is February with an average daily high temperature of 73 degrees Fahrenheit (Maui County Data Book, 2012).

Rainfall in the region is seasonal, with most precipitation occurring from November to March, as recorded at Kahului Airport. Annual rainfall data for Central Maui shows an average of 18.49 inches (Maui County Data Book, 2012).

The winds in the region are predominantly tradewinds from the north-northeast. In general, tradewinds blow stronger in the afternoon. The tradewinds blow onshore toward the warmer land mass during the day; and during the evening, the tradewinds blow offshore toward the relatively warmer ocean.

b. Potential Impacts and Mitigation Measures

The proposed Waiale Road Extension and East Waiko Road Improvements are not anticipated to have an adverse effect on the micro-climate of the surrounding area.

3. Agricultural Land

a. Existing Conditions

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

The proposed alignment for the Waiale Road Extension project is comprised mostly of lands that have been defined as “Prime” agricultural lands, with a small portion defined as “Other Important” agricultural lands. The East Waiko Road Improvements project area, as reflected by the ALISH map are located on lands designated as "Other Important" agricultural lands. See **Figure 8**. The lands in the project area for the Waiale Road Extension are currently cultivated in sugar cane. The existing East Waiko Road project area will remain predominantly unchanged with the proposed roadway re-paving and re-striping work carried out within the existing right-of -way.

Additionally, the University of Hawaii, Land Study Bureau (LSB) developed the Overall Productivity Rating, which classified soils according to five (5) levels, with “A” representing the class of highest productivity soils and “E” representing the lowest. These letters are followed by numbers which further classify the soil types by conveying such information as texture, drainage and stoniness. The LSB classifications for the proposed project area include “B72i”, “A71i” and “E3” classified lands. See **Figure 9.**

The “B72i” classification reflects an Overall Productivity Rating of B. The soils are characterized as stony, with soil depths over 30 inches and an average slope between 3 to 7 percent. The soil composition is moderately fine, well-drained with an elevation of 0 to 300 feet and a mean annual rainfall of 10 to 30 inches. The color of the soils is dark brown to dark reddish brown and is part of the Pulehu, Alae, and Puunene series.

The “A71i” classification reflects an Overall Productivity Rating of A. The soils are characterized as non-stony, with soil depths over 30 inches and an average slope between 2 to 5 percent. The soil composition is moderately

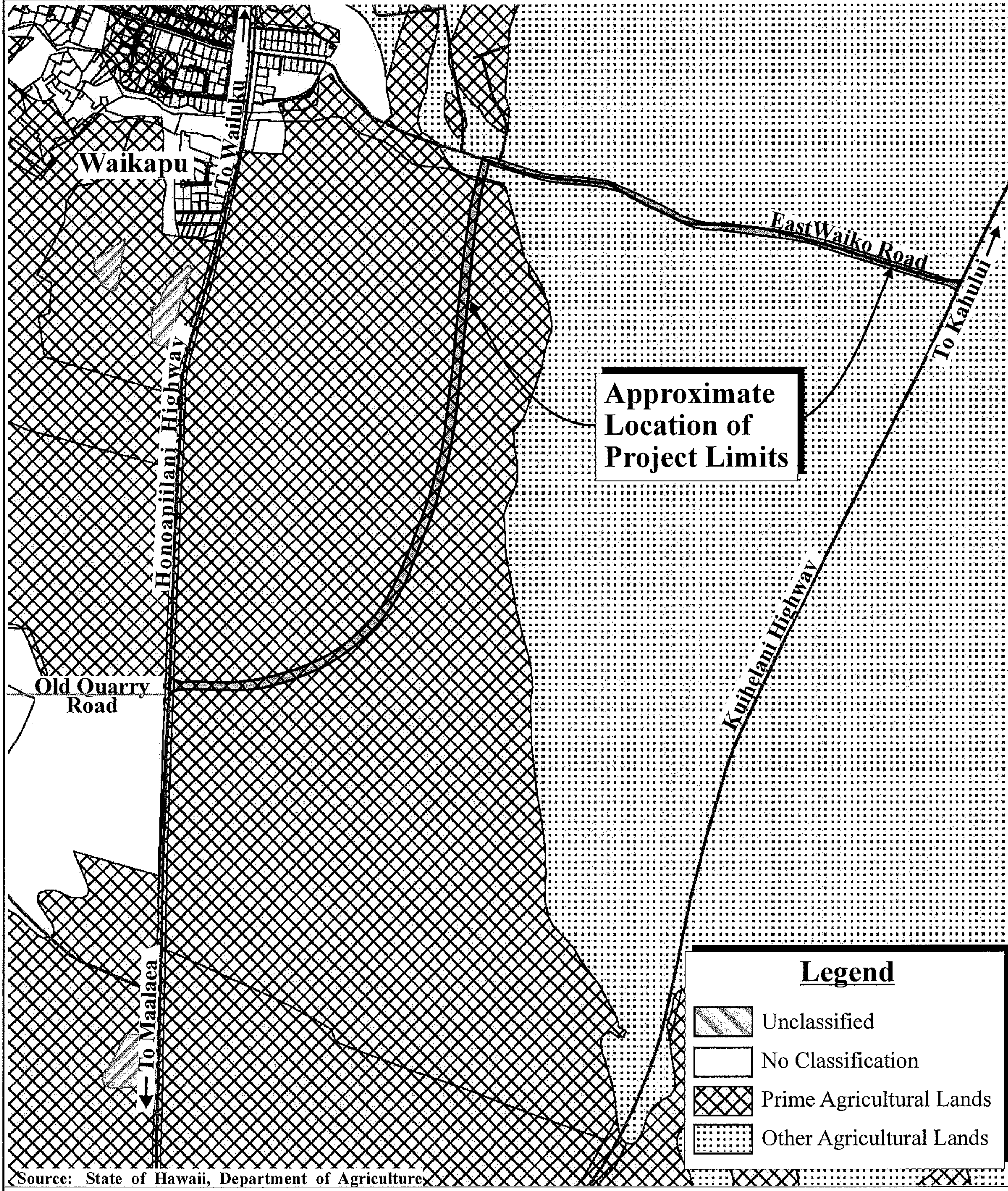


Figure 8 Proposed Waiale Road Extension and East Waiko Road Improvements

NOT TO SCALE

Agricultural Lands of Importance to the State of Hawaii

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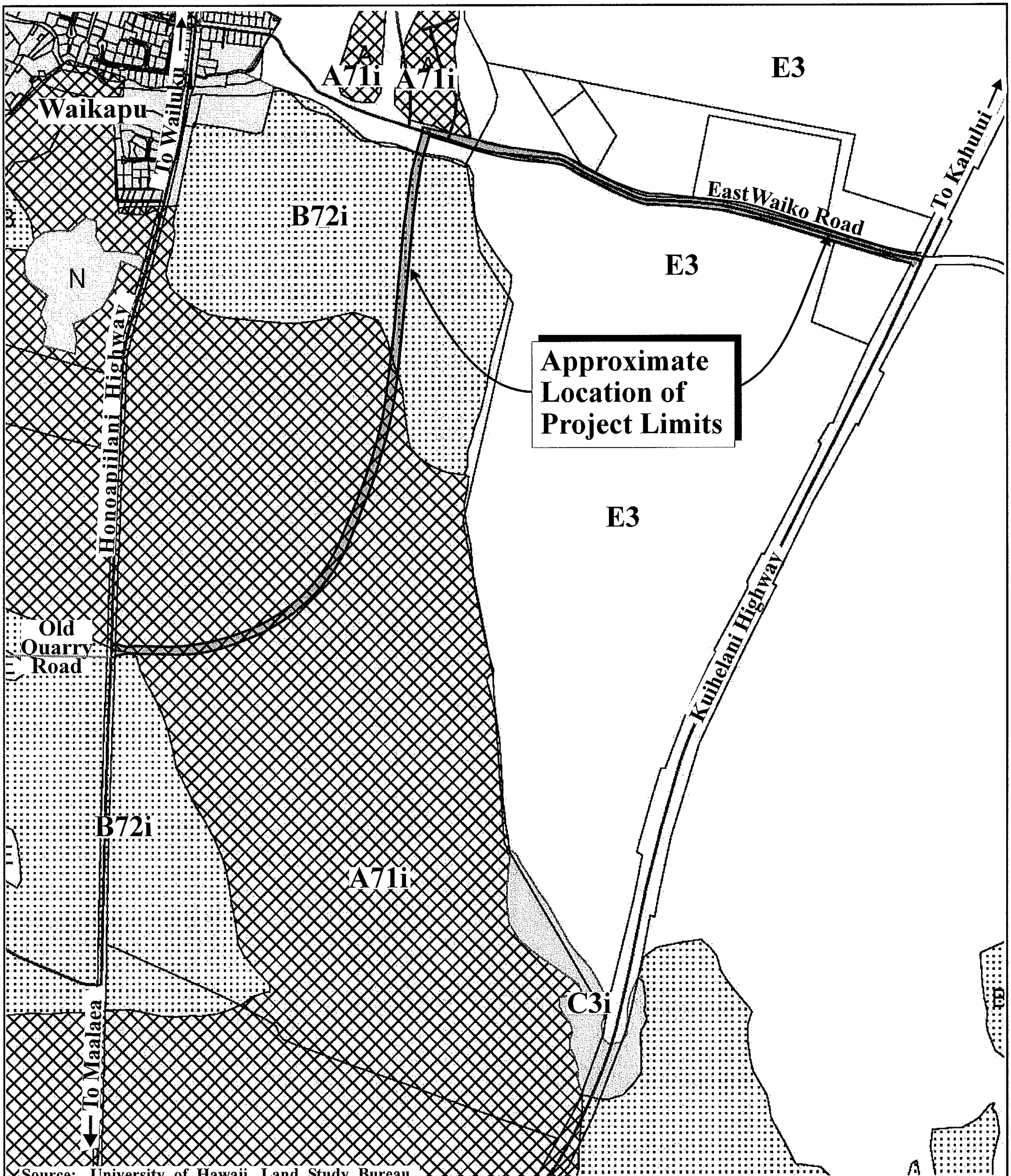

Figure 9 Proposed Waiale Road Extension and East Waiko Road Improvements NOT TO SCALE

Soil Productivity Map

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COM\DPW WaialeExt\Final EA\soilproductivity fine, well-drained with an elevation of 0 to 400 feet and a mean annual rainfall of 10 to 30 inches. The color of the soils is dark brown to dark reddish brown and is part of the Pulehu, Alae, and Puunene series.

The "E3" classification reflects an Overall Productivity Rating of E. The soils are characterized as non-stony, with soil depths over 30 inches and an average slope of 4 percent. The soil composition is coarse, excessively drained with an elevation of 0 to 100 feet and a mean annual rainfall of 10 to 30 inches. The color of the soil is light brown and is part of the Catano series.

b. Potential Impacts and Mitigation Measures

The proposed Waiale Road Extension portion of the project consists of "Prime" and moderately productive soils. The proposed corridor will traverse approximately 16 acres of agricultural lands. The use of these lands for the purpose of the Waiale Road Extension is not anticipated to adversely impact agricultural productivity in this region. As previously noted, the Waiale Road Extension will encompass approximately 8,600 lineal feet, with a right-of-way width of 80 feet. Lands underlying the right-of-way alignment are presently cultivated in sugar cane by HC&S through a lease with the landowner. The proposed extension will not affect the ability to continue to cultivate the agricultural lands adjacent to the new corridor. As may be required, coordination with the adjacent landowner and lessee will be done to determine if an agricultural crossing will be needed to access the agricultural lands between Honoapiilani Highway and Waiale Road Extension right-of-way. The loss of 16 acres agricultural lands is not considered large in the context of the 35,000 acres of agricultural land available for large scale mono-crop agriculture such as sugar cane in the Central Maui region (Chris Hart & Partners, Inc., 2007).

The proposed East Waiko Road Improvements will consist of upgrading the existing pavement section, re-striping, and drainage improvements within the existing East Waiko Road right-of-way. Adverse impacts to agricultural productivity for this component of the project are not anticipated since the area is currently used as a roadway.

4. Topography and Soils Characteristics

a. Existing Conditions

Most of the area surrounding the proposed Waiale Road Extension project area is currently cultivated in sugar cane. The topography in this area reflects general topographical patterns of the Central Maui isthmus, characterized by generally flat land and slightly sloping easterly and towards the ocean. Elevations at the project area range from approximately 260 to 360 feet above mean sea level (amsl) with an average slope of three (3) percent.

The project area is located in Waikapu and consists of soils within the Pulehu-Ewa-Jaucas association, which is characterized as having deep, nearly level to moderate slope, with well drained soils that have moderately fine to course texture (U.S. Dept. of Agriculture Soil Conservation Service 1972). See **Figure 10.** Underlying the project area for the Waiale Road Extension are soils mainly classified as Iao Clay (IcB), Pulehu Silt Loam (PpA), Pulehu Cobbly Silt Loam (PrB), and Pulehu Cobbly Clay Loam (PtB, PtA). The soil types found underlying the East Waiko Road area including Jaucas Sand (JaC) and Puuone Sand (PZUE). See **Figure 11**.

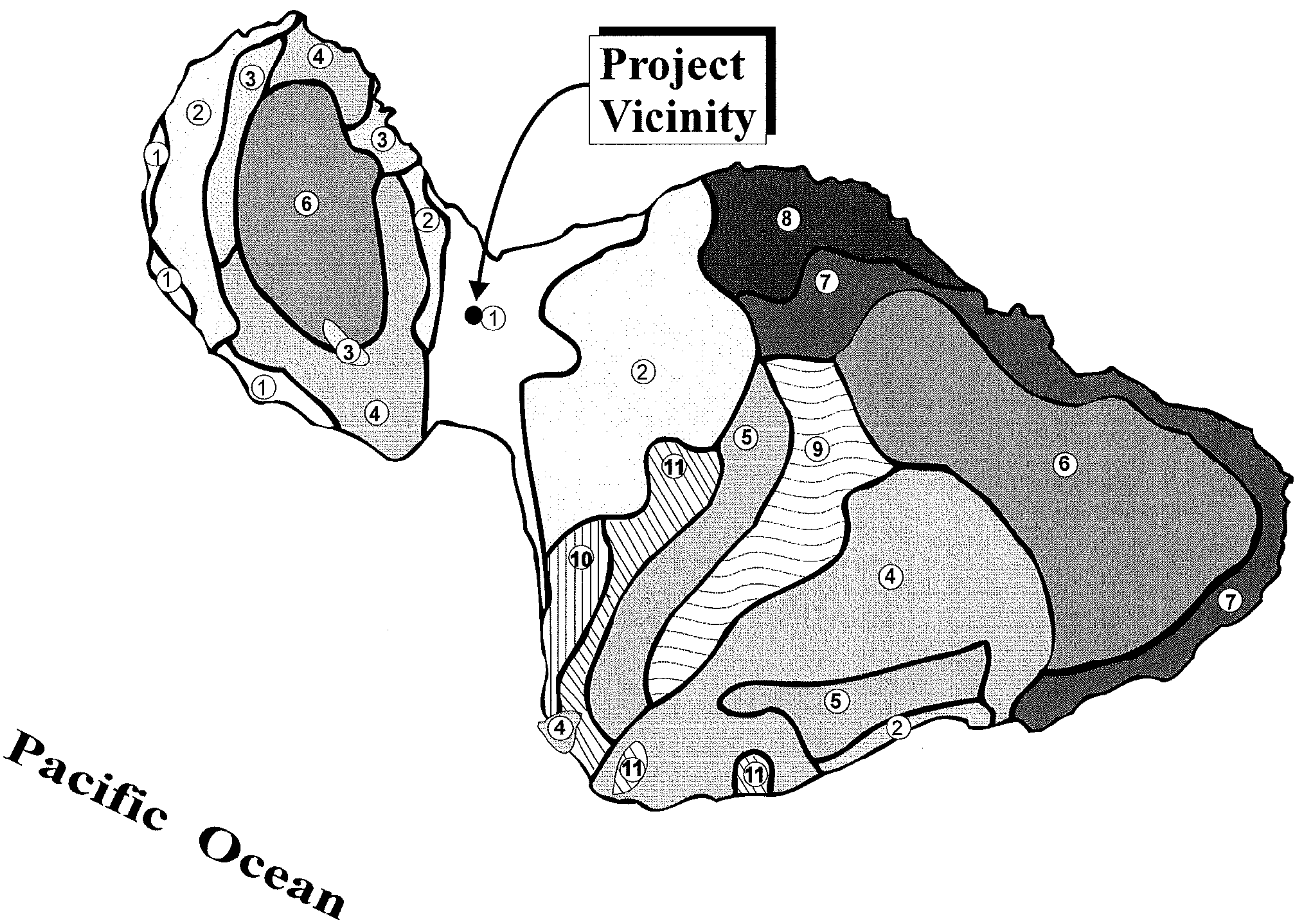
The Iao Clay (IcB) is a dark brown clay found on well-drained valley fill and alluvial fans. It has moderately slow permeability, medium runoff, an erosion hazard of slight to moderate, and a Hydrologic Soil Group (HSG) rating of "B". HSG is a measure of permeability in soils, ranging from A to D with A having the highest permeability. Soils belonging to the Iao Clay Series are suitable, primarily for agricultural uses, such as sugar cane cultivation and pasture.

The Pulehu series soils (PrB, PpA, PtA, and PtB) are dark brown silt clays and are also found on well-drained soils on alluvial fans, stream terraces and in basins. These soils have moderate permeability, slow runoff, an erosion hazard of no more than slight, and a HSG rating of "B". These soils are used for sugar cane, truck crops, pasture, homesites and wildlife habitat.

Jaucas Sand (JaC) is a brown, single grain sand. Permeability is rapid, runoff is very slow to slow, the erosion hazard is slight, and the HSG rating is "A".

LEGEND

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



Map Source: USDA Soil Conservation Service

Figure 10 Proposed Waiale Road Extension and East Waiko Road Improvements

NOT TO SCALE

Soil Association Map

Prepared for: County of Maui, Dept. of Public Works

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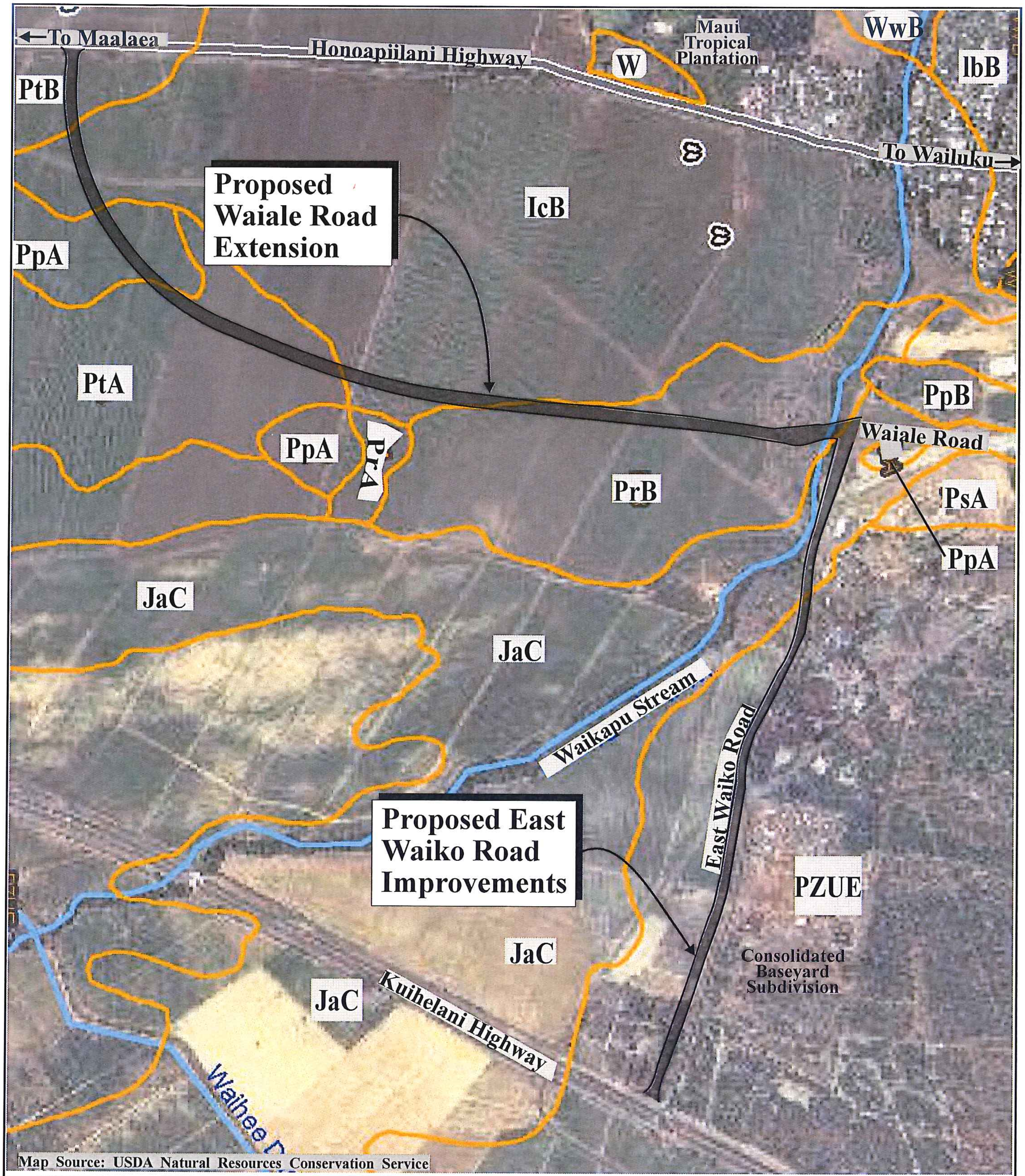

Figure 11 Proposed Waiale Road Extension and East Waiko Road Improvements

Soils Classification Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

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COM\DpwWaiale\Final EA\soilsclass

Exposed Jaucas Sand soils can be susceptible to severe erosion where vegetation has been removed. These soils are used primarily for pasture, sugar cane, recreational areas, and urban development.

The Puuone Sand (PZUE) consists of approximately 20 inches of sand over a strong cemented sand layer. Permeability is rapid above the cemented layer, runoff is slow, and the hazard of wind erosion is slight to moderate. The HSG for Puuone Sand is "C". These soils are used for pasture and homesites.

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

Vertical roadway profile grading will not alter local topographic and soils conditions. Moderate grading for the Waiale Road Extension will be necessary to meet the standards required for a County collector road. Grading plans of the overall project will balance excavation and embankment quantities to the extent possible. An estimated net volume of approximately 48,600 cubic yards is expected to be used during construction activities for the Waiale Road Extension.

The improvements to East Waiko Road will maintain the existing roadway grading, requiring an estimated net weight volume of approximately 6,900 cubic yards to be exported. See the Preliminary Engineering and Drainage Report, **Appendix "C"**. Drainage patterns will be maintained to ensure minimal impact to downstream properties (see Drainage Section D.4. of this Chapter). The underlying soil conditions and topography are not anticipated to be adversely impacted resulting from grading of the proposed Waiale Road Extension and the proposed East Waiko Road Improvements because of the underlying soil types and mild topography. However, special care will be taken on East Waiko Road when widening the existing 20 feet width to 36 feet width of AC pavement due to the loose sandy soils within this area.

Best Management erosion practices will also be incorporated during the construction to minimize soil loss, such as periodic water spraying of the disturbed soils to help prevent airborne dirt particles from reaching adjacent properties. Also, during construction, an 8-inch thick ingress/egress gravel access way will be constructed near the entrance of the project site to minimize the tracking of onsite soils by construction vehicles onto existing roadways. Additionally, a process water basin will be used during construction to contain processed water, such as wash water from cleaning construction trucks and equipment. The processed water basin will be developed in compliance with the National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit application will be submitted to the State Department of Health prior to construction for review and approval. As per standard conditions of the NPDES, the processed water basin will be designed and inspected regularly to remove pollutants and contaminants before percolating into the ground. Geotechnical soil investigation will be done during the design phase to determine the roadway design and geotechnical mitigation measures for pavement stability.

5. Flood and Tsunami Hazards

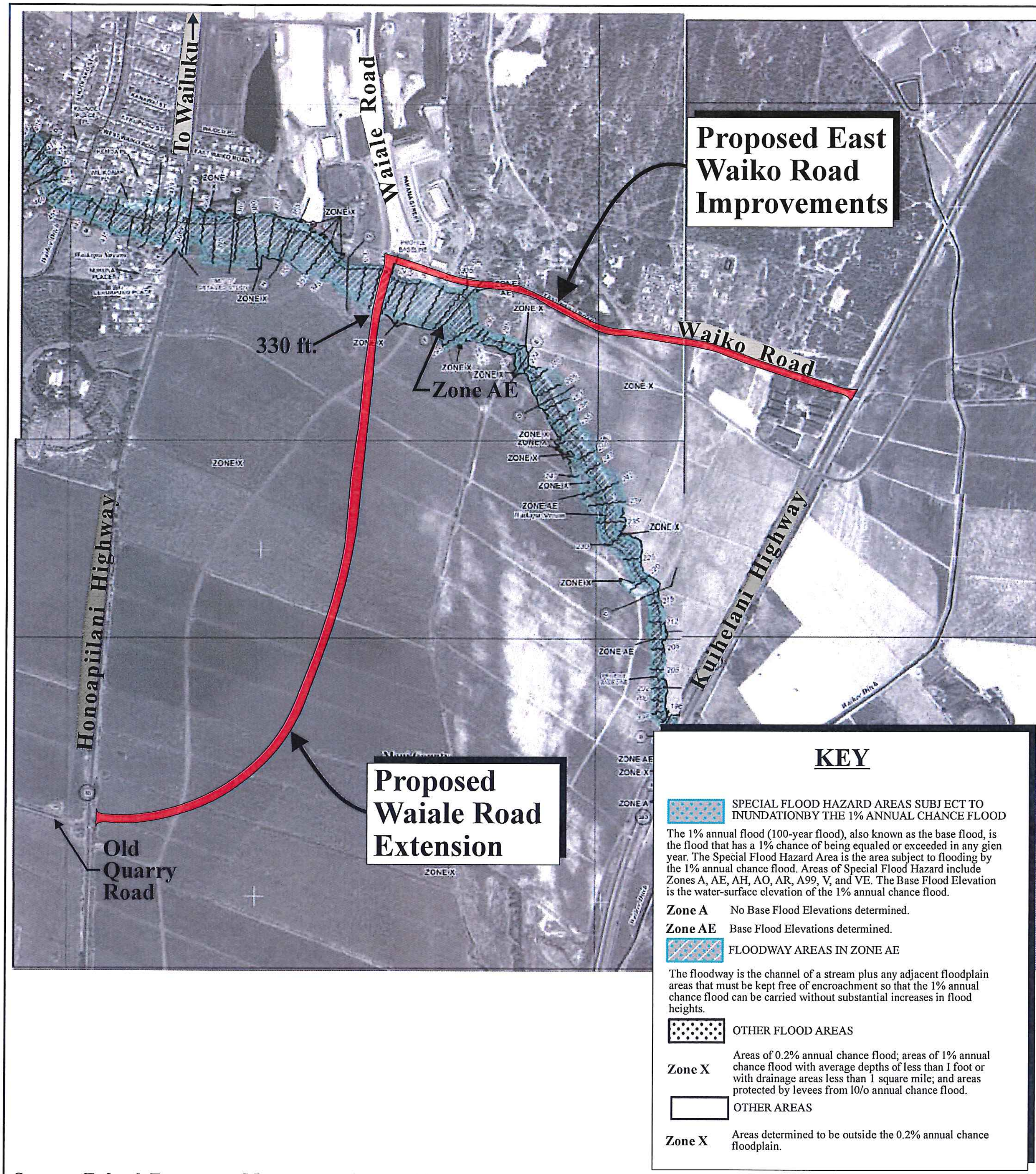
a. Existing Conditions

The project area is located near the eastern base of the West Maui Mountains. As indicated by the Flood Insurance Rate Map for the County of Maui, the majority of the project area is located within Zone X. Zone X is the flood insurance rate zone that corresponds to areas of 0.2 percent annual chance of flood. A small portion of the existing East Waiko Road right-of-way and the proposed crossing of the Waikapu Stream are located within Zone AE. Zone AE is within the 100-year floodway with base flood elevations determined in the vicinity of the stream crossing at 330 ft. amsl. See **Figure 12**.

The project area is located inland and outside the tsunami inundation zone.

b. Potential Impacts and Mitigation Measures

Waikapu Stream naturally flows from the mountain slopes towards the ocean across the proposed Waiale Road Extension alignment. As such, there is no practical alternative to avoid crossing the stream by the proposed roadway corridor. The crossing of Waikapu Stream can be mitigated by a bridge structure design that will not interfere with the natural drainage characteristics of the Waikapu Stream. The bridge will be designed to accommodate a 100-year storm in order to minimize the probability of stormwater overtopping the bridge. In order to address the portion of the existing East Waiko Road right-of-way within Zone AE, evaluation will be



Source: Federal Emergency Management Agency, FIRM Nos. 150003093E and 1500030394E

Figure 12 Proposed Waiale Road Extension and East Waiko Road Improvements
Flood Insurance Rate Map

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COM/DPW WaialeExt/Final EA/FIRM

carried out during the design phase of the proposed project, to determine if the existing berm may need to be raised to contain the flow within the Waikapu Stream. Modifications to the existing berm will be carried out if necessary.

The proposed project will comply with rules and regulations of the National Flood Insurance Program (NFIP) as presented in Title 44 of the Code of Federal Regulations (44CFR) and County of Maui flood zone rules and regulations.

As such, there are no anticipated adverse effects to adjacent or downstream properties from flooding as a result of the proposed project.

6. <u>Streams and Wetlands</u>

a. <u>Existing Conditions</u>

As mentioned previously, the proposed Waiale Road Extension will cross the Waikapu Stream. The Waikapu Stream originates in the West Maui mountains, at an elevation of approximately 3,300 feet through Waikapu Valley ultimately discharging into the Kealia Pond. The stream is intersected throughout its course by at least four (4) ditches (Everett, Upper Waihee, Lower Waihee, and Upper Maalaea Road) diverting water for agricultural use in central Maui.

Waikapu Stream is classified by the State of Hawaii as a perennial stream. The stream appears on the State of Hawaii, Department of Health list of impaired waters in Hawaii. The list indicates that the water quality within the stream may not meet State of Hawaii water quality criteria for streams. The stream is listed as impaired for turbidity during the dry season (May to October).

Historical data from previous biological surveys in the Waikapu watershed (the Waikapu watershed encompasses eight (8) named streams) indicates that several native aquatic species occur in the Waikapu watershed. Most of the native species were historically reported near Kealia Pond. *Opaekaleole* and *oopu* are historically reported to inhabit the middle and lower reaches of this watershed, while the *oopu nopili* is historically reported in the upper reaches of the watershed. See Biological and Water Quality Surveys of Waikapu Stream, **Appendix "D"**.

There are no wetlands in the immediate vicinity of the project corridor. There are also no wildlife refuges within or around the surrounding area of the project. However, the Waikapu Stream, as noted previously, discharges into Kealia Pond, most of which is in the Kealia National Wildlife Refuge. The project area is approximately 4.5 miles away from the Kealia National Wildlife Refuge.

The proposed project corridor passes through a highly altered area which has been the focus of large scale agriculture for over 100 years. Only the Waikapu Stream channel shows some resemblance of its original character.

b. Potential Impacts and Mitigation Measures

In August 2009, AECOS, Inc. (AECOS) surveyed approximately 2.5 miles of Waikapu Stream to identify the stream's aquatic biota and characterize the quality of the stream water. Refer to **Appendix "D"**. On the date of the survey, the stream flow was observed to be "good in segments upstream and near the project site". However, downstream of the project site, near Kuihelani Highway, the stream flow was "relatively poor".

Waikapu Stream is listed as impaired waters by Hawaii Department of Health (HDOH 2008) prepared under the Federal Clean Water Act. The stream is listed as impaired for turbidity during the dry season (May 1 to October 31) based on data from the wet and dry season. During AECOS's August 2009 survey, water quality was very good based on turbidity and concentrations of total nitrogen, nitrate-nitrite, suspended solid, and total phosphorus were also low indicating good stream water quality. AECOS recognized that a single sampling is not necessarily representative of stream conditions during the season sampled and compliance with State criteria in geometric means value requires computation of a geometric mean based on a minimum of three (3) samples from a station within a season. As such, a pre-construction survey and sampling of the Waikapu Stream will be conducted to verify the single sampling 2009 survey results in compliance with the State Department of Health criteria.

In regards to aquatic life, the survey indicated that "very little aquatic biota is found in lower Waikapu Stream" (area of potential impact). The biota that was present comprised of non-native species, such as pouch snails, American crayfish, guppies, cane toads, and black-crowned night herons. None of the aquatic species observed are listed as threatened or endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act.

AECOS recommended that any changes to the stream should be designed to accommodate diadromous life cycle of native fish and invertebrates. And, as previously mentioned, the intent of the bridge design is to allow the natural flow of the stream to continue to occur. If the bridge design requires culverts or steep slopes, the design will allow for surfaces to be continuously wet for passage of native fauna.

Furthermore, AECOS recommended that Best Management Practices (BMPs) during construction be designed and implemented to prevent degradation to water quality and allow aquatic biota recruitment. See further discussion in the Drainage Section, Chapter II.D.4. Also, the bridge crossing requires further consultation for a Section 404, Department of Army permit for placement or discharge of dredge and/or fill material into the Waikapu Stream.

With the mitigative measures explained above, the streams and wetlands are not anticipated to be adversely affected by the proposed project.

7. Flora and Fauna

a. Existing Conditions

A Biological Resources Survey and Botanical Survey were conducted in June and July 2009 by Robert Hobdy for the Waiale Road Extension. However, since the East Waiko Road Improvements will stay within the existing right-of-way and the area is highly altered, a survey for biological and botanical resources was not conducted in the East Waiko Road project area. See **Appendix "E"**.

A walk-through botanical survey was completed for the area surrounding the Waiale Road Extension to ensure maximum coverage of the area. Areas such as Waikapu Stream, which are most likely to contain native or rare plants were more intensively examined. About 90 percent of the proposed Waiale Road Extension corridor area is in sugar cane cultivation (*Saccharum officinarum*) growing in a dense monoculture. Sugar cane is a 1.5 to 2 year cycle that involves plowing, planting, burning and harvesting. This mono-crop agricultural activity creates a highly altered agricultural environment.

The other 10 percent of the area contains numerous plantation access roads, commonly called cane haul roads. The vegetation along the cane haul roads consists of agricultural weeds.

A small portion of the roadway corridor will cross Waikapu Stream. The stream was dry at the time of the survey which indicates the stream has an unvegetated stream bed consisting of boulders and gravel. The banks are densely forested with trees including Java plum (*Syzygium cumini*), koa haole (*Leucaena leucocephala*) and parasol leaf tree (*Macaranga tanarius*). On either side of Waikapu Stream, the vegetation consists of dry grasses, including buffel grass (*Cenchrus ciliaris*), Guinea grass (*Panicum maximum*) and brush species including koa haole and sourbush (*Pluchea carolinesis*).

A total of 67 plant species were recorded during the survey. By far, the most abundant species was sugar cane. Only one (1) common native species was found, the *uhaloa* (*Waltheria indica*) which is indigenous in Hawaii but widespread throughout Hawaii and in the Pacific. The remaining species were all non-native agricultural crop plants or weeds.

A fauna survey was also conducted in conjunction with the botanical survey. No mammals were observed within the study area during the three (3) site visits. Mammals that would be expected to be found in this area would include axis deer (*Axis axis*), rats (*Rattus*), mice (*Mus domesticus*), feral cats (*Felis catus*), and mongoose (*Herpestes auropuntatus*).

Birdlife was also rather sparse mainly due to dry summer conditions and the scarcity of food resources. Nine (9) species of non-native birds were observed, including spotted dove, zebra dove, house finch, common myna, house sparrow, northern cardinal, Japanese white-eye, red-crested cardinal, and black francolin. A number of non-native birds would have been expected to be observed in this area and at different times of the year, such as the gray francolin, cattle egret, and the northern mocking bird. Migratory Pacific golden-plovers may also be observed during the fall and winter months during their non-breeding phase. The indigenous black-crowned night-heron (*aukuu*) may also be seen along the stream fishing and roosting in trees when the stream is flowing.

While insects in general were not surveyed, a special examination for the native Blackburn's sphinx moth (*Manduca blackburni*) or their larvae was conducted. The Blackburn's sphinx moth has been put on the Federal Endangered Species list. There was no evidence of the Blackburn's sphinx moth or their larvae in the study area. Additionally, no endangered damsel flies were observed, but could possibly occur in the habitat within Waikapu Stream. However, the stream was dry and these damsel flies require running streams to reproduce.

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

No federally listed endangered or threatened plant species were found in the project area, nor were any species found that are candidates for such status. Only one (1) common indigenous species was found – *uhaloa*. Based on the findings of the Botanical Survey, it has been determined that the anticipated disturbances associated with the development of the proposed roadway extension are not expected to have a significant adverse impact on the botanical resources in this area of Maui. Nonetheless, the Botanical Survey recommended that the bridge crossing over Waikapu Stream be engineered to not impede the natural flow of the stream. The design intent of the bridge will follow the Botanical Survey's recommendation.

In regards to the fauna, no federally listed endangered or threatened species were found, nor were any species that are candidates for such status found in the project area. Additionally, no native fauna were observed during the field survey. Only common, non-native birds were observed. For these reasons, it was determined that the proposed project is not anticipated to have a significant negative impact on fauna resources in this area of Maui. However, the protected seabirds, *uau* and *ao*, are known to fly over the area at dawn and dusk to their burrows high in the mountains between March through November. The young birds are easily confused by bright lights, therefore, the biological survey recommended that any street lights of the roadway corridor be shielded to direct the light downward. Street lights are not proposed for the roadway design, except at intersections. At these locations, the street lights will be designed to be shielded to direct the light downward so it is not visible from above to birds. Furthermore, if necessary, construction lights will be shielded to direct lights downward during night work.

U.S. Fish and Wildlife Service (USFWS) provided comments on the Draft EA requesting additional mitigation measures for the project. Although the Biological Survey did not observe the endangered Hawaiian goose (*Branta sandvicensis, nene),* the USFWS noted that it has been observed in the vicinity of Waiko Road and Honoapiilani Highway. The construction of the proposed improvements is anticipated to be undertaken in one (1) phase and will take approximately 24 to 36 months. It would be difficult to interrupt the construction during the period of December to April, once it has started. Therefore, part of the construction protocol during this period will be to incorporate nest searches by biologists familiar with the nesting behavior of the Hawaiian goose to ensure the proposed work will not adversely impact the endangered Hawaiian goose. The DPW will incorporate this mitigation measure into the construction bid documents.

USFWS also noted that the Hawaiian hoary bat (*Lasiurus cinereus semotus*) will roost in woody vegetation. The project area is currently under sugar cane cultivation and the only area of woody vegetation is along the Waikapu Stream channel. The project will be occupying a small area of the stream channel for the Waiale Road Extension crossing right-of-way. Nevertheless, to avoid the risk that young bats could inadvertently be harmed or killed, the DPW will not remove or trim any trees greater than 15 feet during the period from May 15 to August 15. The DPW will incorporate this mitigation measure requirement into the construction bid documents.

Although the Biological Survey did not indicate the presence of Blackburn's sphinx moth, the field surveys were conducted during the dry season of the year in July. The USFWS recommended that a survey be conducted during the wettest portion of the year (noted as November to April) when the emergent larvae are feeding. It is noted that the majority of the project area remains in sugar cane cultivation. Nevertheless, a survey by a qualified biologist familiar with the habitat and life cycle of the moth will be conducted in the areas that are not in sugar cane, in the vicinity of East Waiko Road and Waikapu Stream channel crossing. This survey will be conducted during the wettest portion of the year and prior to construction.

Given the above mitigation measures, flora and fauna resources are not anticipated to be adversely impacted by the proposed project.

8. Archaeological Resources

a. Existing Conditions

Scientific Consultant Services, Inc. (SCS) prepared an Archaeological Inventory Survey (AIS) for the proposed project dated March 2010. See **Appendix "F"**. In general, the project area has been significantly altered by sugar cane cultivation. The AIS consisted of a pedestrian survey and excavation of 64 trenches in the project area. The extensive subsurface testing from the excavation failed to discover any traditional Hawaiian or historic era cultural features.

One (1) site with a single feature was documented during the pedestrian survey. The site (SIHP No. 50-50-04-6668) consisted of a historic era boulder terrace located on the south bank of the Waikapu Stream in the area under the proposed bridge crossing of the proposed Waiale Road extension.

b. Potential Impacts and Mitigation Measures

The function of SIHP No. 50-50-04-6668 (Site 6668) could not be determined, but it is believed to represent either a water diversion feature or possibly a footing for a former footbridge. No soil or sediments were observed within the site.

Site 6668 was assessed as significant under Criterion D of Hawaii State Historic Preservation criteria. The AIS report concludes that based on the results of the survey and depth of documentation, the site has yielded all potential information important to this historic period. This site has been thoroughly documented with photographs, scale plan, view maps and written description. No additional archaeological mitigation was recommended for this site, allowing for the removal, if necessary.

Subsurface testing demonstrated that no subsurface cultural layers were present and continued use of the project area for sugar cane cultivation has likely destroyed any surface sites that may have existed along the proposed Waiale Road Extension right-of-way. SCS, however, did recommend that archaeological monitoring be conducted for any ground disturbing activities along East Waiko Road because of the potential for sand deposits.

State of Hawaii, Department of Land and Natural Resources, State Historic Preservation Division (SHPD) has approved the AIS and concurs with the monitoring recommendation on East Waiko Road. Therefore, DPW will submit to SHPD a monitoring plan and receive an approval of the plan prior to construction. See **Appendix "F-1"**. Additionally, if any inadvertent discoveries of cultural materials and/or burials are found during construction, all work in the immediate area of the find will cease and SHPD will be notified.

9. Cultural Impact Considerations

a. Existing Conditions

SCS also conducted a Cultural Impact Assessment (CIA) dated February 2009. See **Appendix "G"**. The CIA included archival and documentary research which provided a cultural and historical context. Waikapu was the most southern valley of the Na Wai Eha (The Four Streams), a region that was famous for the largest continuous area of wet taro cultivation in the islands. Although it has been said that Waikapu Valley contained many cultural and archaeological sites, unfortunately, most of their locations were not recorded. Historically, the CIA reports on a *moolelo* recounting the origin of its name. It also discussed the story of the battle of *Ahulau ka piipii i Kakanilua*.

In regards to settlement patterns, a large traditional population lived in Waikapu because of the vast taro-producing valley. After the Great Mahele, large tracts of land in Waikapu were purchased and cultivated in sugar cane.

By 1862, Waikapu, Waihee, and Wailuku sugar cane lands combined to form Wailuku Sugar.

No specific suggestions for further contacts or interviews were received from County of Maui, Cultural Resource Commission, SHPD, Central Maui Hawaiian Civic Club, Na Kupuna O Maui, and Native Hawaiian Preservation Council. In addition, no cultural inquiries were received on *The Maui News* and *The Honolulu Advertiser* notices. The Office of Hawaiian Affairs did submit a letter dated February 23, 2009 to SCS providing individual names and organizations for possible Hawaiian cultural interview candidates. SCS sent letters of inquiries to the listed individuals and organizations but received no responses.

b. Potential Impacts and Mitigation Measures

Based on historical research and the inquiry process undertaken, it is reasonable to conclude that the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access or other customary activities will not be affected by the proposed project.

10. Air Quality

a. Existing Conditions

In general, the project vicinity does not experience adverse air quality conditions. There are no point sources of airborne emissions within the proximity of the project area. Pollutants that exist may be attributable to a variety of sources: vehicular exhaust off Honoapiilani Highway or East Waiko Road; dust generated through agricultural operations conducted in the Waikapu area and industrial operations along East Waiko Road; and/or burning from sugar cane harvesting and cultivation operations conducted in the central valley area. Emissions from these sources are intermittent and minimal, and are quickly dispersed by prevailing tradewinds.

b. Potential Impacts and Mitigation Measures

The proposed Waiale Road Extension and East Waiko Road Improvements will result in temporary construction-related air impacts. During construction, airborne particulates as a result of construction-related activities may temporarily affect the ambient air quality within the immediate vicinity of the project. Mitigation measures will involve, but not limited to, utilization of dust barriers, water wagons, and/or sprinklers to control dust. Other appropriate Best Management Practices (BMPs) will be employed to ensure that fugitive dust from the project area is minimized.

In regards to the use of the roadways, the proposed project will be appropriately setback from adjacent land uses through the width of the right-of-way. Additionally, emissions from vehicular traffic will be quickly dispersed by prevailing tradewinds.

The potential for roadway projects to impact air quality via Mobile Source Air Toxics (MSAT) has been an emerging area of environmental concern. MSATs are a subset of the 188 air toxins defined by the Clean Air Act. The MSATs for the proposed projects are compounds emitted from highway vehicles and non-road equipment. This project has been determined to generate minimal air quality impacts for Clean Air Act criteria pollutants and has not been linked with any particular MSAT concerns.

Moreover, Environmental Protection Agency (EPA) regulations for vehicle engines and fuels will cause overall MSAT emissions to decline significantly over the next several decades. Based on regulations now in effect, an analysis of national trends with EPA's MOBILE6.2 model forecasts a combined reduction of 72 percent in the total annual emission rate for the priority MSAT from 1999 to 2050 while vehicle-miles of travel are projected to increase by 145 percent. This will reduce the background level of MSAT as well as the possibility of minor MSAT emissions from this proposed project (Marchese 2009). Thus, the proposed project is not anticipated to have a long-term adverse impact on air quality parameters.

11. Noise

a. Existing Conditions

The predominant source of noise in the vicinity of the project site is from traffic traveling along Honoapiilani Highway. Other background noise sources include traffic traveling along local roads in the vicinity and agricultural and light industrial operations conducted along East Waiko Road.

Y. Ebisu & Associates (Ebisu) conducted an Acoustic Study (March 2010) for existing and future traffic noise levels to evaluate potential noise impacts associated with the proposed project. See **Appendix "H"**. Calculations of the changes in traffic noise levels associated with or without the project were based on the traffic counts conducted in 2009. Along East Waiko Road, between Waiale Road and Kuihelani Highway, the existing sound levels are approximately 65 Equivalent Hourly Sound Level (Leq). The existing traffic noise levels do not exceed the 71 Leq noise abatement criteria for FHWA and SDOT for industrial uses.

The existing traffic noise levels along Waiale Road near Waikapu Gardens are approximately 63 Leq and do not exceed the 66 Leq noise abatement criteria for FHWA and SDOT for residential uses. It should be noted that the existing traffic noise levels would be approximately 60 Leq if the existing average vehicle speeds along Waiale Road were 30 mile per hour (MPH) which is still 10 MPH over the posted speed limit of 20 MPH.

The existing traffic noise levels along Honoapiilani Highway and Kuihelani Highway are approximately 70 to 75 Leq due to the higher traffic volumes and higher average vehicle speeds. The existing traffic noise levels along these two (2) highways currently exceed the 66 Leq noise abatement criteria for developed land including residential uses.

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

(1) <u>East Waiko Road</u>

In the Acoustic Study, future traffic noise levels were evaluated for both the No Build Alternative and the Preferred Alternative. For future noise levels along East Waiko Road, for both No Build and the Preferred Alternatives, the Leq noise abatement criteria will not be exceeded at the existing industrial buildings along East Waiko Road.

(2) <u>Kuihelani Highway</u>

The future noise levels along Kuihelani Highway north of East Waiko Road are expected to increase by 0.3 decibel (dB) as a result of the proposed project. This increase is relatively small when compared to the 2.5 dB increase predicted to occur from normal traffic along this highway regardless of the proposed project. Furthermore, noise levels along Kuihelani Highway south of East Waiko Road are expected to decrease by 0.2 dB as a result of the project. The decrease will occur in addition to the 3.2 dB increase in traffic noise levels predicted to occur at this location regardless of the proposed project. The Acoustic Study concluded that no adverse noise impacts are anticipated along Kuihelani Highway in the vicinity of East Waiko Road intersection as a result of the proposed project.

(3) **Honoapiilani Highway**

The future noise levels along Honoapiilani Highway south of the Preferred Alternative are expected to increase by 0.4 dB as a result of the project. Again, this increase is relatively small when compared to the 2.9 to 4.1 dB increase predicted to occur along the highway regardless of the proposed project.

Along Honoapiilani Highway, north of Maui Tropical Plantation intersection, the future noise levels are expected to decline by 1.7 to 2.1 dB as a result of the proposed project. This decrease in traffic noise along this portion of Honoapiilani Highway from the proposed project will reduce the expected increase in future traffic noise regardless of the project. The Acoustic Study concluded that no adverse noise impacts are anticipated along Honoapiilani Highway as a result of the proposed project.

(4) **Waiale Road**

The future noise levels along Waiale Road near Waikapu Gardens are expected to increase by 1.4 dB as a result of the project. This is relatively small when compared to the 4.4 dB increase predicted to occur along the Waiale Road regardless of the project. Future traffic noise levels will exceed the 66 Leq noise abatement criteria at existing residences along Waiale Road near Waikapu Gardens with or without the proposed project based on existing average vehicle speeds. If the average vehicle speeds were 30 MPH, which is 10

MPH over the posted speed limit of 20 MPH, then the noise level would drop to approximately 65 Leq which is below the Leq noise abatement criteria level. If the average vehicle speeds were 20 MPH to comply with the posted speed limit, then the noise level would further drop to approximately 63 Leq.

In recent years, the Maui Police Department (MPD) has stepped up their programs to control vehicle speeding as evidenced in a recent Operation SPEED. The program issued 364 tickets over a three (3) day operation in May 2010 (Maui News, May 15, 2010). These programs provide awareness of speeding to help reduce speeding. Further noise mitigation measures can be provided by traffic calming to reduce average vehicle speed within the area and includes speed humps or tables, chicanes, or bump outs.

This area near the Waikapu Gardens subdivision is outside the limits of project construction area. FHWA and SDOT regulations do not require noise abatement measures to mitigate their pro-rata share of noise impact because this area is outside of the limits of the project construction area.

Furthermore, the lands along both sides of the Waiale Road Extension are agricultural lands and because there are no noise sensitive activities in the area, adverse traffic noise levels are not expected to occur.

In summary, the traffic noise levels generated by the proposed project are not expected to exceed the Leq noise abatement levels within the project area. Therefore, traffic noise mitigation measures are not required for the proposed project.

(5) <u>Construction Noise</u>

Ambient noise conditions may be temporarily affected by construction-related activities. Heavy construction machinery, such as backhoes, dump trucks, front-end loaders, paving equipment, and material transport vehicles, are anticipated to be the dominant noise-generating sources during the construction period.

Mitigation measures for construction-related activities will include proper equipment and vehicle maintenance which are anticipated to reduce noise levels. Equipment mufflers or other noise attenuating equipment may also be employed as required. Heavy noise-generating construction activities will be restricted to hours between 7:00 a.m. and 6:00 p.m. from Monday through Friday, excluding holidays. If such construction activities occur outside of these hours, the surrounding community will be notified. The construction activity will be carried out in compliance with Hawaii Administrative Rules (HAR), Chapter 11-46, "Community Noise Control", and a noise permit will be obtained for the project, if required.

12. Scenic and Open Space Resources

a. Existing Conditions

The project area offers views and vistas of the Pacific Ocean, Kihei, and Kahului, as well as the island of Kahoolawe. However, the location of the proposed action is not part of a significant view corridor. Open space resources in the region are characterized by the slopes of the West Maui and Haleakala Mountains, while the valley between these mountains is covered with agricultural fields predominantly in sugar cane.

b. Potential Impacts and Mitigation Measures

The project is not part of a designated scenic corridor and will not affect views from inland vantage points. The road improvements will be at grade level; vertical construction is minimal (street lights at intersections). Additionally, the proposed project will not present adverse impacts on open space resources.

13. Chemicals and Hazardous Materials

a. Existing Conditions

The majority of the project area is currently in sugar cane cultivation. The use of agricultural chemicals in agricultural operations is undertaken in strict accordance with all laws, regulations, and manufacturer's specifications.

b. Potential Impacts and Mitigation Measures

The proposed Waiale Road Extension is expected to reduce the amount of agricultural chemicals used on the project area compared to land remaining in agricultural operations. The proposed roadway will not require use or storage of chemicals or hazardous materials during long-term operations of the roadway. Use of fertilizers within the landscaped areas along the roadway right-of-way will be in a manner consistent with best landscape practices to avoid over use of soil amendments and nutrients. With such practices, there are no anticipated adverse effects on groundwater resources attributed to fertilizer use.

14. Beach and Mountain Access

a. Existing Conditions

As previously mentioned, a Cultural Impact Assessment (CIA) was completed for the proposed project by SCS. Refer to **Appendix "G"**. The CIA did not identify a traditional Hawaiian access corridor or trails within the project area. To note, the coast is approximately four (4) miles away.

b. Potential Impacts and Mitigation Measures

Since no traditional Hawaiian access corridor was identified by the CIA within the project area, there are no anticipated adverse impacts to beach and mountain access from the proposed project.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Population

a. Existing Conditions

The population of residents and visitors in the County on any given day (De Facto population) is projected to increase from 169,499 in 2000 to 262,264 in 2030, a gain of more than 54 percent. The County's resident population is expected to grow at nearly an identical rate as the De Facto population, with the resident population of the County of Maui reaching 199,550 by 2030 (SMS, 2006).

Year 2000 population for the Wailuku-Kahului Community Plan region was 41,503. The region's population increased to 46,626 in 2005. By the year 2030, population in the region is projected to increase to 71,223 (SMS, 2006).

b. Potential Impacts and Mitigation Measures

The proposed project in of itself is not a population generator. The proposed Waiale Road Extension is identified as an infrastructure project to improve long-term transportation needs that will support the anticipated population growth. This portion of the project will likely benefit the existing Waikapu Village neighborhood along East Waiko Road by providing an alternate route to Kuihelani Highway and Honoapiilani Highway. Once the Waiale Road Extension is completed, less traffic will utilize East Waiko Road to connect to the highways, thus keeping East Waiko Road along the Waikapu Village area a local road. Additionally, East Waiko Road Improvements will upgrade the existing roadway conditions to increase safety and use of this route.

2. Economy

a. Existing Conditions

The Wailuku region is the island's center of governmental activity. Along with neighboring Kahului, the region encompasses a broad range of commercial, service and public sector activity. In addition, the region is surrounded by acres of sugar cane. The vast expanse of agricultural land, managed by Hawaiian Commercial & Sugar Company (HC&S), are key contributors to the local economy.

Maui County and the island of Maui unemployment rates in March 2014 were 4.6 percent and 4.5 percent, respectively (Labor and Occupational Information Hawaii, State Department of Labor and Industrial Relations, May 2014).

The recent economic recession has affected Maui County's major industries of tourism, construction and real estate due to, among other factors, reduction in discretionary income and tightening of credit. The tourism sector is slowly recovering with higher levels of visitor arrivals and occupancy rates.

b. Potential Impacts and Mitigation Measures

In the short term, the proposed project will provide construction and construction-related employment. Accordingly, the project will have a beneficial impact on the local economy during the construction phase. The estimated cost of the project is $17.3 million (2010 dollars) which includes expenditures made towards land acquisition, planning, design, and construction.

In the long term, the proposed project will improve the existing roadway network in and around Waikapu for Maui residents, visitors, and businesses by providing an efficient travel route and improving traffic movements. In summary, the proposed action is expected to have a positive benefit to the economy of Maui County.

C. PUBLIC SERVICES

1. Police and Fire Protection

a. Existing Conditions

Police protection for the Wailuku and Waikapu region is provided by the Maui County Police Department headquartered on Mahalani Street, approximately 2.0 miles from the project area. The region is served by the

Department's Central Maui station, which is divided in three (3) sectors. Each sector is divided into three (3) beats, each patrolled by a single officer.

Fire prevention, suppression, and protection services for the Wailuku region is provided by the County Department of Fire and Public Safety's Wailuku station, located on Kinipopo Street in Wailuku Town, approximately 3.0 miles from the project area. The region is also served by the Department's Kahului Station, located on Dairy Road, approximately 4.0 miles from the project area.

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

The proposed project will not affect the service area limits or personnel for police and fire protection. The proposed project provide a more efficient network of roadways which will benefit emergency response time for both the Department of Fire and Public Safety and the Police Department.

2. <u>Medical Services</u>

a. <u>Existing Conditions</u>

The only major medical facility on the island is Maui Memorial Medical Center, located approximately 2.0 miles from the project area, midway between Wailuku and Kahului. Acute, general, and emergency care services are provided at the 231-bed facility. Other private medical service providers in the Central Maui region, which have regular hours, include Maui Medical Group and Kaiser Permanente.

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

The proposed project will not affect the requirements for medical services. As with fire and police services, the proposed roadway expansion and improvement will provide for improved traffic conditions for medical emergency responders. As previously noted, the proposed project will benefit residents and visitors with a more efficient network of roadways.

3. **Solid Waste**

a. **Existing Conditions**

Single-family residential solid waste collection service is provided by the County of Maui. Residential solid waste collected by County crews is disposed at the County's Central Maui Landfill, located four (4) miles southeast of the Kahului Airport. Commercial waste from private collection companies is also disposed of at the Central Maui Landfill.

Privately owned facilities, such as the Maui Demolition and Construction Landfill accept solid waste from demolition and construction activities. The facility is located at Maalaea, south of the subject property, near Honoapiilani Highway's intersection with North Kihei Road.

b. **Potential Impacts and Mitigation Measures**

The design intent of the Waiale Road Extension is to balance the cut and fill, thus minimizing construction waste associated with the improvements. Cleared and grubbed materials, from the construction of the proposed improvements will be disposed for composting use, as practicable. Construction waste which may be generated from the improvements will be recycled or disposed of at the appropriate construction waste disposal location. With these solid waste management measures, the contribution of the construction waste to the appropriate landfills will be minimized.

The East Waiko Road Improvements include upgrading the existing pavement section and re-striping the roadway. These improvements are anticipated to create minimum construction waste, thus the proposed project is not anticipated to adversely affect collection or capacity parameters of the County's or private solid waste system.

4. **Recreational Resources**

a. **Existing Conditions**

The Wailuku-Kahului region encompasses a full range of recreational opportunities, including shoreline and boating activities at the Kahului Harbor and adjoining beach parks, and individual and organized athletic activities offered at numerous County Parks. The Keopuolani Park has various trails for walking or running, as well as two (2) ballfields, a skate park, an open field area and three (3) restroom facilities. Across the street from the park are various ballparks, a multi-purpose field, the War Memorial Gymnasium and the War Memorial Stadium. The Velma Santos Community Center (also known as the Wailuku Community Center) is located nearby. Wells Park and Papohaku Park are also located within a three-mile radius.

The Waikapu Community Center is located on East Waiko Road in the immediate vicinity of the project area. This County-owned facility includes a baseball field, basketball court, and community center building. In addition, Waikapu Gardens, a residential community, is located in the vicinity of the proposed project area which includes a passive park with picnic tables and walking trails. A nearby park, adjacent to the Hale Makana O Waiale Affordable Housing complex in Wailuku, contains a baseball field, basketball court, and playground equipment.

b. Potential Impacts and Mitigation Measures

The proposed project is not a population generator. Therefore, the proposed project is not anticipated to adversely impact existing public recreational facilities. The proposed project right-of-ways will not pass through park lands, nor require any right-of-way from existing park lands. The proposed Waiale Road Extension will include a bike/pedestrian path separate from the vehicle travel lanes that will allow recreational activity along the new roadway. In this respect, the proposed project will be beneficial to the community.

5. Schools

a. Existing Conditions

The Wailuku-Kahului region is served by the State Department of Education's (DOE) public school system, as well as several privately operated schools. DOE facilities in the Kahului area include Lihikai, Kahului, and Pomaikai Elementary Schools (Grades K-5), Maui Waena Intermediate School (Grades 6-8), and Maui High School (Grades 9-12). Existing facilities in the Wailuku area include Wailuku Elementary School (Grades K-

5), Pu`u Kukui (Grades K-5), Iao Intermediate School (Grades 6-8), and Baldwin High School (Grades 9-12). University of Hawaii, Maui College serves as the island's primary higher education facility.

In Wailuku, there is a Catholic-faith based private school, St. Anthony, which operates a high school, junior high school, elementary school and pre-school. In addition, there is one (1) private pre-school for 3 to 4 year olds of Native Hawaiian ancestry, operated by Kamehameha Schools, located in the Paukukalo subdivision.

b. Potential Impacts and Mitigation Measures

Inasmuch as the proposed roadway project is not a population generator, the proposed project is not anticipated to adversely impact school enrollments and facility requirements.

D. INFRASTRUCTURE

1. Roadways

The following section summarizes the main roadways in the area of the proposed project. See **Figure 13**.

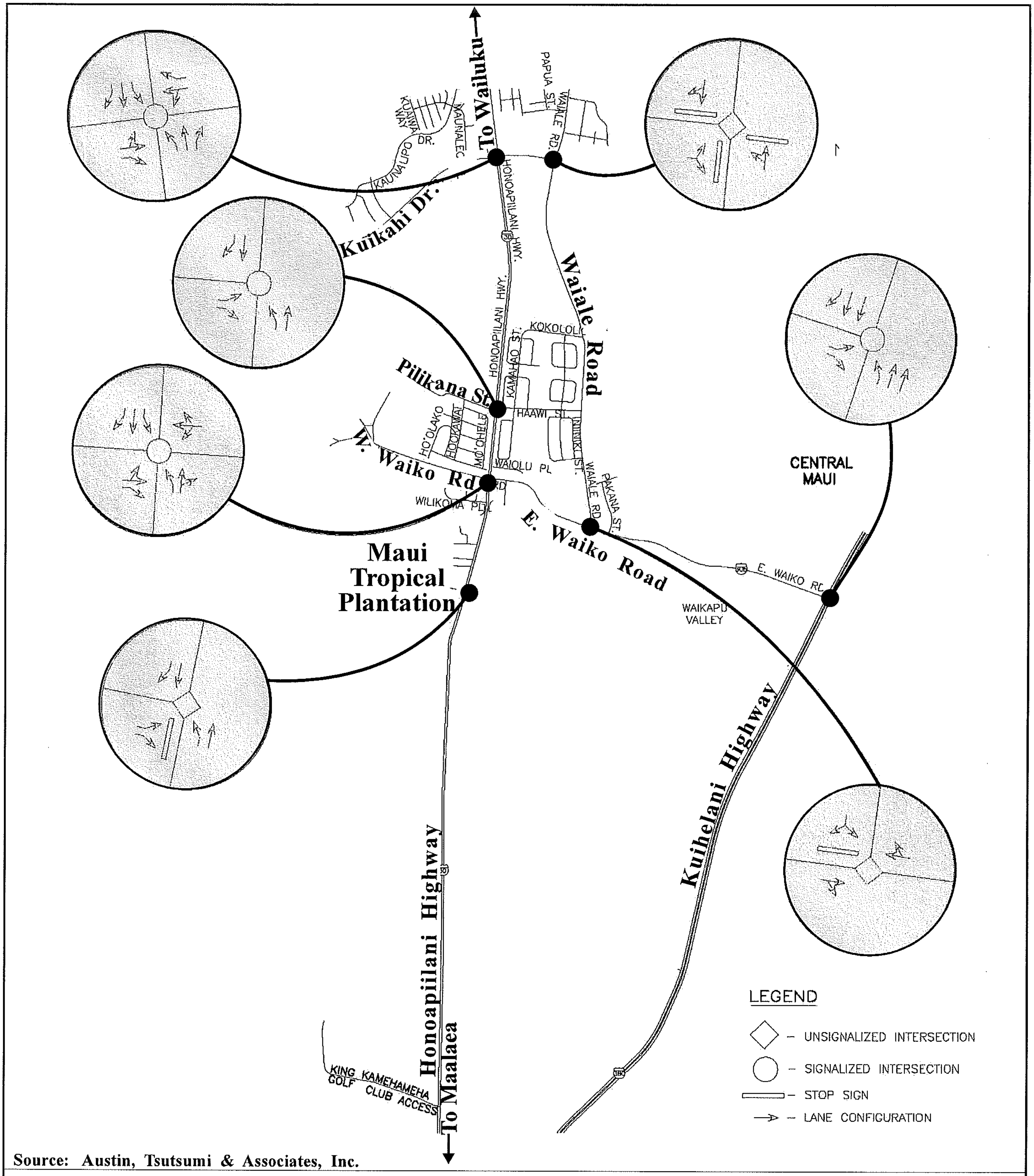
a. Existing Conditions

(1) West Waiko Road

West Waiko Road is an east-west oriented, two-way, two-lane undivided collector road with a posted speed limit of 20 MPH. West Waiko Road begins approximately 4,500 feet west of Honoapiilani Highway in an established residential neighborhood, and extends eastward towards its terminus at its intersection with Honoapiilani Highway and East Waiko Road.

(2) East Waiko Road

East Waiko Road is an east-west oriented, two-way, two-lane, undivided collector road with a posted speed limit of 20 MPH. East



Source: Austin, Tsutsumi & Associates, Inc.

Figure 13 Proposed Waiale Road Extension and East Waiko Road Improvements

NOT TO SCALE

Roadways and Lane Configuration

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

Waiko Road currently serves residential and industrial land uses, while also providing connectivity (via Waiale Road) to the Waikapu Gardens Subdivision and areas further north, including Wailuku. Through the Waikapu region, the 20-feet wide East Waiko Road is currently narrow and winding; the road appears to offer limited sight distance around some of its curves, and is stop-controlled approximately 650 feet east of its intersection with Waiale Road. Eastern terminus is Kuihelani Highway.

East Waiko Road is owned by Wailuku Agribusiness Co., Inc., Waiko Baseyard, LLC, and County of Maui.

(3) <u>Waiale Road</u>

Waiale Road is a north-south oriented, two-way, two-lane, undivided ollector road with a posted speed limit of 20 MPH. To the north, Waiale Road serves as the extension of Lower Main Street where it extends south past the Maui Community Correctional Center and residential areas, and terminates at its intersection with East Waiko Road.

Between Kuikahi Drive and East Waiko Road, Waiale Road serves as the sole access to residents of the Waikapu Gardens Subdivision. Each of the Waikapu Gardens' three (3) existing accesses intersect with Waiale Road as "tee-" intersections, with single-lane approaches. In the immediate vicinity of the project at the intersection with East Waiko Road, Waiale Road is owned by Wailuku Agribusiness Co., Inc.

(4) <u>Honoapiilani Highway</u>

The State-owned Honoapiilani Highway is a north-south oriented, two-way, two-lane, undivided arterial with posted speed limits ranging between 30 MPH and 45 MPH in the vicinity of the proposed project. Honoapiilani Highway begins as the continuation of South High Street near Kahookele Street, and continues south through Waikapu, Maalaea, and wraps around the "Pali" towards West Maui.

(5) Kuihelani Highway

The State-owned Kuihelani Highway is a north-south oriented, two-way, four-lane, divided arterial with a posted speed limit of 55 MPH in the vicinity of the proposed project. Kuihelani Highway begins to the north in Kahului at its intersection with Puunene Avenue and Dairy Road. The road extends southward along the eastern border of the Maui Lani master planned community, intersects with East Waiko Road, and ultimately terminates at its signalized intersection with Honoapiilani Highway to the south near Maalaea.

(6) Kuikahi Drive

Kuikahi Drive is an east-west oriented, two-way, two-lane, undivided collector road with a posted speed limit of 30 MPH. Kuikahi Drive begins approximately 1.2 miles west of Honoapiilani Highway within the Wailuku Heights development extending east to intersect with Honoapiilani Highway, and continuing east to Maui Lani Parkway and on to Kuihelani Highway, thereby providing connectivity to Kuihelani Highway and the Maui Lani community.

The Kuikahi Drive/Honoapiilani Highway intersection and Kuikahi Drive/Waiale Road intersection are signalized.

(7) Pilikana Street

Pilikana Street is an east-west oriented, two-way, two-lane undivided collector road with a posted speed limit of 20 MPH. Pilikana Street serves as the sole access to Waiolani Mauka and Waiolani Subdivision and intersects Honoapiilani Highway approximately 4,700 feet south of Kuikahi Drive/Honoapiilani Highway intersection. The Pilikana Street/Honoapiilani Highway intersection is signalized.

(8) Maui Tropical Plantation (MTP) Access

The MTP Access is an east-west, two-way, two-lane privately-owned driveway providing access to the MTP via Honoapiilani Highway.

A Traffic Impact Assessment Report (TIAR) was prepared by Austin, Tsutsumi & Associates, Inc. (ATA) for the proposed project. Refer to **Appendix "A"**. ATA conducted traffic turning movement counts for the roadways previously listed in January 2009. Based on the manual traffic counts, it was determined that AM peak hour traffic occurs between 7:15 a.m. and 8:15 a.m. and PM peak hour traffic occurs between 4:00 p.m. and 5:00 p.m.

There are six (6) Levels-Of-Service (LOS), "A" through "F", which are performance measures that relate to the driving conditions from best to worst, respectively. In general, LOS "A" is a value representing free-flow conditions with no congestion. LOS "F", on the other hand, is a value representing severe congestion with stop-and-go conditions. Level-Of-Service "D" is typically considered acceptable for peak hour conditions in urban areas.

Honoapiilani Highway and Kuihelani Highway serve as the primary arterials through the Waikapu area. While the Honoapiilani Highway generally serves traffic originating from or destined towards Wailuku, Kuihelani Highway serves traffic originating from or destined towards Kahului, Hana, or Upcountry. During the AM peak hour of traffic, congestion occurs along Honoapiilani Highway heading towards Wailuku town. No congestion was observed along Kuihelani Highway within the study area.

Waiale Road serves as a collector road for Waikapu Gardens and the nearby industrial areas, and provides an alternate north-south route between east Wailuku and Waikapu. However, its capacity to process traffic is limited by its posted speed limit of 20 MPH and termination at East Waiko Road. Waikapu Gardens residents have expressed that speeding is an issue along Waiale Road between Kuikahi Drive and East Waiko Road.

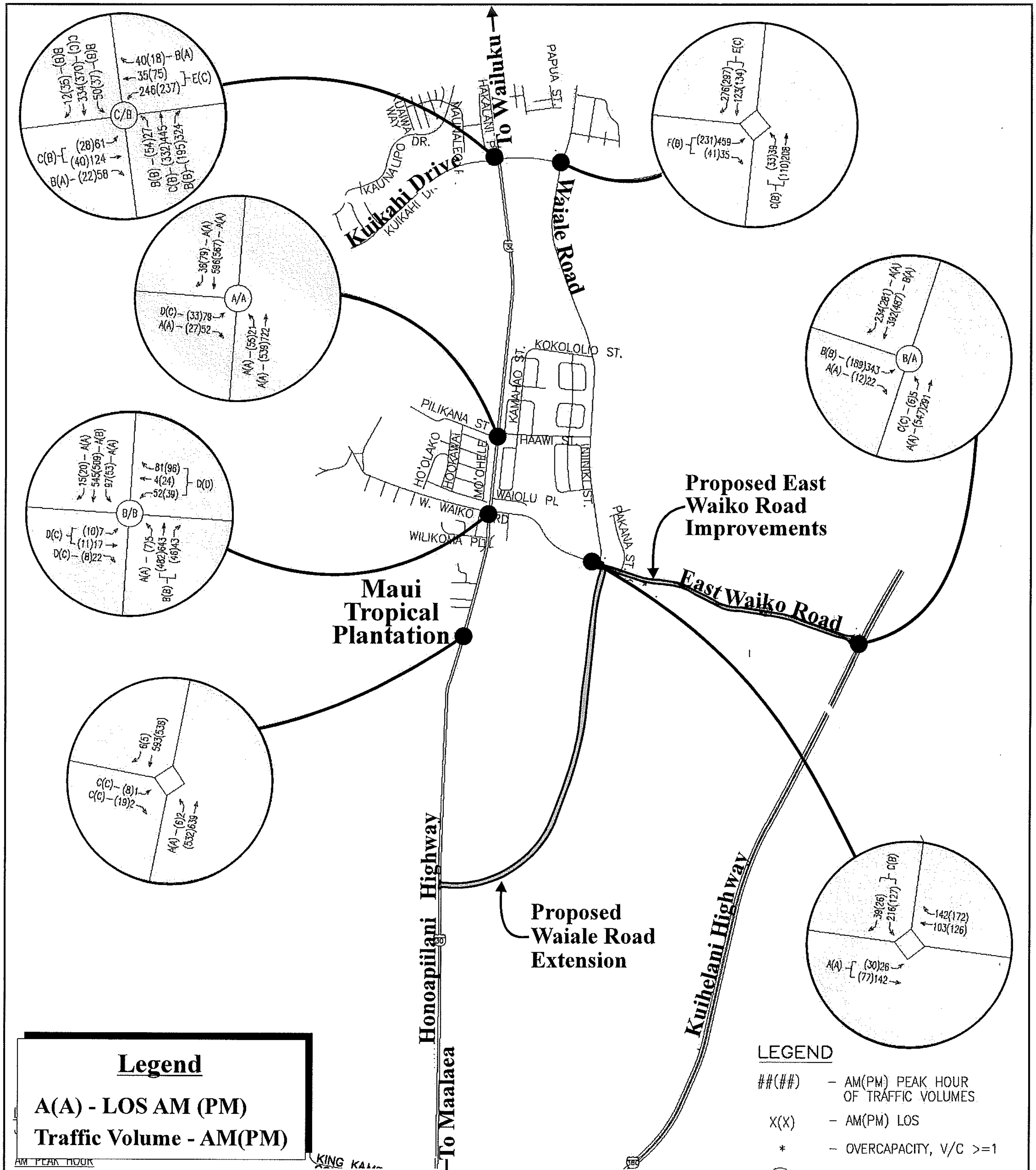
The Waikapu/South Wailuku area has experienced considerable growth in residential land use; this growth is anticipated to continue together with commercial, industrial, park facilities, and other ancillary land uses. Currently, Waikapu traffic within the study area and within the region bounded by Honoapiilani Highway and Kuihelani Highway is afforded relatively limited access to Honoapiilani Highway, since the only major connections are at East Waiko Road and Kuikahi Drive.

The existing traffic volume and LOS analysis of existing conditions are summarized in **Figure 14**. Shown are the peak hour traffic volumes and LOS for each traffic turning movement. Details on the analysis of existing conditions for the study intersections are included in the TIAR. Refer to **Appendix "A"**. A few traffic turning movements experience congestion, such as the westbound left-turn movement on Kuikahi Drive and Honoapiilani Highway at LOS E during peak hours of traffic. It appears that vehicles making this traffic maneuver originate from East Wailuku (via Waiale Road) or Kahului (via Maui Lani Parkway/Waiinu Road) as a means of bypassing the more congested areas of Honoapiilani Highway and High Street. However, the vehicle queues for this traffic movement were observed to be between six (6) and eight (8) vehicles long, clearing at the end of each traffic signal cycle. Other than the peak hours, this signalized intersection operates smoothly.

The other traffic turning situation that causes congestion is the unsignalized, all-way stop controlled intersection of Kuikahi Drive and Waiale Road. It should be noted that at the time of the TIAR, Kuikahi Drive did not connect to Maui Lani Parkway nor was it signalized. Currently Kuikahi Drive connects to Maui Lani Parkway to provide an additional regional roadway between Kahului and Wailuku. In addition, this intersection is now signalized. As such, the LOS at this intersection has improved.

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

As previously mentioned, a TIAR was prepared by ATA. Refer to **Appendix "A"**. It is noted that the traffic impacts for the East Waiko Road Improvements are based on the widening of the pavement from its existing width of 20 feet to 36 feet. This, in combination with the improved roadway conditions, will improve capacity along East Waiko Road; hence, the effect of the East Waiko Road Improvement project is included as a component of the studied roadway capacities in the TIAR.



Source: Austin, Tsutsumi & Associates, Inc.

Figure 14 Proposed Waiale Road Extension and East Waiko Road Improvements

Existing Traffic Volume and Level-of-Service

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DPW Waiale\Final EA\ExistVolumeandLOS

To reiterate, the purpose and need of the Waiale Road Extension are to:

1. Increase the viability of Waiale Road as an alternative route to Honoapiilani Highway and Kuihelani Highway through the Waikapu area;

2. Improve regional vehicular access to Honoapiilani Highway and Kuihelani Highway for existing and future growth within the Waikapu and Wailuku areas; and

3. Reduce traffic turning movements to and from Honoapiilani Highway from Kuikahi Drive and East Waiko Road, which would otherwise serve as the only means of accessing Honoapiilani Highway within this region.

<u>Base Year 2030</u>

Traffic demand projected at the base year of 2030 (without the proposed project improvements) will increase significantly, primarily as a result of the new and/or continuing development of:

- Waikapu Country Town (planning phase) (renamed Waikapu Tropical Plantation)
- Maui Lani (partially constructed)
- Kehalani (partially constructed)
- Waiale (planning phase)
- Pu'unani Residences (planning phase)

Development will also occur in Kahului and other parts of the island. It is assumed that the new developments will need to provide new roadways with access to Kuihelani Highway, Honoapiilani Highway, and Kaahumanu Avenue (via Kamehameha Avenue).

Heavy congestion will likely occur along Honoapiilani Highway due to the increased north-south traffic demand, and heavy concentration of traffic turning movements at the East Waiko Road/West Waiko Road/Honoapiilani

Highway and Kuikahi Drive/Honoapiilani Highway intersections, particularly eastbound approach.

Mitigation would require widening Honoapiilani Highway beyond its existing right-of-way, and in some cases would be through established communities.

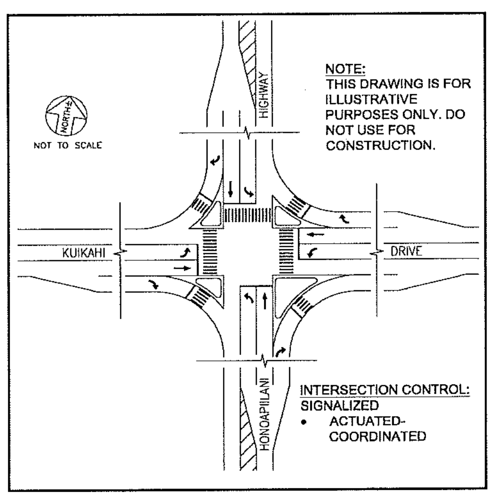
Base Year 2030 Recommendations

To accommodate continuing development, the following improvements are recommended as future projects previously identified come online. Each project will be required to submit a TIAR and identify future improvements needed as a result of each project's impacts.

1. Implement Waiale Road Extension concurrently with the East Waiko Road Improvements.

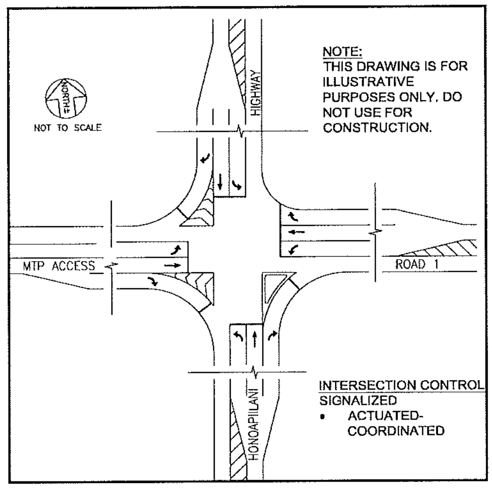
2. Acquire right-of-way along Honoapiilani Highway from south of Waiko Road (beyond existing housing) to the Honoapiilani Highway and Kuihelani Highway intersection to eventually widen Honoapiilani Highway to four (4) lanes as necessary.

3. Modify the Honoapiilani Highway and Kuikahi Drive intersection to provide the following lane configuration:



Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment

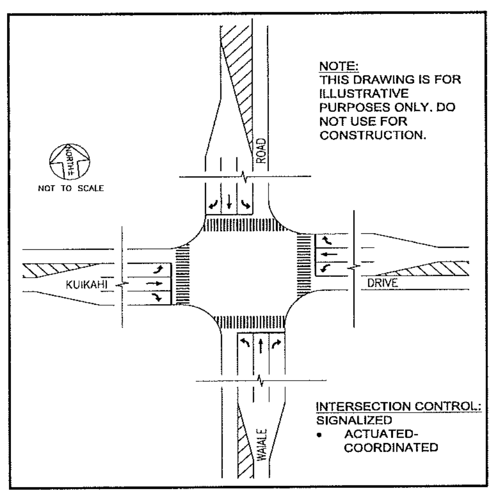
4. Signalize the Honoapiilani Highway and Maui Tropical Plantation intersection when warranted. Based upon current information, provide the following lane configuration:



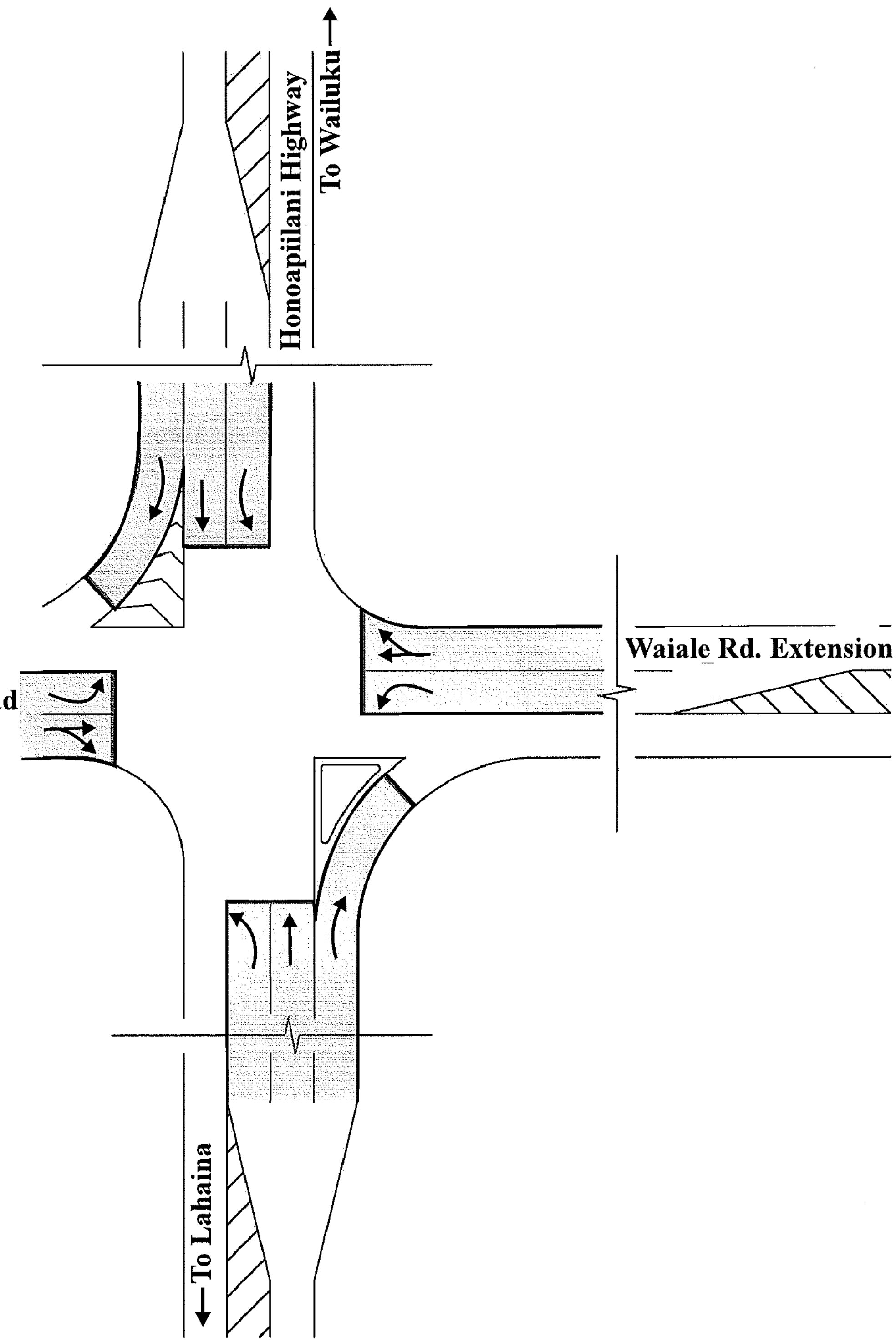
Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment

5. Signalize the Honoapiilani Highway and Waiale Road Extension intersection (at Old Quarry Road) when warranted. Provide the lane configuration, as shown on **Figure 15**.

6. Modify the Kuikahi Drive and Waiale Road Intersection to provide the following lane configuration:



Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment



Source: Austin, Tsutsumi & Associates, Inc.

Figure 15 Proposed Waiale Road Extension and East Waiko Road Improvements

Waiale Road Extension/Honoapiilani Highway Intersection (at Old Quarry Road)

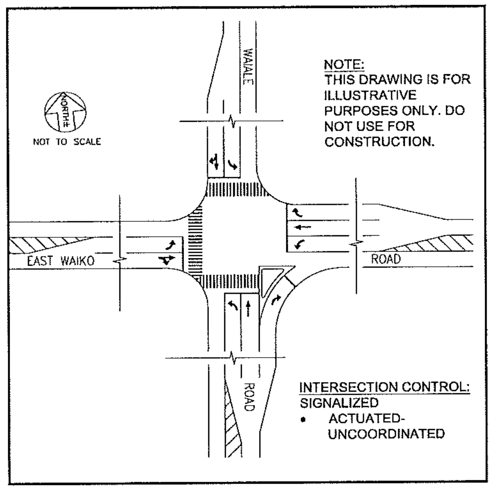
NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

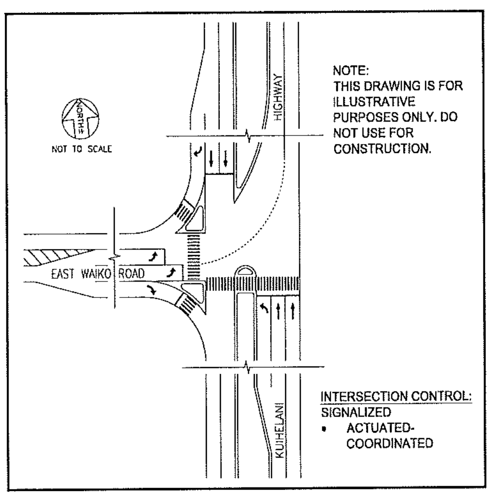
COM\DPW Waiale\Final EA\SouthAccess

7. Signalize the Waiale Road and East Waiko Road Intersection when warranted. Provide the following lane configuration:



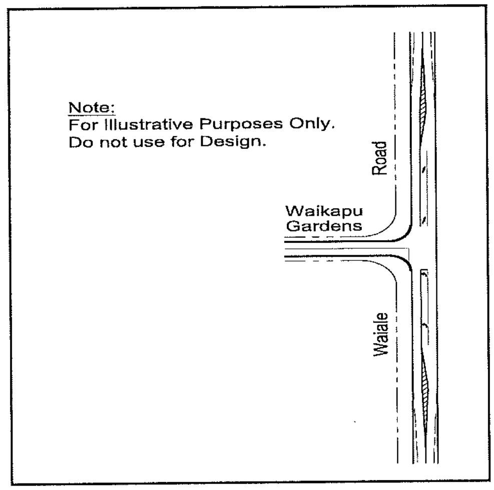
Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment

8. Modify the East Waiko Road and Kuihelani Highway intersection to provide the following lane configuration:



Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment

9. Construct median acceleration and deceleration lanes along Waiale Road and its intersections with Kokololio Street, Haawi Street, and Nokekula Street.



Source: Austin, Tsutsumi & Associates, Inc.
See Appendix A, Traffic Impact Assessment

The East Waiko Road Improvements portion of the project will require acquisition of a portion of land from Waiko Baseyard, LLC and Spencer Homes, Inc. Additionally, the Waiale Road Extension portion of the project will require land acquisition from Waiko Baseyard, LLC and Waiale 905 Partners, LLC.

Project Impacts

The following discussion will highlight a few of the main intersections that will experience changes in traffic volume and differ from projected Base Year 2030 conditions as a result of the proposed project. Base Year is defined within the context of ATA's Maui Travel Demand Forecasting Model (Model). The Model assigned land use and socio-economic data to Traffic Analysis Zones (TAZs). The attributes were obtained from the Maui County in 2007 and used to generate and assign traffic across the roadway network. The Model forecasted traffic attributes to the year 2030. Details of all studied intersections are included in the TIAR. Refer to **Appendix "A"**.

(1) Honoapiilani Highway and Kuikahi Drive

Operations at this intersection will improve over Base Year 2030. The Base Year 2030 projects the overall LOS F and overcapacity traffic conditions during peak hours of traffic. With the proposed Waiale Road Extension, the overall LOS will improve to LOS D during the peak hours of traffic. However, some minor traffic movements will continue to experience a LOS F. Improvement to the LOS will result from the diversion of westbound left-turn and northbound right-turn movement from Kuikahi Drive on to Waiale Road.

(2) **<u>Honoapiilani Highway and East Waiko Road/West Waiko Road</u>**

Operations at this intersection will improve over Base Year 2030 as a result of the diversion of westbound left-turn and northbound right-turn movements from East Waiko Road on to Waiale Road. The Base Year projects the overall LOS F and overcapacity traffic conditions during peak hours of traffic. With the proposed Waiale Road Extension, the overall LOS will improve to LOS D during the peak hours of traffic. However, some minor traffic movements will continue to experience a LOS F.

(3) **<u>Honoapiilani Highway and Maui Tropical Plantation</u>**

The intersection will improve over Base Year 2030 to LOS E or better for all traffic movements during the PM peak hour of traffic, and LOS D or better for all traffic movements during the AM peak hour of traffic.

(4) **<u>Honoapiilani Highway and Waiale Road Extension (at Old Quarry Road)</u>**

It is likely that this new intersection will warrant a traffic signal. It is recommended that this intersection provide deceleration lanes for its northbound and southbound right-turn and left-turn movements. For the westbound approach, a dedicated left-turn and shared through/right-turn are recommended. Refer to **Figure 15**. With these improvements, the intersection will operate at LOS E or better and within roadway capacity for all movements during the peak hours of traffic.

(5) Waiale Road and East Waiko Road

This intersection will differ from that of Base Year 2030 in that a connection will be added as the Waiale Road Extension. As such, the traffic volume will increase.

An analysis was completed on this intersection design-roundabout versus a signalized intersection. The analysis indicated that a roundabout would operate at LOS F on its northbound and southbound approaches during the AM peak hour of traffic and on its westbound and southbound approaches during the PM peak hour of traffic. A roundabout requires significant right-of-way acquisition to accommodate the approaches' realignments.

A traffic signal would most likely be warranted at this intersection. It is recommended that dedicated left-turn lanes be provided on all approaches, and that an exclusive right-turn lane be provided for the westbound and northbound approaches. Although right-of-way may need to be acquired near the intersection, the land acquisition needed will likely be less than what is needed for a roundabout. With the traffic signal, all traffic movements would operate at LOS D or better during the AM and PM peak hours of traffic. A traffic signal is recommended because the LOS, as compared to a roundabout of LOS F, would provide an acceptable level of service at LOS D.

(6) Waiale Road and Waikapu Gardens Access Roads

It is estimated that the Waiale Road Extension would increase traffic along Waiale Road near the intersections that access Waikapu Gardens by an additional 32 percent over Base Year 2030. However, no additional improvements are recommended given the fact that a traffic signal is not warranted, and a mini-roundabout would have traffic volumes in excess of the planning-level recommended Averaged Daily Traffic (ADT) of 15,000 vehicles per day.

Summary and Mitigation

Currently, traffic within the study area runs relatively smoothly along Honoapiilani Highway and Kuihelani Highway. However, during the AM peak hour of traffic, congestion occurs in the northbound direction of Honoapiilani Highway headed towards Wailuku; the vehicle queue was observed to extend to Kehalani Mauka Parkway.

The all-way stop controlled (AWSC) Kuikahi Drive and Waiale Road intersection was the only intersection with movements analyzed as LOS F and this occurred for the eastbound shared left-turn/right-turn at the time of the study. However, this intersection is now a signalized intersection that continues on to connect to Maui Lani Parkway and on to Kuihelani Highway. As such, the LOS at this intersection has likely improved since the time of the TIAR study.

At the East Waiko Road and Kuihelani Highway intersection, a 20-vehicle queue was observed to form in the eastbound left-turn movement due to its high-volume, single-lane operation. This queue began to form at 6:50 a.m., and had dispersed by 7:00 a.m. The queue did not appear to have any regional implications; the congestion was localized and based on traffic fluctuation.

Consideration of Roundabouts

SDOT's December, 2008 "Modern Roundabouts Policy Guideline "requires that the feasibility of roundabouts be studied. The construction of roundabouts along Honoapiilani Highway or Kuihelani Highway would not be feasible because:

- The traffic volumes are much greater along Honoapiilani Highway and Kuihelani Highway than on the intersecting side streets (i.e., East Waiko Road); therefore, the traffic flow will not be balanced and could introduce excessive delay or speed inconsistencies on the highways.
- At this time, the SDOT roundabout policy only allows the consideration of modern single-lane roundabouts. The analysis indicates that double-lane roundabouts would be required at the major intersections along Honoapiilani Highway and Kuihelani Highway.

Thus, roundabouts at these highways are not compatible with SDOT's roundabout policy.

Construction Considerations

The Waiale Road Extension and East Waiko Road Improvements will have construction impacts to the nearby local roadways as well as Honoapiilani Highway and Kuihelani Highway. General construction impacts include traffic congestion due to construction and temporary single-lane closures outside of the peak hours of traffic. Specific impacts to local roadways and the highway system will be identified during the project design process. As part of the design process, the DPW will provide a Construction Management Plan that will include recommendations to minimize the impact of construction activities to the roadway networks.

2. Water

a. Existing Conditions

Water to the Wailuku-Kahului region is provided by the County Department of Water Supply (DWS) Central Maui System which also serves the Paia, Maalaea, Kihei, and Makena areas. About 75 percent of the water is drawn from the Iao Aquifer, which has a capacity of 20 million gallons per day (MGD). The remaining 25 percent is drawn from the adjacent Waihee Aquifer, from the North Waihee wells.

b. Potential Impacts and Mitigation Measures

The proposed Waiale Road Extension project is anticipated to have landscape improvements along the project corridor. Irrigation will be from non-potable sources which will be expanded in conjunction with the expansion of the proposed Waikapu Country Town development. The proposed landscaping improvements are not anticipated to adversely impact potable well production or potable water source supply. The proposed Waikapu Country Town water system will be privately owned and maintained. It is anticipated irrigation for the landscaped area will use approximately 6,000 to 10,000 gallons per day.

3. Wastewater

a. Existing Conditions

Wastewater from the Wailuku-Kahului region is treated at the Wailuku-Kahului Wastewater Reclamation Facility (WKWWRF). The WKWWRF also receives flow from Kuau, Paia, Skill Village, and Spreckelsville. Currently, the WKWWRF has a design capacity of 7.9 million gallons per day (MGD) and average dry weather flow of 4.4 MGD. Effluent disposal from the WKWWRF is via eight (8) gravity injection wells. Solids from the WKWWRF are treated, processed and digested, dewatered and then composted at the Central Maui Landfill in accordance with State and Federal regulations. There are 15 major wastewater pump stations which are part of the WKWWRF system.

The proposed project will not require connection to wastewater facilities.

b. Potential Impacts and Mitigation Measures

Currently, there are no County wastewater facilities within the project area. Since there is no need to connect or utilize wastewater facilities, the proposed project is not anticipated to adversely impact wastewater service in the region.

4. Drainage

a. Existing Conditions

A Preliminary Engineering and Drainage Report was prepared for the projects by ATA. Refer to **Appendix "C"**.

The Waiale Road Extension project area is currently cultivated in sugar cane cultivation. Stormwater runoff flows in a west to east direction through the existing sugar cane lands, eventually draining into the Waikapu Stream which outlets in Kealia Pond. The Waiale Road Extension project site currently generates a 50-year, 1 hour peak runoff of 17 cubic feet per second (cfs).

Offsite areas mauka of the Waiale Road Extension project site and makai of Honoapiilani Highway similarly flows stormwater runoff in a west to east direction. The existing offsite areas currently generate a 100-year, 24 hour runoff rate of 417 cfs. This stormwater amount eventually drains into the Waikapu Stream which outlets into Kealia Pond.

The Waiale Road Extension will cross the Waikapu Stream. The Waikapu Stream has a large offsite watershed area - Waikapu Valley which contributes to its flow. As previously mentioned, the FEMA maps have indicated that the Waikapu Stream is within a Zone AE 100-year floodway area, an area of 1 percent annual chance of flooding. A USGS stream gauge is located approximately 500 feet makai of Honoapiilani Highway within the Waikapu Stream. This gauge has only been in service since 2002, so a historical estimate of the 100-year, 24-hour flow rate cannot be determined from the gauge. The highest flow rate measured at the gauge was 1,400 cfs in 2004.

Existing East Waiko Road slopes approximately three (3) percent towards Kuihelani Highway. Paved swales on East Waiko Road convey runoff along the road alignment and eventually are collected by a storm drain and ditch system at Kuihelani Highway. The existing 50-year, 1-hour runoff for East Waiko Road project area is 21 cfs.

Community members have expressed concerns regarding flooding within East Waiko Road. The cause of the flooding has been determined by DPW to be an old cane haul crossing over Waikapu Stream just mauka of the intersection of Waiale Road and East Waiko Road. The old cane haul crossing is no longer in use.

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

Roadway runoff will be collected in paved roadside swales. Drainage inlets within the roadway swales will convey the roadway runoff into retention/detention basins located within the project area. Refer to **Figure 2** and **Appendix "C"**.

The proposed Waiale Road Extension area is expected to generate a post development runoff of 61 cfs for a 50-year, 1-hour rate. The increase in runoff from the Waiale Road Extension is estimated to be approximately 44 cfs since the existing runoff is approximately 17 cfs. The increase in stormwater runoff, as previously mentioned, will be retained in an open air retention/detention basin. Refer to **Appendix "C"**.

The East Waiko Road Improvement is expected to generate a post development runoff of approximately 30 cfs for a 50-year, 1-hour rate. The increase in runoff from East Waiko Road Improvement is estimated to be approximately 9 cfs since the existing runoff is approximately 21 cfs. Again, the increase in stormwater runoff will be retained in an open air retention/detention basin. Refer to **Appendix "C"**.

The proposed Waiale Road Extension will cross over Waikapu Stream. The crossing will need to accommodate the large amount of water flowing down the stream during heavy rains. As part of the design phase, the crossing will be designed to span the Waikapu Stream and with capacity for stream water flow. Although the layout and type of crossing will be determined during the design phase, a bridge or arch-culvert design is being considered. The intent of the bridge design is to span the Waikapu Stream without altering the natural flow of the stream. In addition, stormwater runoff on the Waikapu bridge crossing will be directed away from the bridge deck towards the drainage collection system to avoid storm water runoff into Waikapu Stream. The design will also accommodate a 100-year stormwater event to avoid the possibility of overtopping the bridge.

The offsite drainage areas that sheet flow across the project area will be intercepted by ditches placed mauka of the Waiale Road Extension and the collected runoff will pass under the roadway through culverts.

The use of the drainage system and retention/detention basins for the Waiale Road Extension and East Waiko Road Improvement will accommodate the increase in stormwater runoff that the project is estimated to generate. Various methods of stormwater retention will be studied further during the design phase. Additionally, the Waikapu bridge crossing will be designed to span the Waikapu Stream. With these mitigative measures, impacts on stormwater runoff are not anticipated to have an adverse impact on the Waikapu Stream and adjacent and downstream properties.

5. **Electrical Systems**

a. **Existing Conditions**

Electrical needs in the project vicinity are provided by Maui Electric Company, Ltd. Overhead transmission lines are located along the western border of the project area, along Honoapiilani Highway.

Traffic signals, when warranted, and street lights will be installed at the intersections of Waiale Road Extension and Honoapiilani Highway and at East Waiko Road and Waiale Road Extension.

b. **Potential Impacts and Mitigation Measures**

Coordination with the Maui Electric Company, Ltd. will be undertaken, as required, to ensure the timely delivery of utility services for the proposed project.

E. CUMULATIVE AND SECONDARY IMPACTS

Cumulative impacts are defined by Title 11, Chapter 200, Hawaii Administrative Rules (HAR) Environmental Impact Statement (EIS) Rules as the impact on "*the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*"

A "secondary impact" or "indirect effect" from the proposed action are defined by Title 11 Chapter 200 HAR EIS Rules as "*effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.*"

1. **Context for Cumulative and Secondary Impacts Analysis**

In this case, the context for analyzing cumulative and secondary impacts is defined by the time horizon within which "reasonably foreseeable" conditions may occur. From a local planning standpoint, the future context is established by the Maui County General Plan. The General Plan defines parameters for growth.

The General Plan, as currently being updated, looks to the horizon year 2030. Thus, "reasonable foreseeable" conditions may be considered within this future context. To better understand the relationship between the proposed project and the General Plan, and therefore, the nature of indirect effects associated with the proposed action, background information regarding the key components of the General Plan Update process is provided herein.

a. General Plan Overview

The Maui County General Plan, as set forth in Chapter 2.80.B of the Maui County Code provides for the update of the County General Plan. The General Plan is a long term, comprehensive blueprint for the physical, economic, environmental development and cultural identity of the County through 2030. The components of the General Plan include the following:

- Countywide Policy Plan provides broad policies and objectives which portrays the desired direction of the County's future. It will include a Countywide vision, statement of core principles, and objectives and policies for population, land use, the environment, the economy, and housing.
- Maui Island Plan (MIP) provides a land use strategy, water assessment, nearshore ecosystem assessment, an implementation strategy, and milestone measurements. Within the land use strategy, a Managed and Directed Growth Plan will be completed that will identify existing and future land use patterns and determine planned growth.
- Community Plans provide actions to implement based on consistency with the Countywide and MIP's vision, goals, objectives, and policies.

The Maui County Council has approved the Countywide Policy Plan and the MIP.

Whereas the Countywide Policy Plan covers planning goals and objectives at the broadest levels, and the regional Community Plans consider specific regional needs and opportunities, the MIP addresses functional elements of the General Plan and islandwide growth parameters which will ultimately dictate growth patterns on the island. For this reason, further explanation of the MIP is provided below.

b. **Maui Island Plan (MIP) Component of the General Plan**

In general, the purpose of the MIP is to:

- Assess existing conditions, trends, and issues specific to the Island of Maui;

- Provide policy direction for the use and development of land, the extension and improvement of transportation services and infrastructure, the development of community facilities, the expansion of the Island's economic base, the provision of housing, and the protection of natural and cultural resources;

- Establish policies to manage change and to direct decisions about future land use and development; and

- Provide the foundation for setting capital improvement priorities, revising zoning regulations, and developing other implementation tools.

The MIP looks comprehensively at the range of factors that will influence the physical development of the island. It establishes an island-wide framework that provides clear direction for the future, while maintaining enough flexibility to respond to a variety of situations and changing conditions. Importantly, it establishes the location and type of development that is appropriate in different areas of the island, including where new development should occur and where resources should be directed.

The MIP will be used by the County Council, Planning Commission, County staff and the community as a policy foundation for day-to-day decision making by:

- Providing direction for the development of future policies and regulations (for example, zoning and other ordinances, guidelines and area-specific plans that describe what kind of development can occur where);

- Providing policy to help determine the appropriateness of development proposals;

- Assigning resource for capital investments and programmatic initiatives.

The Directed Growth Plan, which is a key element of the MIP, provides a framework for managing outcomes of growth based on analysis of natural hazards, sensitive lands, cultural resources, scenic corridors, and related environmental and human community parameters. An important result of the Directed Growth Plan was the preparation and adoption of maps that delineate urban small town and rural growth areas. Referred to as Urban, Small Town and Rural Growth Boundaries, these maps set the boundaries for the physical limits of development. In so doing, the Directed Growth Plan seeks to manage use of other non-urban and non-rural resources important in sustaining the island to the year 2030. The other objectives of the Directed Growth Plan are:

- To protect important agricultural lands; and
- Ensure timely provision of infrastructure systems to address needs for proposed growth areas.

The MIP Urban Growth Boundary (UGB), Small Town Boundary (STB) and Rural Growth Boundary (RGB) maps provide for an additional residential units in Central Maui to meet projected population parameters to 2030. Long-term housing projects planned for the 2030 time horizon within the immediate vicinity of the project area include the future buildout of Maui Lani and Kehalani and the proposed projects of Waiale, Waikapu Tropical Plantation, and Pu'unani Residences. A transportation corridor within the proposed project area is also outlined in the MIP to facilitate transportation infrastructure development within the growth boundaries.

The proposed alignment of the Waiale Road Extension project was established in conjunction with the STB of the Maui Island Plan for the Central Maui region. The Waiale Road Extension established the future boundary (or edge) that would delineate the urban/rural area of the Waikapu Tropical Plantation small town. The mauka (western) area between Waiale Road Extension and Honoapiilani Highway is shown within the STB for urban/rural uses while the makai (southeastern) area is shown as urban and planned open space areas which include the Central Maui Regional Park, Community Park, Preservation and County facility area. Refer to **Appendix "I"**.

Generally, the area of impact is the Waikapu and lower Wailuku area near the terminus of northern end of Waiale Road. As previously noted, the projects identified for future growth are within this area of impact.

2. Cumulative Impact Evaluation Parameters

As defined by Title 11, Chapter 200, HAR EIS Rules, to ensure that cumulative impacts are analyzed in a structured and systematic manner, criteria described in **Table 2** have been used to address and identify cumulative effects.

Table 2. Criteria for Evaluating Cumulative Impacts

Assessment Criteria	Basis for Impact Evaluation
Time Crowding	Effects of frequent and repetitive actions on the environment
Time Lags	Delayed effects of a proposed action
Space Crowding	Effects of spatial density on the environment
Cross Boundary	Effects of an action occurring away from the source
Fragmentation	Effects or changes in landscape pattern
Compounding Effects	Effects arising out of multiple pathways
Indirect Effects	Secondary effects
Triggers and Thresholds	Effects defined by agency laws, policies or regulations.

3. Methodology for Addressing Cumulative Impacts

A list of potential cumulative impact issues and concerns were identified through full review of comment letters received during the preparation of the Draft EA. While the issues and concerns addressed a broad range of impact considerations, screening of these issues and concerns was required to ensure that the scope of the cumulative and secondary impacts assessment fell within the scope of a "cumulative and secondary impact" analysis. Pre-screening issues and concerns relating to cumulative and secondary impacts are listed below.

1. Impacts of the project upon the existing Waikapu Garden residential community

2. Impacts upon infrastructure systems serving the region

3. Impacts on agricultural productivity

4. Analysis of Cumulative and Secondary Impacts

The assessment of cumulative and secondary impacts for each issue/concern set forth above is presented below:

Impacts to the Existing Waikapu Gardens Residential Community

Impacts to the Waikapu Gardens Community include the generation of new traffic along Waiale Road adjacent to this community. Traffic mitigation measures for the proposed Waiale Road Extension are detailed in the TIAR. Refer to Section III. D. 1. Roadways and **Appendix "A"**. From a cumulative and secondary impact perspective, the TIAR considered the traffic generated by the regional growth parameters of the MIP's UGB to the year 2030. Based on the analysis, the TIAR recommends mitigation measures to address specific concerns from the Waikapu Gardens Community. The recommended mitigation measure for base year 2030 includes constructing median acceleration and deceleration lanes along Waiale Road and the Waikapu Gardens' road intersections. The portion of cumulative and secondary impacts that can be attributed to the proposed project is 32 percent over the base year 2030 projections. Without the proposed project, the base year conditions will still apply and in 2030 the acceleration and deceleration lanes will need to be constructed at the intersection of Waiale Road and the Waikapu Gardens access roads.

In regards to noise impacts, the Waikapu Gardens will experience an increase of 4.4 dB for the base year 2030 of which 1.4 dB is a result of the proposed project. This increase results from future traffic noise levels that will exceed the 66 Leq noise abatement criteria at the existing residence at year 2030 with or without the proposed project based on existing average vehicle speeds of 43 MPH. It is noted that if the average vehicle speeds were 30 MPH, which is 10 MPH over the posted speed limits of 20 MPH, then the noise level would drop to approximately 65 Leq, which is below the noise abatement criteria level. Additionally, this area is outside of the limits of project construction area. FHWA and SDOT regulations do not require mitigative noise abatement measures to mitigate their pro-rata share of noise impacts because this area is outside of the limits of the project construction area.

Impacts Upon Infrastructure Systems Serving the Region

In regards to the cumulative and secondary impacts to infrastructure systems, for the base year 2030, water, wastewater, and electrical system impacts will be significantly impacted. The proposed project's contribution to these infrastructure systems is minimal due to the nature of a roadway project. Water resources of 6,000 to 10,000 GPD will be provided by a private water company and will utilize non-potable water sources. Wastewater resources are not needed for the proposed project. And, electrical requirements are limited to traffic signal, when warranted, and street lights at the intersections of Honoapiilani Highway and the Waiale Road Extension and East Waiko Road and Waiale Road Extension.

In regards to stormwater management, the drainage systems in 2030 will need to be constructed to handle future urban growth. The proposed project's contribution to drainage will be 53 cfs and this increase will be managed with the use of an open air retention/detention basin.

Impacts on Agricultural Productivity

In regards to the cumulative and secondary impacts to agricultural productivity, the future urban growth planned for the Wailuku/Waikapu area will impact agricultural lands. The MIP Small Town Boundary represents urbanization of approximately 360 acres of agricultural lands and 142 acres in the rural classification. The portion of agricultural lands that will be needed for the Waiale Road Extension is 16 acres. Given the minimal contribution of the proposed project, the pro-rata share of the cumulative impact to agricultural productivity is not considered to be large.

Further, the Waiale Road Extension will provide a feature to delineate the urban/rural growth area within the context of the MIP STB. Mauka (west) side of the Waiale Road Extension is envisioned for urban and rural uses while makai (east) side is envisioned to be in urban uses including large park and County facility uses.

In conclusion, the proposed project has been planned in consideration of the 2030 time horizon envisioned in the MIP and future development of the Waiale/Waikapu area. Implementation of the planned land uses surrounding the proposed project will undergo impact assessment prior to granting entitlements. This assessment would take into consideration cumulative and secondary impacts and mitigation, as necessary.

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

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

A. STATE LAND USE DISTRICTS

Pursuant to Chapter 205, Hawaii Revised Statutes (HRS), all lands in the State have been placed into one (1) of four (4) land use districts by the State Land Use Commission. These land use districts have been designated "Urban", "Rural", "Agricultural", and "Conservation". The project area is classified "Agricultural". See **Figure 16**. Roadways are a permitted use in the "Agricultural" district.

B. CHAPTER 226, HRS, HAWAII STATE PLAN

Chapter 226, HRS, also known as the Hawaii State Plan, is a long-range comprehensive plan which serves as a guide for the future long-range development of the State by identifying goals, objectives, policies, and priorities, as well as implementation mechanisms. The proposed action is consistent with the following goals of the Hawaii State Plan.

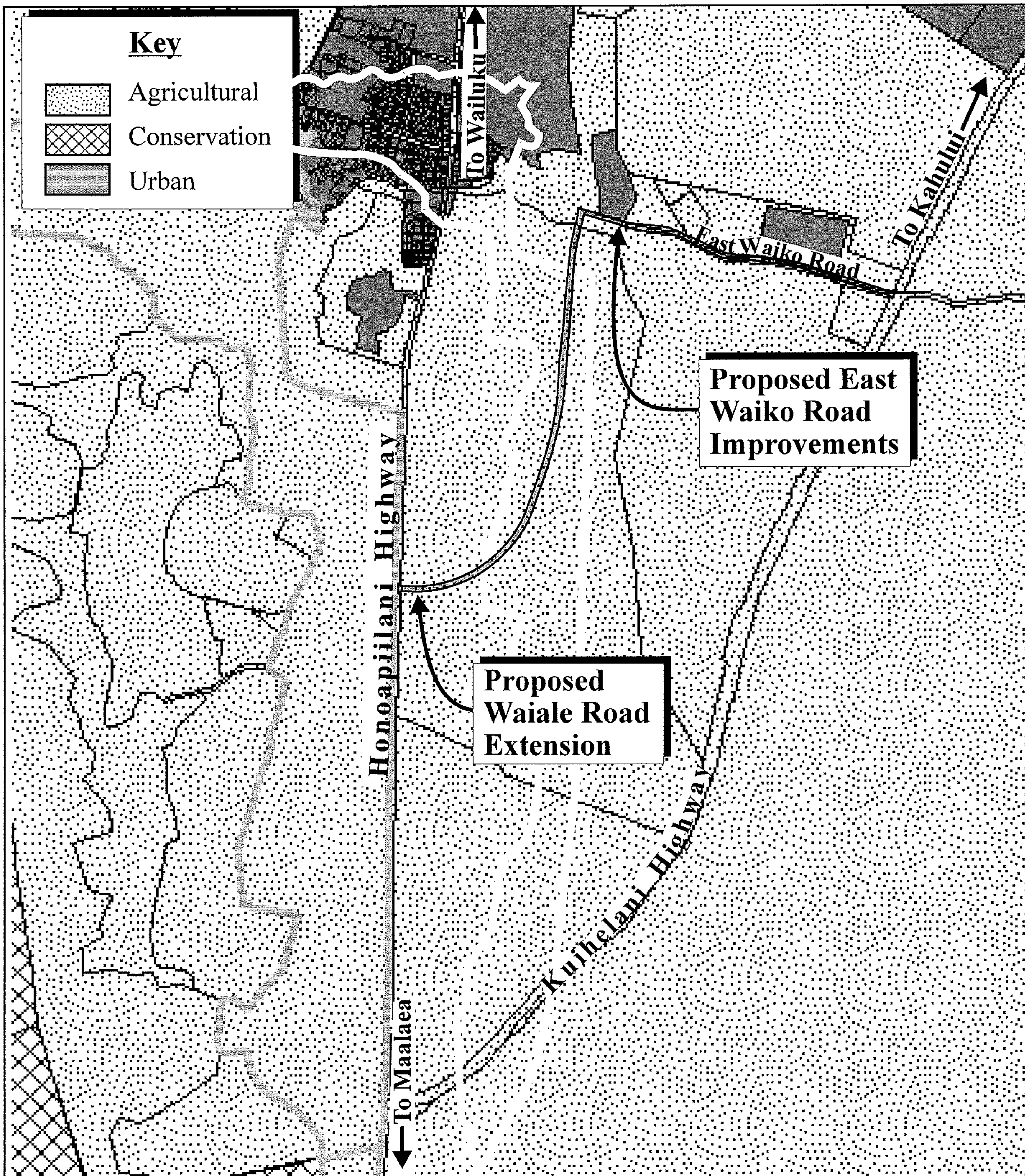
- A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.
- Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

1. Objectives and Policies of the Hawaii State Plan

The proposed action is consistent with the following objectives and policies of the Hawaii State Plan:

Chapter 226-5, HRS, Objectives and Policies for Population

226-5(a), HRS: It shall be the objective in planning for the State's population to guide population growth to be consistent with the



Source: State Land Use Commission

Figure 16 Proposed Waiale Road Extension and East Waiko Road Improvements

State Land Use Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaialeExt\Final EA\slud

achievement of physical, economic, and social objectives contained in this chapter.

226-5(b)(1), HRS: Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county.

<u>Chapter 226-6, HRS, Objective and Policy for the Economy - in General</u>

226-6(b)(6), HRS: Strive to achieve a level of construction activity responsive to, and consistent with, State growth objectives.

<u>Chapter 226-11, HRS, Objectives and Policies for the Physical Environment - Land-Based, Shoreline, and Marine Resources.</u>

226-11(b)(3), HRS: Take into account the physical attributes of areas when planning and designing activities and facilities.

226-11(b)(8), HRS: Pursue compatible relationships among activities, facilities, and natural resources.

<u>Chapter 226-13, HRS, Objectives and Policies for the Physical Environment - Land, Air, and Water Quality.</u>

226-13(b)(2), HRS: Promote the proper management of Hawaii's land and water resources.

226-13(b)(7), HRS: Encourage urban developments in close proximity to existing services and facilities.

<u>Chapter 226-14, HRS, Objective and Policy for Facility Systems - in General:</u>

226-14(a), HRS: Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

<u>226-17, HRS, Objectives and Policy for Facility Systems–Transportation:</u>

226-17(a), HRS: Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:

(1) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.

2. Priority Guidelines of the Hawaii State Plan

The proposed action coincides with the following priority guidelines of the Hawaii State Plan.

Chapter 226-103, HRS, Economic Priority Guidelines:

226-103(1): Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.

a. Encourage investments which:

(i) Reflect long term commitments to the State;

(ii) Rely on economic linkages within the local economy;

(iii) Diversify the economy;

(iv) Reinvest in the local economy; and

(v) Are sensitive to community needs and priorities.

Chapter 226-104, HRS, Population Growth and Land Resources Priority Guidelines

226-104(a)(1), HRS: Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.

226-104(a)(3), HRS: Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.

226-104(b)(1), HRS: Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

226-104(b)(12), HRS: Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline conservation lands, and other limited resources for future generations.

C. STATEWIDE TRANSPORTATION PLAN

The Hawaii Statewide Transportation Plan (HSTP) is a guidance document for implementation of a statewide transportation process. HSTP, with a planning horizon to 2025, intends to provide policy-level direction to Hawaii Department of Transportation and each of the county transportation agencies. The mission of HSTP is *to provide for the safe, economic, efficient, and convenient movement of people and goods*. The proposed project will meet the following goals and objectives of the HSTP:

GOAL 1: Achieve an integrated multi-modal transportation system that provides mobility and accessibility for people and goods.

Objective 1: To preserve, maintain, and improve the air, land, and water transportation system.

Objective 1 will be met by:

A. Improving inter-modal connectivity of the transportation system.

B. Increasing capacity and services to respond to current and anticipated growth.

C. Pursue the maintenance of the transportation system.

Objective 2: To increase the efficiency of the air, land, and water transportation systems' operations.

Objective 2 will be met by:

A. Enhancing inter-modal connectivity.

GOAL 2: Ensure the safety and security of the air, land, and water transportation systems.

Objective 1: To enhance the safety of the transportation system.

Objective 1 will be met by:

A. Providing safe facilities and infrastructure.

ENVIRONMENT AND QUALITY OF LIFE

GOAL 3: Protect and enhance Hawaii's unique environment and improve its quality of life.

Objective 1: To provide an air, land, and water transportation system that is environmentally compatible and sensitive to cultural, historic, and natural resources.

A. Provide an infrastructure and facilities that are environmentally friendly, safe, and appropriate to each community's character and scale.

Objective 1 will be met by:

A. Providing safe roadway infrastructure appropriate to the surrounding community character.

Objective 2: To ensure that the statewide air, land, and water transportation system supports comprehensive land use policies and livability in urban and rural areas.

A. Provide a transportation system that supports and enhances quality of life.

B. Minimize disruption of existing neighborhoods due to transportation.

Objective 2 will be met by:

A. Increasing roadway capacity to respond to current and anticipated growth.

B. Minimize pass-through traffic on East Waiko Road through Waikapu Town.

ECONOMIC DEVELOPMENT

GOAL 4: Support Hawaii's economic vitality.

Objective 1: To provide and operate an air, land, and water transportation system to accommodate existing and emerging economic developments and opportunities.

A. Provide a direct, convenient, and physically suitable system for goods movement to transportation facilities and to commercial and industrial areas.

B. To promote efficient and cost effective operations of the transportation system.

Objective 1 will be met by:

A. Increase roadway capacity to respond to current and anticipated growth.

B. Enhancing inter-modal connectivitiy.

Objective 2: To develop an air, land, and water transportation system that complements and preserves Hawaii's unique, natural environment as an asset for economic and quality of life issues.

A. Make transportation investments that reflect each island's character and scale and that foster the residents' quality of life.

B. Target transportation investments in coordination with community involvement.

Objective 2 will be met by:

A. Providing roadway infrastructure appropriate to the surrounding community character.

B. Providing opportunity for community input.

D. STATEWIDE TRANSPORTATION IMPROVEMENT PROGRAM

The Hawaii Statewide Transportation Improvement Program (STIP) provides a multi-year listing of the State and County projects and identifies those projects that will receive federal funding. It is a multi-modal transportation improvement program that is developed by utilizing existing transportation plans and policies, and current highway, transit and transportation programming processes.

The Waiale Road Extension is listed as a future transportation project in the STIP. In the STIP, the terminus location is identified as the intersection of MTP and Honoapiilani Highway. As discussed in Chapter 2.E., Honoapiilani Highway Terminus Alternatives, the preferred Honoapiilani Highway Highway terminus was identified as the Old Quarry terminus as the traffic flow would follow the adopted Small Town Boundary as set forth in the Maui Island Plan. This preferred terminus location was chosen in consultation with SDOT Maui District and County of Maui Department of Planning.

E. GENERAL PLAN OF THE COUNTY OF MAUI

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

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

Chapter 2.80B of the Maui County Code, relating to the General Plan and Community Plans, implements the foregoing Charter provision through enabling legislation for a Countywide Policy Plan and a Maui Island Plan. The Countywide Policy Plan was adopted as Ordinance No. 3732 on March 24, 2010. The Maui Island Plan was adopted as Ordinance No. 4004 by the Maui County Council on December 28, 2012.

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

> *The countywide policy plan shall provide broad policies and objectives which portray the desired direction of the County's future. The countywide policy plan shall include:*
>
> 1. *A vision for the County;*
> 2. *A statement of core themes or principles for the County; and*
> 3. *A list of countywide objectives and policies for population, land use, the environment, the economy, and housing.*

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

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

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

1. Natural environment
2. Local cultures and traditions

3. Education

4. Social and healthcare services

5. Housing opportunities for residents

6. Local economy

7. Parks and public facilities

8. Transportation options

9. Physical infrastructure

10. Sustainable land use and growth management

11. Good governance

With respect to the Waiale Road Extension and East Waiko Road Improvements, the following goals, objectives, policies and actions to implement are in accord with the Countywide Policy Plan:

DIVERSIFY TRANSPORTATION OPTIONS

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

Objective:

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

Policies:

a. Execute planning strategies to reduce traffic congestion.

d. Increase route and mode options in the ground-transportation network.

In summary, the Waiale Road Extension and East Waiko Road Improvements is consistent with the goal, objective and policies of the Countywide Policy Plan.

F. MAUI ISLAND PLAN

The Maui Island Plan (MIP), is applicable to the island of Maui only, providing more specific policy-based strategies for population, land use, transportation, public and community facilities, water and sewage systems, visitor destinations, urban design, and other matters related to future growth.

As provided by Chapter 2.80B, the MIP shall include the following components:

1. *An island-wide land use strategy, including a managed and directed growth plan*

2. *A water element assessing supply, demand and quality parameters*

3. *A nearshore ecosystem element assessing nearshore waters and requirements for preservation and restoration*

4. *An implementation program which addresses the County's 20-year capital improvement requirements, financial program for implementation, and action implementation schedule*

5. *Milestone indicators designed to measure implementation progress of the MIP*

It is noted the Ordinance No. 4004 does not address the component relating to the implementation program. Chapter 2.80B of the Maui County Code, relating to the General Plan, was amended via Ordinance No. 3979, October 5, 2012, to provide that the implementation program component be adopted no later than one (1) year following the effective date of Ordinance No. 4004. In December 2013 and March 2014, the Council approved time extensions for approval and adoption of the implementation chapter of the MIP. As such, the implementation program component will require adoption prior to May 29, 2014.

The MIP addresses a number of planning categories with detailed policy analysis and recommendations which are framed in terms of goals, objectives, policies and implementing actions. These planning categories address the following areas:

1. *Population*

2. *Heritage Resources*

3. *Natural Hazards*

4. *Economic Development*

5. *Housing*

6. *Infrastructure and Public Facilities*

7. *Land Use*

Additionally, an essential element of the MIP is its directed growth plan which provides a management framework for future growth in a manner that is fiscally, environmentally, and culturally prudent. Among the directed growth management tools developed through the MIP process are maps delineating urban growth boundaries (UGB), small town boundaries (STB) and rural growth boundaries (RGB). The respective boundaries identify areas appropriate for future growth and their corresponding intent with respect to development character.

The proposed Waiale Road Extension forms the hard edges of the STB. In this regard, it is consistent with the directed growth strategy defined via growth maps adopted in the MIP.

In addition, the proposed Waiale Road Extension has been reviewed with respect to pertinent goals, objectives, policies and implementing actions of the MIP. A summary of these policy statements are provided below:

INFRASTRUCTURE AND PUBLIC FACILITIES - TRANSPORTATION

Goal: **6.4** An interconnected, efficient, and well-maintained, multimodal transportation system.

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

Policies: **6.4.2.a** Ensure transit-, roadway-, and pedestrian-facilities design and level-of-service standards respect the unique character of our communities.

6.4.2.c Require new development, where appropriate, to integrate sidewalks, pathways, bikeways, and transit infrastructure into new commercial and residential projects while enhancing community character.

In summary, the proposed Waiale Road Extension and East Waiko Road project is consistent with the above-noted themes and principles of the Countywide Policy Plan and the Maui Island Plan.

G. WAILUKU-KAHULUI COMMUNITY PLAN

The project area is located within the Wailuku-Kahului Community Plan region, which is one (1) of nine (9) community plan regions established in the County of Maui. Planning for each region is guided by the respective community plans which are designed to implement the Maui County General Plan. Each community plan contains recommendations and standards which guide the sequencing, patterns and characteristics of future development in the region.

The Wailuku-Kahului Community Plan was adopted by the County of Maui through Ordinance No. 3061 which took effect on June 5, 2002.

Land use guidelines are set forth by the Wailuku-Kahului Community Plan Land Use Map. See **Figure 17**. The project area is designated "Agriculture" by the Wailuku-Kahului Community Plan Map.

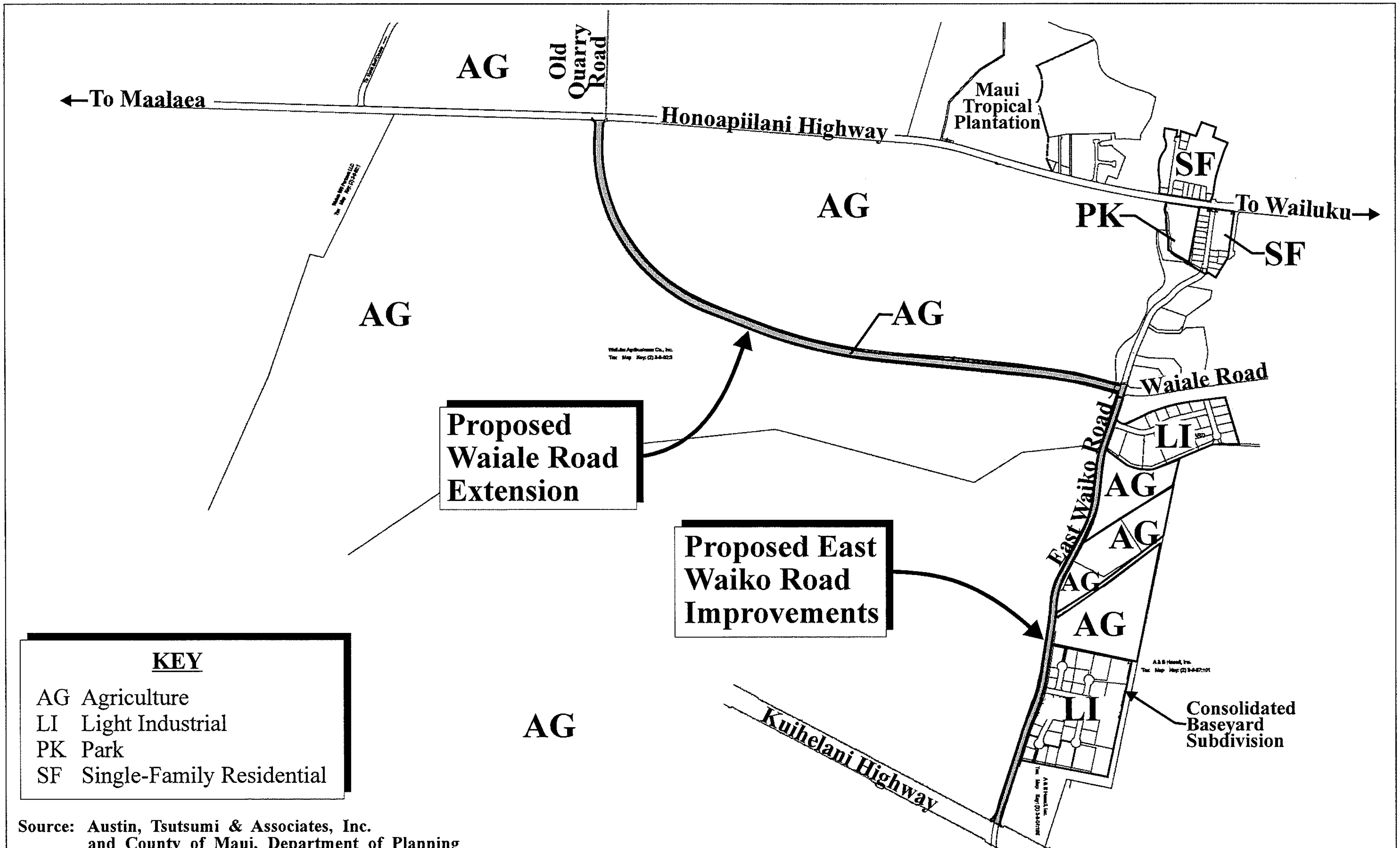
The proposed action is consistent with the following goals, objectives, and policies of the Wailuku-Kahului Community Plan.

Infrastructure:

Timely and environmentally sound planning, development and maintenance of infrastructure systems which serve to protect and preserve the safety and health of the region's residents, commuters and visitors through the provision of clean water, effective waste disposal and drainage systems, and efficient transportation systems which meet the needs of the community.

Transportation:

1. Support the extension of Waiale Drive to a new intersection with Honoapiilani Highway south of Waikapu Village.



Source: Austin, Tsutsumi & Associates, Inc.
and County of Maui, Department of Planning

Figure 17

Proposed Waiale Road Extension and East Waiko Road Improvements
Community Plan Designation Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

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H. COUNTY ZONING

The proposed project area is zoned "Agricultural", according to Maui County zoning. Roadways are permitted uses under the current zoning designation for the project area. See **Figure 18**.

I. COASTAL ZONE MANAGEMENT OBJECTIVES AND POLICIES

Pursuant to Chapter 205A, Hawaii Revised Statutes, projects should be evaluated with respect to Coastal Zone Management (CZM) objectives, policies and guidelines. The project area is approximately four (4) miles away from the coastline and will not involve work within the County of Maui's Special Management Area (SMA). However, the applicability of coastal zone management considerations have been reviewed and assessed.

1. Recreational Resources

Objective:

Provide coastal recreational opportunities accessible to the public.

Policies:

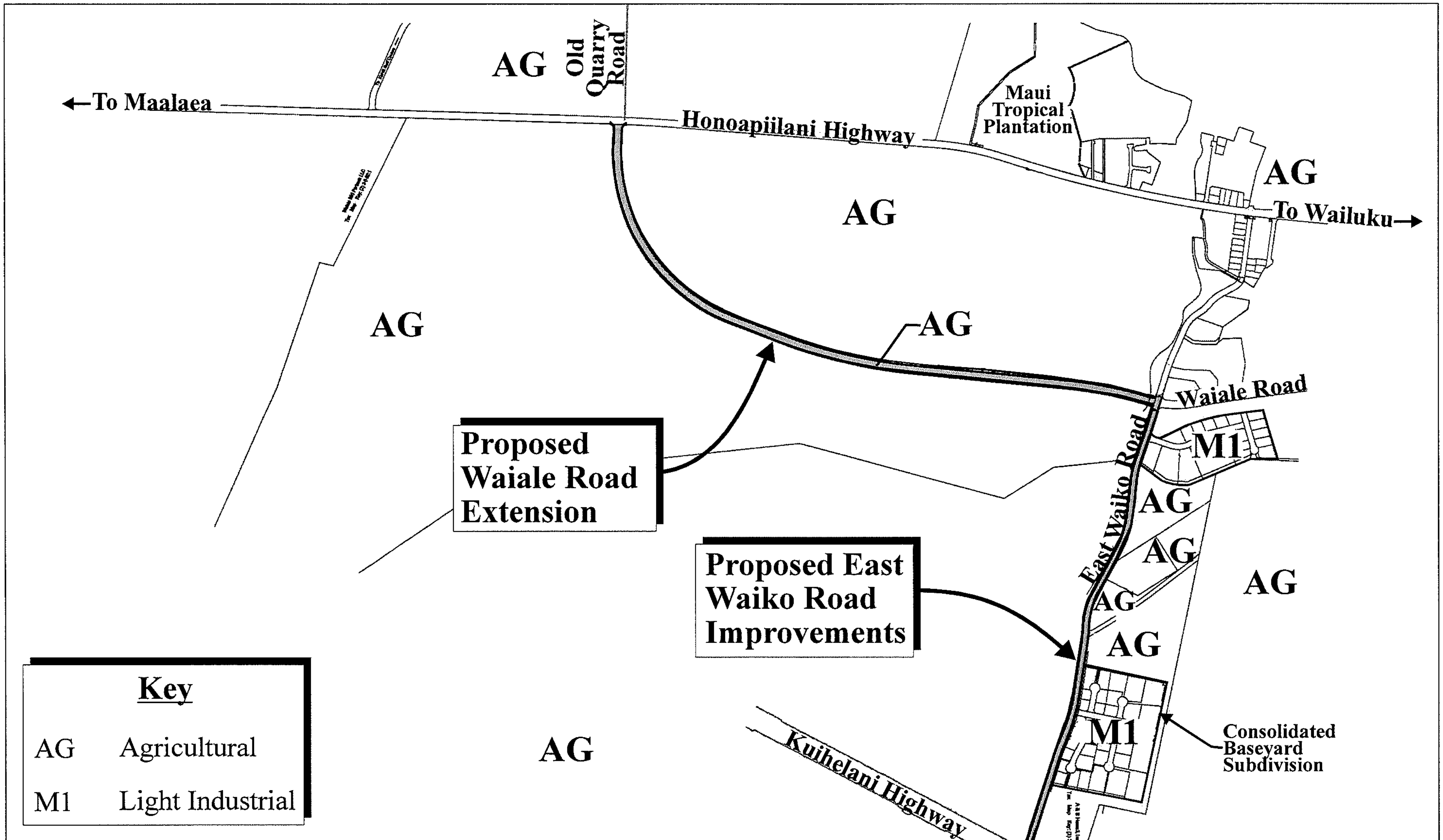
(A) Improve coordination and funding of coastal recreational planning and management; and

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

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

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

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



Source: Austin, Tsutsumi & Associates, Inc.
and County of Maui, Department of Planning

Figure 18

Proposed Waiale Road Extension
and East Waiko Road Improvements
County Zoning Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\Final EA\countyzoning

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

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

(vi) Adopting water quality standards and regulating point and non-point sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;

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

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

Response: The project area is located inland, approximately four (4) miles from the coastline. As such, there should be no impact on coastal recreational opportunities or adverse effect on existing public access to the shoreline. The Waiale Road Extension will include a bike/pedestrian path that will provide recreational opportunities thus benefitting the community.

2. Historic Resources

Objective:

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

Policies:

(A) Identify and analyze significant archeological resources;

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

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

Response: An Archaeological Inventory Survey (AIS) and Cultural Impact Assessment (CIA) were completed for the project area. As explained previously, the project area has been significantly altered by sugar cane cultivation. The AIS documented one (1) site SIHP No. 50-50-04-6668, which consisted of an historic era boulder terrace located on the south bank of Waikapu Stream part of which is under the proposed bridge crossing location of the proposed Waiale Road Extension. The site was believed to represent either a water diversion feature or possibly a footing for a former bridge. No additional archaeological mitigation is required for this site, allowing for the removal, if necessary.

SHPD recommended monitoring be conducted for any ground disturbing activities along East Waiko Road because of the potential for sand deposits.

Additionally, if any inadvertent discoveries of cultural materials are found during construction, all work in the immediate area of the find will cease and SHPD will be notified.

The CIA concluded that the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access or other customary activities will not be affected by the proposed project.

3. Scenic and Open Space Resources

Objective:

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

Policies:

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

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

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

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

Response: The project area does not lie within a designated coastal scenic view corridor, nor along the shoreline. As mentioned previously, the project area is located inland, approximately four (4) miles from the shoreline. The proposed Waiale Road will follow the existing topography to minimize the alteration of natural land form. For these reasons, it is anticipated that there should be no adverse impacts on scenic and open space resources.

4. Coastal Ecosystems

Objective:

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

Policies:

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

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

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

(D) Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards.

Response: The proposed action is not expected to adversely impact coastal ecosystems. The use of the drainage system and design of the retention/detention basins will be in accordance with applicable regulatory standards to ensure there is no adverse effect on downstream properties. Additionally, the Waikapu bridge crossing will be designed to span the Waikapu Stream. Appropriate erosion and flood control measures will be implemented to minimize the effects of stormwater runoff during project construction and to ensure that coastal ecosystems are not adversely impacted.

5. Economic Uses

Objective:

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

Policies:

(A) Concentrate coastal dependent development in appropriate areas;

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

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

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

(ii) Adverse environmental effects are minimized; and

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

Response: The proposed project is not a coastal dependent development because the proposed roadway is located four (4) miles inland. The proposed project will stimulate the economy through construction-related employment. Additionally, the proposed Waiale Road Extension will provide a new transportation roadway that facilitates economic use with the efficient movement of people and goods. East Waiko Road Improvement will improve the roadway conditions along East Waiko Road in order to increase safe use of this route. The proposed project is consistent with the objective and policy for economic use.

6. **Coastal Hazards**

Objective:

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

Policies:

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

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

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

(D) Prevent coastal flooding from inland projects; and

(E) Develop a coastal point and nonpoint source pollution control program.

Response: The majority of the project area falls within Zone X, an area of 0.2 percent annual chance of flood. A portion of the Waiale Road Extension and East Waiko Road Improvement areas are located within Flood Insurance Rate Map Zone AE, areas within the 100-year flood zone. As such, a Special Flood Hazard Area Development Permit will be obtained for portions of the proposed project within Zone AE, as applicable. Drainage improvements will be designed in accordance with the Drainage Standards of the County of Maui to ensure that the project will not adversely affect downstream properties from the effects to flooding and erosion. Moreover, the project area is not located within a tsunami inundation area.

7. **Managing Development**

Objective:

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

Policies:

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

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

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

Response: The Chapter 343, Hawaii Revised Statutes, EA process involves review by governmental agencies and provides the public opportunities for involvement and comments on the project. Applicable State and County requirements will be adhered to in the design and construction of the project.

8. Public Participation

Objective:

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

Policies:

(A) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management program;

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

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

Response: Implementation of this project will meet County objectives for public awareness, education and participation. An opportunity for agency and public review will be provided as part of the notification and comment process required for the EA. In addition, a public information meeting on the proposed project was held on March 16, 2010. In general, participants were in support of the project, but raised concerns about traffic, design of roadway, and drainage on East Waiko Road. Refer to **Appendix "J"**. These issues are addressed in the EA.

9. **<u>Beach Protection</u>**

<u>Objective</u>:

Protect beaches for public use and recreation.

<u>Policies</u>:

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

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

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

<u>Response</u>: The proposed project is located inland, approximately four (4) miles from the shoreline and as a result, impact on beach resources is not anticipated.

10. **<u>Marine Resources</u>**

<u>Objective</u>:

Implement the State's ocean resources management plan.

<u>Policies</u>:

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

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

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

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

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

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

Response: As previously stated, the project is located inland, away from the ocean and is therefore, not anticipated to have any impact on marine or coastal resources. Appropriate Best Management Practices (BMPs) will be utilized to ensure that construction runoff is appropriately captured, minimizing adverse impact to downstream properties.

In addition to the foregoing objectives and policies, HRS Section 205A-30.5 Prohibitions, provides specifications for the limitation of lighting in coastal shoreline areas in relation to the granting of SMA permits:

No special management area use permit or special management area minor permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

(b) Subsection (a) shall not apply to special management area use permits for structures with:

(3) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

Response: The proposed project is not located on or near the shoreline. For the most part, the proposed project improvements do not include relocating or installing new lighting fixtures. However, traffic signals and street lighting are anticipated to be located at the new intersections of the Waiale Road Extension/Honoapiilani Highway and Waiale Road/East Waiko Road, when warranted. The lighting will be directed downward and will not directly illuminate the shoreline or ocean waters. Construction during the night time is not anticipated for the proposed project. However, if night work becomes necessary, construction lighting will be directed downward.

J. MAUI LONG RANGE LAND TRANSPORTATION PLAN

The proposed Waiale Road Extension with a terminus at the Maui Tropical Plantation was identified in the Maui Long Range Land Transportation Plan in 1997 by the SDOT in consultation with the County of Maui. The plan serves as a "*guide for development of the major surface transportation facilities ... to be implemented within the County of Maui ... of an integrated inter-modal transportation system that facilities the efficient movement of people and goods.*" The proposed project was recognized as a long range strategy (to the Year 2020) to improve traffic flow within and around Waikapu Village and provide an alternate route between the urban areas of Kahului and Wailuku. During the corridor alignment review with the DPW and Department of Planning, it was decided the preferred alternative would be to locate the terminus further west of the Old Quarry Road intersection. DPW will coordinate with State of Hawaii, Department of Transportation to incorporate the preferred Waiale Road extension alignment into the Maui Long Range Land Transportation Plan and State Transportation Improvement Program.

K. BIKE PLAN HAWAII

Bike Plan Hawaii 2003 is a State of Hawaii, Department of Transportation's master plan to create a guide for enhancing the bicycling environment through a variety of means including grassroots initiatives and government actions. The plan recognizes that bicycle facilities have become integral to our State and County transportation infrastructure. The plan identifies Waiale Road to be a "signed shared roadway"meaning the shoulders will also be the bicycle lanes. The existing Waiale Road between Kuikahi Drive and East Waiko Road has a striped bike lane on both sides of the roadway. The proposed Waiale Road Extension will include a separated 10-ft. bike/pedestrian path. Refer to **Figure 4**.

V. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

V. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

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

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

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

In the long term, the proposed project will result in additional acreage of agricultural land being utilized to meet roadway infrastructure needs. Other resources which will be committed in the implementation of the proposed action include material energy, labor and fiscal resources.

Beneficial impacts relate to providing an improved transportation network that meets regional transportation planning needs. The irreversible and irretrievable commitments noted above have been weighed against the long term benefits of the action. The proposed project creates long-term socio-economic and land use benefits by improving traffic flow within and around Waikapu Village and improves roadway conditions.

VII. SIGNIFICANCE CRITERIA ASSESSMENT

VII. SIGNIFICANCE CRITERIA ASSESSMENT

The proposed Waiale Road Extension involves an approximate 8,600 lineal feet (ft.) extension of a County collector road through existing agricultural lands. The roadway will be designed with an 80 ft. wide right-of-way with two (2) 12-ft. travel lanes, 6ft. shoulders, 6-ft. grass swales and a 10-ft. bike/pedestrian path on the west side of the roadway, and landscaping improvements. The East Waiko Road Improvements involve upgrading the existing pavement section and re-striping the roadway to provide two (2) 12-ft. travel lanes, 6-ft. shoulders and AC swales. All construction work will be carried out within the existing East Waiko Road right-of-way. The proposed project will enhance accessibility and traffic circulation within Wailuku and mitigate potential traffic impacts to Waikapu Village from planned long-term development of the surrounding area.

A. CHAPTER 343, HAWAII REVISED STATUTES CRITERIA

Since the proposed action will involve State and County lands and funds, compliance with Chapter 343, Hawaii Revised Statutes (HRS), and Chapter 200 (Title 11), Hawaii Administrative Rules, Environmental Assessment is necessary for the project.

Every phase of the proposed action, expected consequences, both primary and secondary, and the cumulative as well as the short term and long term effects of the action have been evaluated in accordance with the Significance Criteria of Section 11-200-12 of the Administrative Rules. Discussion of project conformance to the criteria is noted as follows:

1. Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.

Flora occupying the Waiale Road Extension project corridor generally consists of sugar cane, buffelgrass and scrub vegetation. The East Waiko Road Improvements will be carried out on areas with scrub vegetation. No wetlands will be impacted by the proposed action. No threatened or endangered species have been identified within the project corridor.

The AIS located one (1) historic site within the bank of the Waikapu Stream in the proposed location of the bridge crossing. Site No. 50-50-04-6668 consisted of historic era boulder terrace believed to represent a water diversion feature or a footing for a former footbridge. In consultation with SHPD, the site has yielded all potential information important to this historic period and no additional archaeological mitigation is required for this site, allowing for removal, if necessary.

The CIA concluded that the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access or other customary activities will not be affected by the proposed project.

Based on the explanation provided above, the proposed project is not anticipated to involve an irrevocable commitment to loss or destruction of any natural or cultural resource.

2. **Curtails the range of beneficial uses of the environment.**

The Waiale Road Extension traverses lands which are designated for agricultural uses. The East Waiko Road Improvements will be done within the existing right-of-way. The proposed project will not curtail the range of beneficial uses of the environment. There are no anticipated impacts to climate, topography, and soils from the proposed project. There are also no known rare, threatened, or endangered species of flora, fauna, or avifauna located within the project areas. Furthermore, the proposed project is located away from the coastline. As such, there will be no anticipated adverse impacts to coastal resources.

3. **Conflicts with the state's long term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.**

The State Environmental Policy and Guidelines are set forth in Chapter 344, HRS. The proposed action conforms with the following policies and guidelines:

Environmental Policy:

Enhance the quality of life by:

(A) Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian.

Guidelines:

Transportation:

(A) Encourage transportation systems in harmony with the lifestyle of the people and environment of the State.

4. **Substantially affects the economic welfare, social welfare, and cultural practices of the community or State.**

The proposed project will directly benefit the local economy by providing construction and construction-related employment. The proposed project will also have a beneficial effect upon the socio-economic fabric of the community by providing for the safe, convenient and efficient movement of traffic in and around the Waikapu Village area. By improving roadway conditions, the proposed project will promote the public welfare by providing vehicular and bike/pedestrian facilities which meet current design and safety standards.

The CIA did not identify any on-going cultural practices occurring within the project area; and as such, cultural practices will not be impacted.

5. **Substantially affects public health.**

An Acoustic Study for the proposed project was completed. Refer to **Appendix "H"** and Noise section, Chapter III.A.11. The Acoustic Study concluded that the traffic noise levels generated by the proposed project are not expected to exceed the noise abatement levels within the project construction area. Therefore, traffic noise mitigation measures will not be required for the proposed project. As such, no adverse impacts to the public's health and welfare are anticipated.

6. **Involves substantial secondary impacts, such as population changes or effects on public facilities.**

The alignment of the Waiale Road Extension has been developed in the context of the long-term planning parameters of the County of Maui. No adverse population changes are anticipated as a result of the proposed project since roadway projects are not population generators. The project involve the extension of Waiale Road and improvements to East Waiko Road to mitigate future traffic volume increases in and around Waikapu Village. There are no anticipated adverse effects on public services, such as police, fire, medical, educational, or solid waste collection.

As necessary, the County of Maui, Department of Public Works (DPW) in conjunction with the SDOT will coordinate the relocation of improvements (e.g., waterlines, utility poles) with the appropriate agencies and utility companies to ensure that the proposed project's activities do not impact their facilities.

7. **Involves a substantial degradation of environmental quality.**

Construction activities will create temporary short-term nuisances related to noise and dust. Appropriate dust control and noise mitigation measures will be implemented by the contractor to ensure that fugitive dust and noise generated in connection with construction is minimized.

As previously mentioned, adverse impacts are not anticipated from the proposed project for the natural resources, cultural resources, and the natural environment. The proposed project is not anticipated to have an adverse impact on the environmental quality of the project area.

8. **Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.**

The proposed action is part of the DPW's and SDOT's ongoing effort to upgrade roadways to accommodate current and future vehicular traffic requirements in the Waikapu Village area. As previously indicated, the alignment of the Waiale Road Extension has been developed in the context of the long-term planning parameters of the County of Maui. No adverse population changes are anticipated as a result of the proposed project as roadway projects are not population generators. The project involves the extension of Waiale Road and improvements to East Waiko Road to mitigate future traffic volume increases in and around Waikapu Village. The analysis of Cumulative and Secondary Impacts in Chapter III. E. discussed the following concerns:

- Impacts to the existing Waikapu Gardens Residential Community
- Impacts upon infrastructure systems serving the region
- Impacts on agricultural productivity

Based on the analysis, there are no anticipated adverse cumulative effects upon the environment nor will this project involve a commitment for larger actions.

The Waiale Road Extension is located along the edge of the Maui Island Plan's Small Town Boundary for this area and provides a land use feature to delineate the small town character.

9. Substantially affects a rare, threatened, or endangered species, or its habitat.

Rare, threatened or endangered species of flora, fauna, avifauna or their habitats are not expected to be impacted by the proposed project. A biological assessment report has been prepared for the project. No rare, threatened, or endangered species were identified during the flora and fauna study. Refer to **Appendix "E"**.

A Biological and Water Quality Surveys of Waikapu Stream was conducted. Refer to **Appendix "D"**. No rare, threatened, or endangered aquatic species were identified during the survey.

Although no rare, threatened, or endangered species or its habitat were identified, the bridge crossing of the Waikapu Stream will be designed to accommodate diadromous life cycle of native fishes and invertebrates. It will be designed to allow for surfaces to be continuously wet for passage of native fauna. In addition, pre-construction surveys will be conducted during November through April for nesting nene and Blackburn sphinx moth larvae and habitat. Also, woody plants greater than 15 feet will not be removed or trimmed from May 15 through August 15. Furthermore, BMPs during construction will be designed and implemented to prevent water quality degradation and allow aquatic biota recruitment.

10. Detrimentally affects air or water quality or ambient noise levels.

Construction activities for the project will result in short-term air quality and noise impacts. Dust control measures, such as regular watering and sprinkling, and setting up dust screens will be implemented to minimize construction air quality impacts. Short-term noise impacts will occur primarily from construction equipment. Equipment mufflers or other noise attenuating equipment, as well as proper equipment and vehicle maintenance, are anticipated to mitigate noise from construction activities.

The Acoustic Study concluded that the traffic noise levels generated by the proposed project are not expected to exceed the noise abatement levels within the project construction area. Refer to **Appendix "H"**. Therefore, traffic noise mitigation measures are not required for the proposed project.

A Water Quality Survey for Waikapu Stream was conducted for the proposed project. Refer to **Appendix "D"**. The survey concluded that the water quality of Waikapu Stream was very good.

Based on the explanation provided above, the proposed project is not anticipated to detrimentally affect air or water quality or ambient noise levels.

11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

The proposed bridge crossing location for Waikapu Stream could be considered to be an environmentally sensitive area since it is listed a perennial stream and a portion of the East Waiko Road Improvements project is located in a floodway area without a bridge. There is no practical alternative to avoid crossing Waikapu Stream. Impacts to the stream can be mitigated by selecting a design for the bridge structure that does not interfere with the natural drainage characteristics of the stream. To that end, the bridge will be designed to accommodate a 100-year storm to minimize the probability of overtopping of the bridge. In order to address the portion of the existing East Waiko Road right-of-way within the floodway, the existing berm may need to be raised to contain the flow within the Waikapu Stream. This determination will be made during the engineering phase of the project. As such, there are no anticipated adverse effects from flooding as a result of the proposed project.

Furthermore, the project area is located away from the shoreline and would not affect environmentally sensitive coastal areas. The project area is not subject to tsunami inundation. A portion of the underlying soils of East Waiko Road Improvement is erosion prone. Special care will be taken when widening the existing 20 feet pavement width to 36 feet width. BMPs will be implemented during construction to minimize soil loss. There are no geologically hazardous lands, estuaries, or coastal waters in close proximity to the project area.

12. **<u>Substantially affects scenic vistas and viewplanes identified in county or state plans or studies.</u>**

The project area is not located in an area identified as a designated scenic corridor in any County and State plans. As such, the proposed project is not anticipated to adversely affect scenic view corridors.

13. **<u>Requires substantial energy consumption.</u>**

The proposed project will involve the commitment of fuel for construction equipment, vehicles, and machinery during construction activities. However, this use will be short term and is not anticipated to result in a substantial consumption of energy resources. In the long term, the proposed project is limited in its consumption of energy to street lights and signals at the intersections. This consumption demand is not substantial.

VIII. LIST OF PERMITS AND APPROVALS

VIII. LIST OF PERMITS AND APPROVALS

The following permits and approvals will be required prior to the implementation of the project:

1. **Federal Government**

   U.S. Department of Army Permit, Section 404

   National Environmental Policy Act (NEPA)

   Section 106, National Historic Preservation Act

2. **State of Hawaii**

   Coastal Zone Management Consistency Determination, as applicable

   Chapter 343, Hawaii Revised Statutes, Environmental Review

   Section 401, Water Quality Certification, as applicable

   National Pollutant Discharge Elimination System (NPDES) Permit

   Commission on Water Resource Management, Stream Channel Alteration Permit

   Community Noise Permit, as applicable

3. **County of Maui**

   Subdivision Approval

   Grading Permits

   Special Flood Hazard Area Development Permit, as applicable

   Work to Perform on County Road

   Construction Permits

IX. AGENCIES CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

IX. AGENCIES CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED AND RESPONSES TO SUBSTANTIVE COMMENTS

The following agencies were consulted during preparation of the Draft Environmental Assessment (EA). Agency comments and responses to substantive comments will be included in the Draft EA.

1. Ranae Ganske-Cerizo, Soil Conservationist
   Natural Resources Conservation Service
   U.S. Department of Agriculture
   77 Hookele Street, Suite 202
   Kahului, Hawaii 96732

2. Mike Johanns, Secretary of Agriculture
   U.S. Department of Agriculture
   Office of the Secretary
   Administration Building, Rm. 240W
   14th Street & Independence Avenue, S.W.
   Washington, D.C. 20250

3. George Young
   Chief, Regulatory Branch
   U.S. Department of the Army
   U.S. Army Engineer District, Honolulu
   Regulatory Branch
   Building 230
   Fort Shafter, Hawaii 96858-5440

4. Wayne Nastri, Regional Administrator
   U. S. Environmental Protection Agency
   Region 9
   75 Hawthorne Street
   San Francisco, California 94105

5. Patrick Leonard
   Field Supervisor
   U. S. Fish and Wildlife Service
   300 Ala Moana Blvd., Rm. 3-122
   Box 50088
   Honolulu, Hawaii 96813

6. Patricia Port
   U. S. Department of Interior
   Regional Environmental Officer
   Environmental Policy and Compliance
   Oakland Region
   Jackson Center One
   1111 Jackson Street, Suite 520
   Oakland, California 94607

7. Cynthia Burbank, Associate Administrator
   U. S. Department of Transportation
   Planning, Environment and Realty
   Federal Highway Administration
   400 7th Street, S.W.
   Washington, D.C. 20590-9898

8. Russ K. Saito, State Comptroller
   Department of Accounting and General Services
   1151 Punchbowl Street, #426
   Honolulu, Hawaii 96813

9. Sandra Lee Kunimoto, Chair
   Department of Agriculture
   1428 South King Street
   Honolulu, Hawaii 96814-2512

10. Theodore E. Liu, Director
    State of Hawaii
    Department of Business, Economic Development & Tourism
    P.O. Box 2359
    Honolulu, Hawaii 96804

11. Kaulana Park, Chairman
Department of Hawaiian Home Lands
P. O. Box 1879
Honolulu, Hawaii 96805

12. Chiyome Fukino, M.D., Director
State of Hawaii
Department of Health
919 Ala Moana Blvd., Room 300
Honolulu, Hawaii 96814

13. Alec Wong, P.E., Chief
Clean Water Branch
State of Hawaii
Department of Health
919 Ala Moana Blvd., Room 300
Honolulu, Hawaii 96814

14. Patti Kitkowski
Acting District Environmental Health Program Chief
State of Hawaii
Department of Health
54 High Street
Wailuku, Hawaii 96793

15. Laura Thielen, Chairperson
State of Hawaii
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

16. Dr. Puaalaokalani Aiu, Administrator
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
601 Kamokila Blvd., Room 555
Kapolei, Hawaii 96707

17. **Maui Archaeologist**
Department of Land and Natural Resources
State Historic Preservation Division
130 Mahalani Street
Wailuku, Hawaii 96793

18. Brennon Morioka, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813
cc: Fred Cajigal

19. Katherine Kealoha, Director
Office Of Environmental Quality Control
235 S. Beretania Street, Suite 702
Honolulu, Hawaii 96813

20. Clyde Nāmu`o, Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

21. Abbey Seth Mayer, Director
State of Hawaii
Office of Planning
P.O. Box 2359
Honolulu, Hawaii 96804

22. Dan Davidson, Executive Officer
State of Hawaii
State Land Use Commission
P.O. Box 2359
Honolulu, Hawaii 96804

23. Joseph Souki, Representative
House of Representatives
Hawaii State Capitol, Room 433
415 S. Beretania Street
Honolulu, Hawaii 96813

24. Charmaine Tavares, Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

25. Gen Iinuma, Administrator
Maui Civil Defense Agency
200 South High Street
Wailuku, Hawaii 96793

26. Jeffrey A. Murray, Fire Chief
County of Maui
Department of Fire and Public Safety
200 Dairy Road
Kahului, Hawaii 96732

27. Lori Tsuhako, Director
County of Maui
Department of Housing and Human Concerns
One Main Plaza
2200 Main Street, Suite 546
Wailuku, Hawaii 96793

28. Tamara Horcajo, Director
County of Maui
Department of Parks and Recreation
700 Halia Nakoa Street, Unit 2
Wailuku, Hawaii 96793

29. Kathleen Ross Aoki, Director
County of Maui
Department of Planning
250 South High Street
Wailuku, Hawaii 96793

30. Gary Yabuta, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

31. Cheryl Okuma, Director
County of Maui
Department of Environmental Management
One Main Plaza
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

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

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

34. Councilmember Mike Victorino
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

35. **Hawaiian Telcom**
60 South Church Street
Wailuku, Hawaii 96793

36. Greg Kauhi, Manager, Customer Operations
Maui Electric Company, Ltd.
P.O. Box 398
Kahului, Hawaii 96733

37. Oceanic Time Warner Cable
350 Hoohana Street
Kahului, Hawaii 96732

38. Pamela Tumpap, Executive Director
Maui Chamber of Commerce
313 Ano Street
Kahului, Hawaii 96732

39. Jacob W. Verkerke, Chair
Glenn M. Adolpho, Development Monitoring Committee Chair
Waikapu Community Association
P.O. Box 2106
Wailuku, Hawaii 96793

40. **Wailuku Community Association**
40 Hoauna Street
Wailuku, Hawaii 96793

41. Joseph G. Blackburn II
Waiolani Community Associations
P. O. Box 1067
Wailuku, Hawaii 96793

42. **Waikapu Gardens Homeowners Association**
67 East Waiko Road
Wailuku, Hawaii 96793

43. **Consolidated Baseyard**
c/o Frampton & Ward, LLC
2073 Wells Street, Suite 101
Wailuku, Hawaii 96793

44. **Rojac Trucking**
150 Pakana Street
Wailuku, Hawaii 96793

45. Jocelyn Perreira, Executive Director
Wailuku Main Street Association
1942 Main Street, Unit 101
Wailuku, Hawaii 96793

46. Scott Nunokawa
P. O. Box 946
Wailuku, Hawaii 96793

47. **Maui Tropical Plantation**
1670 Honoapiilani Highway
Wailuku, Hawaii 96793

48. **Spencer Homes**
67 East Waiko Road
Wailuku, Hawaii 96793

49. Mike Atherton
1132 Norman Drive
Mantela, California 95336

50. Grant Chun
A&B Properties, Inc.
11 Puunene Avenue
Kahului, Hawaii 96732

51. Albert Kanno
ABC Development Co., LLC
815 Waikamilo Road
Honolulu, Hawaii 96817

52. Roderick Fong
495 Hukilike Street, Bay 4
Kahului, Hawaii 96732

JUN 24 2010

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

June 21, 2010

Regulatory Branch

Leilani Pulmano, Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Pulmano:

This responds to your request for written comments for a draft Environmental Assessment (dEA) which will address activities and impacts of the proposed East Waiale Road Extension and East Waiko Road Improvements project located on unidentified TMKs at Waikapu, Maui. The project proponent is the Department of Public Works, County of Maui.

The dEA should indicate whether waters of the United States, as typically represented by perennial or intermittent streams and wetlands, are in, or adjacent to, or absent from, the proposed project corridor. The dEA should state in appropriate sections whether there is the potential for waters of the U.S. to be impacted by construction of project structures and associated ground disturbing activities. Upon our receipt of the dEA, we will provide a determination whether a Department of Army (DA) permit for Section 404 activities of the Clean Water Act may, or may not be, required for the proposed East Waiale Road Extension and East Waiko Road Improvements project.

Section 404 requires that a DA permit be obtained for the placement or discharge of dredged and/or fill material into waters of the U.S., including wetlands, prior to conducting the work (33 U.S.C. 1344). For regulatory purposes, the U.S. Army Corps of Engineers (Corps) defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The area of Corps jurisdiction under Section 404 extends to the Ordinary High Water Mark (OHWM) for navigable waters other than the Pacific Ocean, and to the upland boundary of any adjacent wetlands.

Thank you for your consideration of potential impacts to the aquatic environment of the Waikapu watershed. Please contact Mr. Farley Watanabe of my staff at 438-7701, facsimile 438-4060, or by email at Farley.K.Watanabe@usace.army.mil if you have any questions or need additional information. Please refer to File Number **POH-2010-00147** in any future correspondence with us.

Sincerely,

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

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

George P. Young, P. E., Chief
Regulatory Branch
Department of the Army
U. S. Army Corps of Engineers
Honolulu District
Fort Shafter, Hawaii 96858-5440

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii (File No. POH-2010-00147)

Dear Mr. Young:

Thank you for your letter, dated June 21, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

The Draft Environmental Assessment (EA) will identify any water body that will be affected by the proposed project either during construction activities and/or on-going operations.

We acknowledge that through your review of the Draft EA, your department will make a determination whether a Department of Army (DA) permit for Section 404 activities of the Clean Water Act may, or may not be, required.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at (808) 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
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JUN 03 2010

LINDA LINGLE
GOVERNOR

RUSS K. SAITO
COMPTROLLER

SANDRA YAHIRO
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)1150.0

JUN - 2 2010

Ms. Leilani Pulmano, Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i, 96793

Dear Ms. Pulmano:

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements
Waikapu, Maui, Hawai'i.

Thank you for the opportunity to provide comments for the subject project. The proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please call me at 586-4000, or Mr. Clarence Kubo of the Public Works Division at 586-0488.

Sincerely,

RUSS K. SAITO
State Comptroller

4

JUN 16 2010

LINDA LINGLE
GOVERNOR OF HAWAII

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

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EMD / CWB

06036PJF.10

June 15, 2010

Ms. Leilani Pulmano
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

SUBJECT: **Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu**
Waikapu, Island of Maui, Hawaii

The Department of Health, Clean Water Branch (CWB), has reviewed the subject document and offers these comments on your project.

Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). For the following types of discharges into Class A or Class 2 State waters, you may apply for an NPDES general permit coverage by submitting a Notice of Intent (NOI) form:

   a. Storm water associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than one (1) acre of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. An NPDES permit is required before the start of the construction activities.

   b. Construction dewatering effluent.

   You must submit a separate NOI form for each type of discharge at least 30 calendar days prior to the start of the discharge activity, except when applying for coverage for discharges of storm water associated with construction activity. For this type of discharge, the NOI must be submitted 30 calendar days before to the start of construction activities. The NOI forms may be picked up at our office or downloaded from our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html.

3. For types of wastewater not listed in Item No. 2 above or wastewater discharging into Class 1 or Class AA waters, you may need an NPDES individual permit. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. The NPDES application forms may be picked up at our office or downloaded from our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage is required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

06036PJF.10

If you have any questions, please visit our website at:
http://www.hawaii.gov/health/environmental/water/cleanwater/index.html, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

Alec Wong

ALEC WONG, P.E., CHIEF
Clean Water Branch

JF:ml

c: DOH-EPO #I-3185 [via email only]

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Alec Wong, P. E., Chief
Department of Health
Clean Water Branch
P. O. Box 3378
Honolulu, Hawaii 96801-3378

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii
(EMD / CWB 06036PJF.10)

Dear Mr. Wong:

Thank you for your letter, dated June 15, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

1. We will review the standard comments found on the listed website and provide a discussion within the Draft Environmental Assessment (EA), as applicable.

2. We will review the criteria for Antidegradation Policy, Designated Uses, and Water Quality. The Draft EA will include a discussion on the applicable criteria.

3. We acknowledge that a National Pollutant Discharge Elimination System (NPDES) permit for discharges of stormwater runoff and construction dewatering effluent into State surface waters may be required. Coordination will be carried out with the Department of Health during the project design phase to assess the requirements for the NPDES permit.

4. We also acknowledge that a NPDES individual permit may be required for any discharge into Class 1 or Class AA waters. Again, coordination will be carried out during the project design phase to determine the NPDES permit requirements.

5. We further acknowledge that all discharges related to the project construction or operation activities, whether or not NPDES permit(s) is required, must comply with the State's Water Quality Standards.

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at (808) 244-2015.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
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JUN 15 2010

LINDA LINGLE
GOVERNOR OF HAWAII

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

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

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

June 14, 2010

Ms. Leilani Pulmano
Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Thank you for the opportunity to comment on this project. We have the following comments:

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

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

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

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

Sincerely,

Patti Kitkowski

Patti Kitkowski
Acting District Environmental Health Program Chief

10

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Patti Kitkowski, Acting Environmental
Health Program Chief
Department of Health
Maui District Health Office
54 High Street
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Ms. Kitkowski:

Thank you for your letter, dated June 14, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

We understand that if noise during the construction phase of the project exceeds the maximum allowable levels for Community Noise Control, a noise permit may be required and should be obtained prior to construction. Coordination with your department will be carried out prior to construction.

A National Pollutant Discharge Elimination System (NPDES) permit will be required for the project. The applicant will obtain a NPDES permit prior to construction.

We will review the standard comments found on the listed website and provide a discussion within the Draft Environmental Assessment to applicable comments.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
F:\DATA\COM\DPW WaialeExt\DOHMaui.ecres.doc

JUN 22 2010

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 20, 2010

Munekiyo & Hiraga, Inc.
305 High Street Suite 104
Wailuku, Hawaii 96793

Attention: Ms. Leilani Pulmano, Project Manager

Ladies and Gentlemen:

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements

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

Other than the comments from Division of Aquatic Resources, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Charlene E. Unoki

for Morris M. Atta
Acting Administrator

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

DAR 3101

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 19, 2010

RECEIVED
LAND DIVISION
2010 JUN -4 P 1:38
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

RECEIVED
MAY 19 2010
AQUATIC RESOURCES

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

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu
LOCATION: Island of Maui
APPLICANT: Munekiyo & Hiraga on behalf of the County of Maui, Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by June 11, 2010.

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

Attachments

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

Signed: [signature]
Date: 6-3-10

DIVISION OF AQUATIC RESOURCES - MAUI
DEPARTMENT OF LAND & NATURAL RESOURCES
130 Mahalani Street
Wailuku, Hawai'i 96793
June 3, 2010

To: Alton Miyasaka, Aquatic Biologist

Sh

From: Skippy Hau, Aquatic Biologist

Subject: Proposed Waiale Road Extension and East Waiko Road in Waikapu

The Water Commission is reviewing final recommendations for the Na Wai Eha Case to restore instream flow.

If water is restored to Waikapu Stream, we recommend that road improvements should not impact natural stream flow and the natural migration of stream animals.

15

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Russell Tsuji, Administrator
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mr. Tsuji:

Thank you for your department's letter, dated June 20, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments from the Division of Aquatic Resources noted in your letter.

We note that the State Commission on Water Resource Management has made their decision on the instream flow for Waikapu Stream. Having said that, the bridge crossing at Waikapu stream will be designed to not alter the natural stream flow and provide for the opportunity for natural migration of stream animals.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at (808) 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Skippy Hau, Department of Land and Natural Resources
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
F:\DATA\COM\DPW WaialeExt\DLNRAquatics.ecres.doc

JUN 09 2010

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
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

June 7, 2010

Leilani Pulmano, Project Manager
Munekiyo & Hiraga Inc
305 High Street, Suite 104
Wailuku, Hawai'i 96793

LOG NO: 2010.2042
DOC NO:1006NM21
Archaeology

Dear Ms Pulmano:

SUBJECT: Chapter 6E-42 Historic Preservation Review- Proposed Waiale Road Extension and East Waiko Road Improvements
Waikapu, Maui, Hawai'i
TMK: (1) 4-7-016: 60

An archaeological inventory survey (Perzinski and Dega, SCS 2010) has been undertaken for this project and approved by our office. One historic property was found and thoroughly documented by this AIS. Archaeological monitoring was recommended.

This project is being undertaken in an area of archaeologically sensitive soils – sandy deposits, known to contain subsurface historic properties such as cultural layers, and human burials. Therefore, in order for this project to have "no historic properties affected", we recommend the following conditions:

1) A qualified archaeological monitor shall be present during all ground-altering activities conducted in the project area in order to document any historic properties which may be encountered during the proposed undertaking and to provide mitigation measures as necessary. An acceptable archaeological monitoring plan will need to be submitted to the State Historic Preservation Division for review, prior to the commencement of any ground-altering activities. An archaeological monitoring plan must contain the following nine specifications: (1) The kinds of remains that are anticipated and where in the construction area the remains are likely to be found; (2) How the remains and deposits will be documented; (3) How the expected types of remains will be treated; (4) The archaeologist conducting the monitoring has the authority to halt the construction in the immediate area of the find in order to carry out the plan; (5) A coordination meeting between the archaeologist and construction crew is scheduled, so that the construction team is aware of the plan; (6) What laboratory work will be done on remains that are collected; (7) A schedule of report preparation; (8) Details concerning the archiving of any collections that are made; and (9) An acceptable report documenting the findings of the monitoring activities shall be submitted to the State Historic Preservation Division for review following the completion of the proposed undertaking.

2) The State Historic Preservation Division (O'ahu office) shall be notified via facsimile upon the on-set and completion of the proposed undertaking.

3) 2). If significant historic sites are found, then a burial treatment plan, shall be submitted for review and approval by SHPD.

The Hawai`i State Preservation Division website contains a listing of local firms hhttp://www.hawaii.gov/dlnr/hpd/archcon.htm).

Please contact me at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO),
Archaeology and Historic Preservation Manager

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Theresa K. Donham, Acting
Archaeology Branch Chief
State Historic Preservation Division
601 Kamokila Boulevard, Room 555
Kapolei, Hawaii 96707

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii (Log No. 2010:2042)

Dear Ms. Donham:

Thank you for your Division's letter, dated June 7, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

We acknowledge that the proposed project corridor is in an area of "archaeological sensitive soils, sandy deposits, known to contain subsurface historic properties". As your department recommended, DPW will follow the procedures outlined below:

1. An acceptable archaeological monitoring plan will be submitted to the State Historic Preservation Division (SHPD) for review and approval prior to commencement of any ground altering activities. The archaeological monitoring plan will contain the nine (9) specifications as indicated in your letter.

2. Conduct archaeological monitoring during all ground altering activities in order to document any historic properties that may be encountered. If any inadvertent finds are discovered, the archaeological monitor will provide mitigation measures, as necessary.

3. The SHPD Oahu Office shall be notified via facsimile upon the on-set and completion of the construction of the proposed project.

4. If significant historic sites and/or burial(s) are found, then a preservation plan and/or burial treatment plan will be submitted for review and approval by SHPD.

We appreciate the input provided by your division. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at (808) 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Michael Dega, Scientific Consulting Services, Inc.
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JUN 22 2010

LINDA LINGLE
GOVERNOR

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

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI
JIRO A. SUMADA

IN REPLY REFER TO:
STP 8.0133

June 16, 2010

Ms. Leilani Pulmano
Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

Subject: Waiale Road Extension and East Waiko Road Improvements
Early Consultation for Draft Environmental Assessment (DEA)

Thank you for providing the subject project for the State Department of Transportation's (DOT) review and comments. DOT understands that the County of Maui, Department of Public Works (DPW), is in the process of planning and designing the extension of Waiale Road and to carry out improvements to East Waiko Road. The Waiale Road Extension project involves extending Waiale Road from it current terminus at East Waiko Road southward for a distance of approximately 8,600 feet and to connect with Honoapiilani Highway. Additionally, DPW proposes to improve East Waiko Road from the intersection at Waiale Road to Kuihelani Highway.

Given the location of the subject project, the State highways, Honoapiilani Highway and Kuihelani Highway will be impacted. DOT Highways Division is still conducting its review of the subject project and will provide additional comments as necessary.

1. DOT recommends that the DEA discuss and evaluate project impacts to the State highway (Honoapiilani Highway and Kuihelani Highway) facilities, such as, but not limited to: inconvenience to the public; types of construction vehicles and equipment used at the job site; construction hours.

2. Please note that the applicant should work with the DOT Highways Division, Maui District Office regarding permits for oversized equipment/overweight loads and submission of construction plans for any work done within the State highway right-of-way, which must conform to nationally accepted design standards and completed at no cost to the State.

DOT appreciates the opportunity to provide initial comments on the subject project. When a DEA of the project is completed, DOT requests four (4) copies of the document are provided for staff review and any necessary approvals. If there are any questions, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at telephone number (808) 587-2356.

Very truly yours,

Francis Paul Keeno

for BRENNON T. MORIOKA, Ph.D., P.E.
Director of Transportation

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Glenn Okimoto, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii (STP 8.0133)

Dear Mr. Okimoto:

Thank you for your Department's letter, dated June 16, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

1. As recommended, the Draft Environmental Assessment (EA) will discuss and evaluate project impacts to the State, Honoapiilani Highway and Kuihelani Highway, as it relates to construction impacts.

2. The applicant will continue to work with the State Department of Transportation (SDOT) Highway Division, Maui District Office on the proposed project, specifically regarding permits for oversized equipment/overweight loads and construction plans within the State highway right-of-ways. The design of any improvements to the State highway right-of-ways will conform to nationally accepted design standards.

3. In regards to the cost of the proposed project, the County of Maui will be seeking Federal Highway Administration Funds for design and construction of the project. As such, the Draft EA is being prepared pursuant to the National Environmental Policy Act, 1969. In addition, the project will require improvements at Honoapiilani Highway and Kuihelani Highway at the intersections of the proposed Waiale Road Extension and the East Waiko Road, respectively. As such, the Draft EA is also being prepared pursuant to Hawaii Revised Statutes Chapter 343 for use of State and County lands and funds.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

We appreciate the input provided by SDOT. As requested, four (4) copies of the Draft EA will be submitted to SDOT for review. Should you have any questions or further comments, please contact me at (808)244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Matt Nakamoto, Austin, Tsutsumi & Associates, Inc.
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LINDA LINGLE
GOVERNOR

SEP 09 2010

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
JIRO A. SUMADA

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

IN REPLY REFER TO:

STP 8.0208

September 1, 2010

Ms. Leilani Pulmano
Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

Subject: Waiale Road Extension and East Waiko Road Improvements
Early Consultation for Draft Environmental Assessment (DEA)

The State Department of Transportation (DOT) previously commented on the DEA for the subject project in its letter STP 8.0133 dated June 16, 2010 (attached), and now offers the following supplemental highway comments:

1. The County of Maui Long Range Transportation Plan (MLRTP) includes the extension of Waiale Road to Honoapiilani Highway to Maui Tropical Plantation as a two-lane bypass road of Waikapu Village in the 2006 to 2020 period.

2. The proposed southern terminus of Waiale Road Extension at the Old Quarry Road intersection with Honoapiilani Highway is not in compliance with the MLRTP.

3. The DEA should discuss alternatives for the Waiale Road terminus at Honoapiilani Highway, i.e., Maui Tropical Plantation driveway, golf course driveway, Old Quarry Road, etc., the discussion should include the existing and planned developments on the west side of the Honoapiilani Highway that would be accessed from the cross intersection.

4. The DEA should include a Traffic Impact Analysis Report (TIAR) that addresses the impact of the southern terminus of the Waiale Road Extension on Honoapiilani Highway, where the two lanes of southbound traffic (one on Honoapiilani Highway and one on the Waiale Road Extension) would merge into one lane on Honoapiilani Highway. The DEA should consider, analyze and discuss mitigation alternatives, including: 1) Continuing the Waiale Road Extension to the Kuihelani Highway junction with Honoapiilani Highway and 2) Widening Honoapiilani Highway between Kuihelani Highway and the southern terminus of the Waiale Road Extension.

Ms. Leilani Pulmano
Page 2
September 1, 2010

STP 8.0208

5. Both the Waiale Road Extension and the East Waiko Road improvements should accommodate bicyclists and pedestrians.

6. The DEA should describe the present and proposed roadway system in the Waikapu area, including East Waiko Road between Honoapiilani Highway and Waiale Road and the County's plans for improvements.

7. The site plan in Figure 1 should clearly label the Maui Tropical Plantation Driveway and the golf course road as well as Old Quarry Road.

8. The County's proposed or planned functional classification of the Waiale Road Extension should be described, including the traffic projections and traffic flow on both Waiale Road and East Waiko Road that supports that functional classification.

9. The County of Maui should be advised that when the area bounded by Honoapiilani Highway and the Waiale Road Extension is developed, all access should be from the Waiale Road Extension, not from the principal arterial, Honoapiilani Highway.

DOT appreciates the opportunity to provide these supplemental comments. If there are any questions including a need to meet with DOT Highway Division on the traffic and roadway comments, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at telephone number (808) 587-2356.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Director of Transportation

Attachment: STP ltr 8.0133 dated June 6, 2010

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Glenn Okimoto, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii (STP 8.0133)

Dear Mr. Okimoto:

Thank you for the letter from State of Hawaii, Department of Transportation (SDOT), dated September 1, 2010, providing additional early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

1. We acknowledge that the County of Maui Long Range Transportation Plan (MLRTP) includes the extension of Waiale Road. The purpose of this Environmental Assessment (EA) is to assess the environmental conditions and potential impacts for the implementation of the extension of Waiale Road. The EA will discuss the Maui Tropical Plantation terminus in relation to the MLRTP and other alternative terminus locations.

2. Although the Maui Tropical Plantation terminus was identified in MLRTP for the extension of Waiale Road, other factors were examined to identify the most appropriate terminus location for the extension of Waiale Road. Additionally, DPW discussed with SDOT, Maui District, the Old Quarry terminus in comparison to the Maui Tropical Plantation terminus. DPW received concurrence that the Old Quarry terminus would present a better terminus location. As previously indicated, the EA will discuss terminus alternatives.

3. The terminus locations that you have identified will be discussed in the EA, as well as a discussion on the existing and planned developments on the west side of Honoapiilani Highway.

4. The Draft EA will include a Traffic Impact Analysis (TIAR) that will address the impact of the Waiale Road Extension terminus on Honoapiilani Highway. The Draft EA will also discuss the alternative to continue the Waiale Road Extension to Kuihelani Highway and widening Honoapiilani Highway between Kuihelani Highway intersection and the Waiale Road Extension terminus.

5. Both the Waiale Road Extension and the East Waiko Road Improvements will accommodate bicyclists and pedestrians.

6. The Draft EA will describe the present and proposed roadway system in the Waikapu area.

7. The Draft EA will include a figure clearly labeling the Maui Tropical Plantation driveway, the golf course access, and the Old Quarry Road.

8. The Draft EA will include a discussion on the planned functional classification of Waiale Road Extension. Traffic projections will be included in the discussion.

9. DPW acknowledges that State Department of Transportation favors all access for the area bounded by Honoapiilani Highway and the future Waiale Road Extension be from Waiale Road Extension not from Honoapiilani Highway.

We appreciate the input provided by SDOT. As requested, four (4) copies of the Draft EA will be submitted to SDOT for review. Should you have any questions or further comments, please contact me at (808)244-2015.

Sincerely,

Leilani Pulmano
Project Manager

LP:yp
cc: David Goode, Department of Public Works
Matt Nakamoto, Austin, Tsutsumi & Associates, Inc.

F:\DATA\COM\DPW WaialeExt\SDOT090110.ecres.doc

JUN 01 2010

CHARMAINE TAVARES
MAYOR

200 South High Street
Wailuku, Hawaii 96793-2155
Telephone (808) 270-7855
Fax (808) 270-7870
e-mail: mayors.office@mauicounty.gov

OFFICE OF THE MAYOR
County of Maui

May 26, 2010

Leilani Pulmano
Project Manager
Munekiyo & Hiraga, Inc.
305 South High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

Thank you for your May 12, 2010 letter requesting comments on the proposed Waiale Road Extension and East Waiko Road Improvements project. We believe the project is crucial to improve traffic circulation in Waikapu. There are several developments that have been built in the area in the past few years, including Waikapu Gardens and Waiolani Mauka. As such, the need for the proposed Waiale Road Extension and East Waiko Road Improvements project is even more critical.

Again, mahalo for allowing us to provide comments on this proposed project.

Sincerely,

Charmaine Tavares

CHARMAINE TAVARES
Mayor

c: Milton A. Arakawa, Director of Public Works

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Honorable Alan Arakawa, Mayor
Office of the Mayor
200 High Street
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mayor Arakawa:

Thank you for the letter from the Office of the Mayor, dated May 26, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works, we offer the following information in response to the comments noted in your letter.

Thank you for your acknowledgement that the proposed project is crucial to improve traffic circulation in Waikapu.

We appreciate the input provided by the Office of the Mayor. A copy of the Draft Environmental Assessment will be submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LL

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
F:\DATA\COM\DPW WaialeExt\Mayor.ecres.doc

CHARMAINE TAVARES
MAYOR

JUN 21 2010

JEFFREY A. MURRAY
CHIEF

ROBERT M. SHIMADA
DEPUTY CHIEF

COUNTY OF MAUI

DEPARTMENT OF FIRE AND PUBLIC SAFETY
FIRE PREVENTION BUREAU

313 MANEA PLACE • WAILUKU, HAWAII 96793
(808) 244-9161 • FAX (808) 244-1363

Date : June 16, 2010

To : Leilani Pulmano
Munekiyo & Hiraga, Inc
305 High St. Suite 104
Wailuku, HI 96793

Subject : Proposed Waiale Road Extension & East Waiko Road Improvements Waikapu

Dear Leilani,

Thank you for allowing our office the opportunity to comment on the proposed Waiale Road extension and the East Waiko Road improvements. Our office has no comment in regards to these proposed projects. We would like to provide the minimum specifications for fire apparatus access:

- Minimum 20 feet all-weather surface capable of supporting a 50,000# fire apparatus.
- Maximum grade of 14%.

If there are any questions or comments, please feel free to contact me by mail or at 244-9161 ext. 23.

Sincerely,

Paul Haake
Captain, Fire Prevention Bureau
313 Manea Place
Wailuku, HI 96793

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Paul Haake, Captain
Fire Prevention Bureau
313 Manea Place
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Captain Haake:

Thank you for your memorandum, dated June 16, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works, we offer the following information in response to the comments noted in your memorandum.

We acknowledge the following road specifications for fire apparatus access:

- Minimum 20 feet all-weather surface capable of supporting a 50,000 lbs fire apparatus.
- Maximum grade of 14 percent.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
F:\DATA\COM\DPW WaialeExt\DFPS.ecres.doc

MAY 26 2010

DEPARTMENT OF
HOUSING AND HUMAN CONCERNS
HOUSING DIVISION
COUNTY OF MAUI

CHARMAINE TAVARES
Mayor

LORI TSUHAKO
Director

JO-ANN T. RIDAO
Deputy Director

35 LUNALILO STREET, SUITE 102 • WAILUKU, HAWAII 96793 • PHONE (808) 270-7351 • FAX (808) 270-6284

May 18, 2010

Ms. Leilani Pulmano
Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

The Department has reviewed the above subject project. Based on our review, we have determined that the subject project is not subject to chapter 2.96, Maui County Code. At the present time, the Department has no additional comments to offer.

Please call Ms. Cara Bohne of our Housing Division at 270-5748 if you have any questions.

Sincerely,

Wayde T. Oshiro

WAYDE T. OSHIRO
Housing Administrator

cc: Director of Housing and Human Concerns

JUN 10 2010

CHARMAINE TAVARES
Mayor

TAMARA HORCAJO
Director

ZACHARY Z. HELM
Deputy Director

(808) 270-7230
FAX (808) 270-7934

DEPARTMENT OF PARKS & RECREATION
700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

June 4, 2010

Munekiyo & Hiraga, Inc.
Attn: Leilani Pulmano, Project Manager
305 South High Street, Suite 104
Wailuku, Hawaii 96793

SUBJECT: **Early Consultation Comments for the Proposed Waiale Road Extension and East Waiko Road Improvements Waikapu, Maui, Hawai'i**

Dear Ms. Pulmano:

Thank you for notifying the Department of Parks & Recreation about the subject project. We have no comments at this time, and look forward to reviewing the environmental assessment when it is available.

Please feel free to contact me or Mr. Patrick Matsui, Chief of Parks Planning and Development, at 270-7931 should you have any questions.

Sincerely,

TAMARA HORCAJO
Director of Parks & Recreation

TH:PTM:ca
cc: Patrick Matsui, Chief of Parks Planning and Development
S:\PLANNING\CSA\County Reviews\EA Reviews\Waiale Road Ext DEA Early Consult.doc

CHARMAINE TAVARES
Mayor
KATHLEEN ROSS AOKI
Director
ANN T. CUA
Deputy Director

JUN 15 2010

COUNTY OF MAUI
DEPARTMENT OF PLANNING

June 8, 2010

Ms. Leilani Pulmano, Project Manager
Munekiyo and Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

SUBJECT: PRE-CONSULTATION COMMENTS IN PREPARATION OF A DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS IN AND NEARBY WAIKAPU, ISLAND OF MAUI, HAWAII (RFC 2010/0069)

The Department of Planning (Department) is in receipt of your request for comments in preparation of a Draft EA for the above-referenced project under Chapter 343 of Hawaii Revised Statutes (HRS), and also under the National Environmental Policy Act (NEPA). The Department understands that the proposed action includes the following:

- An extension of Waiale Road from its current eastern terminus at East Waiko Road approximately 8,600 feet south to connect with Honoapiilani Highway; and
- Upgrades to East Waiko Road from its intersection at Waiale Road to Kuihelani Highway.

Based on the foregoing, the Department provides the following comments as pre-consultation in preparation of the Draft EA:

1. The land use designations for the project area are as follows:
   - State Land Use – Agriculture
   - Wailuku-Kahului Community Plan – Agriculture
   - County Zoning – Agriculture
   - Other – None
2. The project would serve to implement Wailuku-Kahului Community Plan Transportation Objective and Policy 9 to "Support the extension of Waiale Drive to a new intersection with Honoapiilani Highway south of Waikapu Village."
3. The project alignment appears to be consistent with the Draft Maui Island Plan.

4. The applicable bicycle facilities map in the state Department of Transportation's Bike Plan Hawaii shows that Waiale Road is supposed to include a "Signed Shared Roadway" type of bikeway. A corresponding "Bike Path" is also shown on the Regional Transportation Network Map (Map 6-2) of the Maui Island Plan. The Waiale Road Extension alignment appears to be more recent than the more conceptual alignment following agricultural roads as shown in the Bike Plan Hawaii and as copied into the Maui Island Plan. For example, the current proposal connects to Honoapiilani Highway much farther north than as shown on the Bike Plan Hawaii map. However, the "Signed Shared Roadway" type of bikeway appears applicable to the project with its shortened alignment as now proposed. Please provide and/or clarify how the roadway section will include the "Signed Shared Roadway" type of bikeway.

5. Please provide the full range on analysis as required by Chapter 343 and NEPA.

Thank you for the opportunity to comment. Should you require further clarification, please contact Current Division Supervisor Jeffrey Dack at jeffrey.dack@mauicounty.gov or 270-6275.

Sincerely,

Kathleen Ross Aoki

KATHLEEN ROSS AOKI
Planning Director

xc: Clayton I. Yoshida, AICP, Planning Program Administrator
Jeffrey P. Dack, Current Division Supervisor
Milton Arakawa, Director, Department of Public Works
RFC File
General File

KRA:JPD:nst
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MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

William Spence, Director
Attention: Jeffrey Dack
Department of Planning
250 South High Street
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mr. Spence:

Thank you for your Department's letter, dated June 8, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

1. Thank you for providing the land use designations for the project area. We will incorporate a discussion on the various land use designations in the Draft Environmental Assessment (EA).

2. Thank you for providing the Community Plan policy that the project will address. A discussion on the Community Plan policies will be incorporate in the Draft EA.

3. We acknowledge that the road alignment is consistent with the Draft Maui Island Plan (MIP). The Planning Department's Director along with the Long Range Division staff met with DPW early in the process to ensure consistency within the development of the Draft Maui Island Plan.

4. The roadway alignment has evolved through the years from the State Department of Transportation's (SDOT) Bike Plan Hawaii's alignment and as shown in the MIP's Regional Transportation Network Map (Map 6-2). The evolution has been based on due diligence by DPW in consultation with various agencies. A discussion of the roadway alignment alternatives will be discussed in the Draft EA.

   In regards to the "Signed Shared Roadway" recommendation within the SDOT Bike Plan Hawaii and MIP Map 6-2, the roadway design will incorporate a bike path. A

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

discussion on roadway design along with the bike path will be included in the Draft EA.

5. The Draft EA will provide an analysis as required by Hawaii Revised Statutes Chapter 343 and National Environmental Policy Act, 1969.

We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
F:\DATA\COM\DPW WaialeExt\DPL.ecres.doc

JUL 09 2010

CHARMAINE TAVARES
Mayor

JEFFREY K. ENG
Director

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793-2155
www.mauiwater.org

July 6, 2010

Ms. Leilani Pulmano
Project Manager
Munekiyo and Hiraga, Inc.
300 High Street, Suite 104
Wailuku, Hawaii 96793

Re: Project Name: Waiale Road Extension and East Waiko Road Improvements Environmental Assessment (EA) Early Consultation

Dear Ms. Pulmano:

Thank you for the opportunity for early consultation on this Environmental Assessment (EA).

Source Availability and Consumption
The project area is served by the Central Maui System. The main sources of water for this system are the designated Iao aquifer, Waihee aquifer, the Iao Tunnel and the Iao Waikapu Ditch in the recently designated Na Wai Eha. New source development projects include Waikapu South Well and the proposed Waiale Surface Water Treatment Plant. There is currently no additional source available according to system standards on the Central Maui System. The Department may delay issuance of meters until new sources are on line.

System Infrastructure
An 18-inch line crosses the Waiko Road Improvements portion approximately 1,400 feet east of the Waiale/East Waiko roads intersection, and a 1.5-inch line is located at the intersection. The nearest hydrants (149,150) are 15 feet north of the proposed Waiko Road Improvements, between Waiale Road and Pakana Street. Construction plans need to be reviewed by The Department of Water Supply (DWS) Engineering Division. Any water valve covers must be lifted to match the finished grade of the roadway.

Waikapu Stream Channel Alteration Permit
The project appears to cross and potentially impact Waikapu Stream, listed as a perennial stream by the Hawaii Stream Assessment. Hawaii Administrative Rules (HAR) 13-169-50 9(a) requires a Stream Channel Alteration Permit so that "stream channels shall be protected from alteration whenever practicable to provide for fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses."

Pollution Prevention
The proposed project lies within 600 feet of the modeled ten-year time of travel zone of three wells, (Maui Lani #7 [5229-06], Maui Lani #6 [5229-05], and Maui Lani #5 [5229-04]) Figure 1.

Although the proposed road extension and improvements lie a few hundred feet away from the wellhead protection area of municipal wells, Best Management Practices (BMPs) should be implemented due to the close proximity of the project and the potential for roadways to generate contaminants of concern.

Contaminants of concern potentially generated from transportation corridors (freeways, state highways, road right of ways) are: Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, Copper, Creosote, Dalapon, Dicamba, 1,4-Dichlorobenzene or P-Dichlorobenzene, Ethylbenzene, Ethylene Glycol, Glyphosate, Lead, Motor oils, Nickel, Picloram, Simazine, Sodium, 1,1,2,2-Tetrachloroethane, Tetrachloroethylene or Perchlorethylene (Perk), Trichloroethylene or TCE, Tin, Toluene, Xylene (Mixed Isomers), Heavy metal/oils and other runoff.

Road Maintenance
To prevent ground and surface water contamination from road maintenance, including pesticide and fertilizer applications; we suggest that the following BMPs–as appropriate--be incorporated into the project design. In addition to the BMPs listed below, please see attached BMPs designed to minimize runoff and infiltration of potential contaminants from road siting and construction..

1. Schedule fertilizer application so that the chance of leaching and run-off of soluble fertilizers is minimized
2. Apply slow release fertilizers that will release nitrogen at a rate comparable to the rate at which it is used by the plants.
3. Apply slow release nitrogen fertilizer in an insoluble form. Calibrate fertilizer application equipment regularly.
4. Calibrate fertilizer and herbicide application equipment regularly.
5. When pesticide and herbicide applications are necessary, consider the persistence, toxicity, runoff potential, and leaching potential of available products. Use these criteria to select the product that is both adequate to control the pest and plants, and that which has the least overall potential for creating non-point source pollution.
6. Use pesticides and herbicides that are for targeted organisms whenever possible (i.e., baits for insects) and use mulches and other non-chemical techniques where appropriate.
7. Encourage the use of alternative pesticides, herbicides and biological controls where appropriate.
8. Evaluate the soil and physical characteristics of the site including mixing and loading areas for potential leaching and run-off.
9. Avoid applying pesticides and herbicides in areas where there is a high potential for leaching.
10. Apply pesticides and herbicides when runoff losses are unlikely.
11. Apply pesticides and herbicides that are sprayed at a lowest possible height and only when the wind speed is slow (3 to 10 miles/hour).
12. Use coarse nozzle and low pressure spray equipment.
13. Calibrate pesticide and herbicide spray equipment regularly.

Conservation

The EA should discuss the project's landscaping and irrigation plans, if applicable. To alleviate demand on the Central Maui system, we suggest that the applicant implement the following conservation measures:

1. Dust Control: Reclaimed water for dust control is available from the Kihei and Kahului sewage treatment plants, and it should be considered as an alternative source of water for dust control during construction.

2. Use climate-adapted native plants where applicable: Please consider the use of native Hawaiian plants adapted to the natural rainfall of the area for decorative borders and other landscape features. Native plants adapted to the natural rainfall of the area conserve water and protect the watershed from degradation due to the spread of invasive alien species. The subject project is located in Plant Zone 4. We have attached a native plant brochure to assist with appropriate plant selection.

3. Prevent Over Watering:
    a. Equip all irrigated areas with smart controllers capable of self-adjusting to account for moisture conditions.
    b. Arrange irrigation valves and circuits such that plants with different water requirements are watered separately and appropriately (hydrozones).
    c. Provide rain sensors and shut-offs on all automated irrigation controllers.
    d. If weather or moisture sensing controllers are not used, at the very minimum check and reset controllers at least once a month to reflect the monthly changes in evapo transpiration rates at the site.

Again, thank you for the opportunity to provide input. Should you have any questions, please contact our Water Resources and Planning Division at 244-8550.

Sincerely,

Jeff K. E

Jeffrey K. Eng, Director
Department of Water Supply
bab

cc: engineering division

Attachments:
1. Figure 1: Location of Maui Lani Wellheads 5, 6, 7; 10-year time of travel zones.
2. Management Measures for Planning, Siting, and Developing Roads and Highways
3. BMPs for Outside Storage of Raw Materials, Byproducts, or Products
4. A Checklist of Water Conservation Ideas for Industrial and Large Landscapes
5. Plant Brochure: "Saving Water in the Yard"

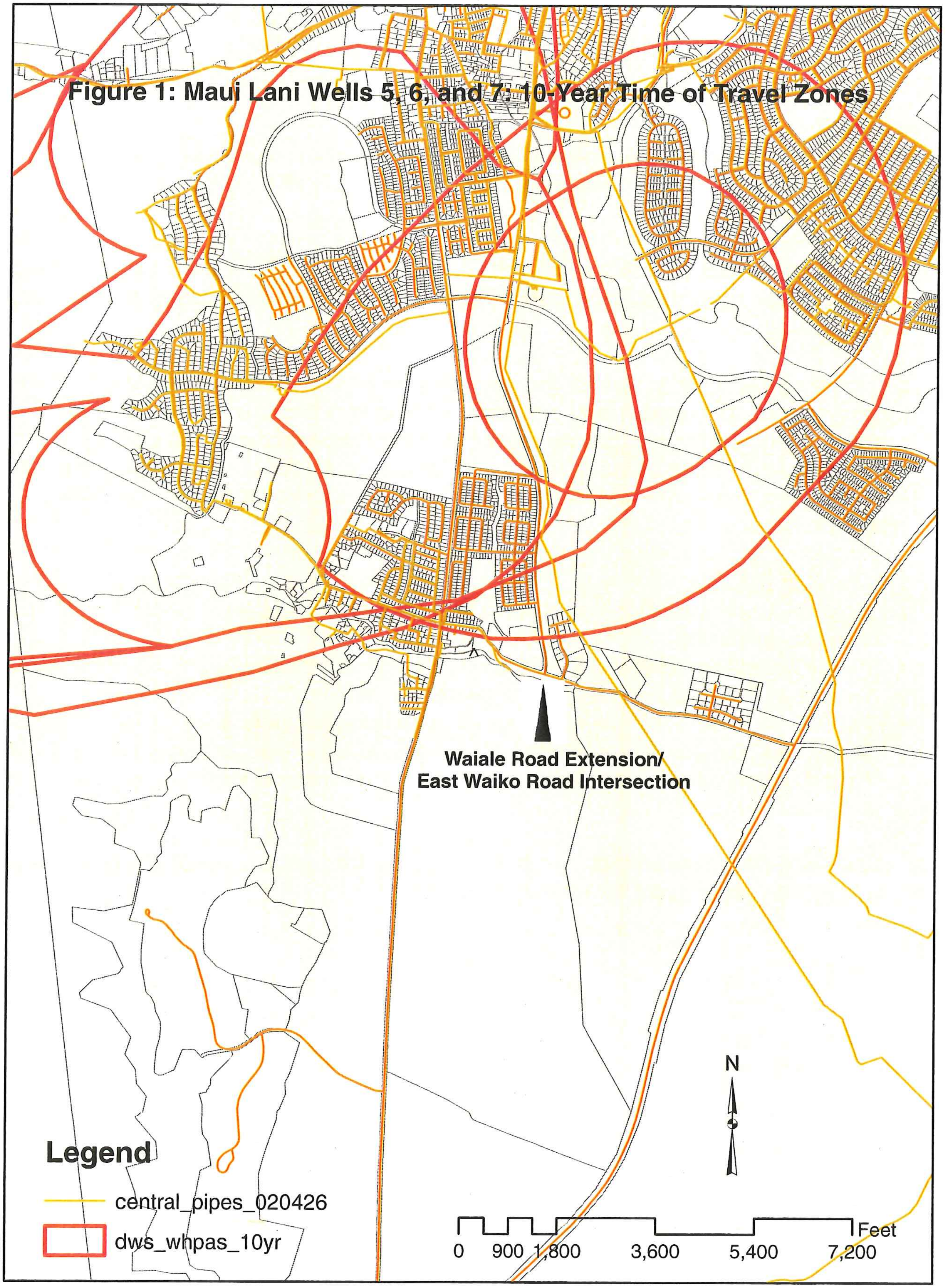


Figure 1: Maui Lani Wells 5, 6, and 7: 10-Year Time of Travel Zones
Waiale Road Extension/
East Waiko Road Intersection
N
Legend
central_pipes_020426
dws_whpas_10yr
0
900
1,800
3,600
5,400
7,200
Feet

Management Measures for Planning, Siting, and Developing Roads and Highways

A. Management Measures for Planning, Siting, and Developing Roads and Highways

Plan, site, and develop roads and highways to:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;
2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and
3. Limit disturbance of natural drainage features and vegetation.

1. Applicability

This measure is intended to be applied by the State to site development and land disturbing activities for new, relocated, and reconstructed (widened) roads (including residential streets) and highways in order to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants from such activities. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration(NOAA) of the U.S. Department of Commerce.

2. Description

The best time to address control of NPS pollution from roads and highways is during the initial planning and design phase. New roads and highways should be located with consideration of natural drainage patterns and planned to avoid encroachment on surface waters and wet areas. Where this is not possible, appropriate controls will be needed to minimize the impacts of NPS runoff on surface waters.

This management measure emphasizes the importance of planning to identify potential NPS problems early in the design process. This process involves a detailed analysis of environmental features most associated with NPS pollution, erosion and sediment problems such as topography, drainage patterns, soils, climate, existing land use, estimated traffic volume, and sensitive land areas. Highway locations selected, planned, and designed with consideration of these features will greatly minimize erosion and sedimentation and prevent NPS pollutants from entering watercourses during and after construction. An important consideration in planning is the distance between a highway and a watercourse that is needed to buffer the runoff flow and prevent potential contaminants from entering surface waters. Other design elements such as project alignment, gradient, cross section, and the number of stream crossings also must be taken into account to achieve successful control of erosion and nonpoint sources of pollution. (Refer to Chapter 3 of this guidance for details on road designs for different terrains.)

Management Measures for Planning, Siting, and Developing Roads and Highways

The following case study illustrates some of the problems and associated costs that may occur due to poor road construction and design. These issues should be addressed in the planning and design phase.

CASE STUDY ANNAPOLIS, MARYLAND

Poor road siting and design resulted in concentrated runoff flows and heavy erosion that threatened several
house foundations adjacent to the road. Sediment laden runoff was also discharged into Herring Bay. To protect the Chesapeake Bay and the nearby houses, the county corrected the problem by installing diversions, a curb and drain urban runoff conveyance, and a rock wall filtration system, at a total cost of $100,000 (Munsey, 1992).

3. Management Measure Selection

This management measure was selected because it follows the approach to highway development recommended by the American Association of State Highway and Transportation Officials (AASHTO), Federal Highway Administration (FHWA) guidance, and highway location and design guidelines used by the States of Virginia, Maryland, Washington, and others.

Additionally, AASHTO has location and design guidelines (AASHTO, 1990, 1991) available for State highway agency use that describe the considerations necessary to control erosion and highway-related pollutants. Federal Highway Administration policy (FHWA, 1991) requires that Federal-aid highway projects and highways constructed under direct supervision of the FHWA be located, designed, constructed, and operated according to standards that will minimize erosion and sediment damage to the highway and adjacent properties and abate pollution of surface water and groundwater resources.

4. Practices

As discussed more fully at the beginning of this chapter and in Chapter 1, the following practices are described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices set forth below have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measure described above.

a. Consider type and location of permanent erosion and sediment controls (e.g., vegetated filter strips, grassed swales, pond systems, infiltration systems, constructed urban runoff wetlands, and energy dissipators and velocity controls) during the planning phase of roads, highway, and bridges. (AASHTO, 1991;Hartiganetat, 1989)

b. All wetlands that are within the highway corridor and that cannot be avoided should be mitigated. These actions will be subject to Federal Clean Water Act section 404 requirements and State regulations.

c. Assess and establish adequate setback distances near wetlands, waterbodies, and riparian areas to ensure protection from encroachment in the vicinity of these areas.

Setback distances should be determined on a site-specific basis since several variables may be involved such as topography, soils, floodplains, cut and fill slopes, and design geometry. In level or gently sloping terrain, a general rule of thumb is to establish a setback of 50 to 100 feet from the edge of the wetland or riparian area and the right-of-way. In areas of steeply sloping terrain (20 percent or greater), setbacks of 100 feet or more are recommended. Right-of-way setbacks from major waterbodies (oceans, lakes, estuaries, rivers) should be in excess of 100 to 1000 feet.

d. Avoid locations requiring excessive cut and fill (AASHTO, 1991)

e. Avoid locations subject to subsidence, sink holes, landslides, rock outcroppings, and highly erodible soils. (AASHTO, 1991; TRB, Campbell, 1988)

f. Size rights-of-way to include space for siting runoff pollution control structures as appropriate. (AASHTO, 1991; Hartigan, et al., 1989)

Erosion and sediment control structures (extended detention dry ponds, permanent sediment traps, catchment basins, etc.) should be planned and located during the design phase and included as part of the design specifications to ensure that such structures, where needed, are provided within the highway right-of-way.

g. Plan residential roads and streets in accordance with local subdivision regulations, zoning ordinances, and other local site planning requirements (International City Managers Association, Model Zoning/Subdivision Codes). Residential road and street pavements should be designed with minimum widths.

Local roads and streets should have right-of-way widths of 36 to 50 feet, with lane widths of 10 to 12 feet. Minimum pavement widths for residential streets where street parking is permitted range from 24 to 28 feet between curbs. In large-lot subdivisions (1 acre or more), grassed drainage swales can be used in lieu of curbs and gutters and the width of paved road surface can be between 18 and 20 feet.

h. Select the most economic and environmentally sound route location. (FHWA, 1991)
1. Use appropriate computer models and methods to determine urban runoff impacts with all proposed route corridors. (Driscoll, 1990)

Computer models to determine urban runoff from streets and highways include TR-55 (Soil Conservation Service model for controlling peak runoff); the P-8 model to determine storage capacity (Palmstrom and Walker); the FHWA highway runoff model

(Driscoll et al., 1990); and others (e.g., SWMM, EPA's stormwater management model; HSP continuous simulation model by Hydrocomp, Inc.).

j. Comply with National Environmental Policy Act requirements including other State and local requirements. (FHWA, T6640.8A)

k. Coordinate the design of pollution controls with appropriate State and Federal environmental agencies. (Maryland DOE, 1983)

l. Develop local official mapping to show location of proposed highway corridors.

Official mapping can be used to reserve land areas needed for public facilities such as roads, highways, bridges, and urban runoff treatment devices. Areas that require protection, such as those which are sensitive to disturbance or development-related nonpoint source pollution can be reserved by planning and mapping necessary infrastructure for location in suitable areas.

5. Effectiveness Information and Cost Information

The most economical time to consider the type and location of erosion, sediment, and NPS pollution control is early in the planning and design phase of roads and highways. It is much more costly to correct polluted runoff problems after a road or highway has already been built. The most effective and often the most economical control is to design roads and highways as close to existing grade as possible to minimize the area that must be cut or filled and to avoid locations that encroach upon adjacent watercourses and wet areas. However, some portions of roads and highways cannot always be located where NPS pollution does not pose a threat to surface waters. In these cases, the impact from potential pollutant loadings should be mitigated. Interactive computer models designed to run on a PC are available (e.g., FHWA's model, Driscoll et al., 1990) and can be used to examine and project the runoff impacts of a proposed road or highway design on surface waters. Where controls are determined to be needed, several cost-effective management practices, such as vegetated filter strips, grassed swales, and pond systems, can be considered and used to treat the polluted runoff. These mitigating practices are described in detail in the discussion on urban developments (Management Measure IV.A).

B. Management Measure for Bridges

Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

1. Applicability

This management measure is intended to be applied by States to new, relocated, and rehabilitated bridge structures in order to control erosion, streambed scouring, and surface runoff from such activities. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

2. Description

This measure requires that NPS runoff impacts on surface waters from bridge decks be assessed and that appropriate management and treatment be employed to protect critical habitats, wetlands, fisheries, shellfish beds, and domestic water supplies. The siting of bridges should be a coordinated effort among the States, the FHWA, the U.S. Coast Guard, and the Army Corps of Engineers. Locating bridges in coastal areas can cause significant erosion and sedimentation, resulting in the loss of wetlands and riparian areas. Additionally, since bridge pavements are extensions of the connecting highway, runoff waters from bridge decks also deliver loadings of heavy metals, hydrocarbons, toxic substances, and deicing chemicals to surface waters as a result of discharge through scupper drains with no overland buffering. Bridge maintenance can also contribute heavy loads of lead, rust particles, paint, abrasive, solvents, and cleaners into surface waters. Protection against possible pollutant overloads can be afforded by minimizing the use of scuppers on bridges traversing very sensitive waters and conveying deck drainage to land for treatment. Whenever practical, bridge structures should be located to avoid crossing over sensitive fisheries and shellfish-harvesting areas to prevent washing polluted runoff through scuppers into the waters below. Also, bridge design should account for potential scour and erosion, which may affect shellfish beds and bottom sediments.

3. Management Measure Selection

This management measure was selected because of its documented effectiveness and to protect against potential pollution impacts from siting bridges over sensitive waters and tributaries in the coastal zone. There are several examples of siting bridges to protect sensitive areas. The Isle of Palms Bridge near Charleston, South Carolina, was designed without scupper drains to protect a local fishery from polluted runoff by preventing direct discharge into the waters below. In another example, the Louisiana Department of Transportation and Development specified stnngent requirements before allowing the construction of a bridge to protect destruction of fragile wetlands near New Orleans. A similar requirement was specified for bridge construction in the Tampa Bay area in Florida (ENR, 1991).

4. Practices

As discussed more fully at the beginning of this chapter and in Chapter 1, the following practices are described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices set forth below have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measure described above.

Additional erosion and sediment control management practices are listed in the construction section for urban sources of pollution (Management Measure IV.A).

a. Coordinate design with FH WA, USCG, COE, and other State and Federal agencies as appropriate.

b. Review National Environmental Policy Act requirements to ensure that environmental concerns are met (FHWA, T6640.8A and 23 CFR 771).

c. Avoid highway locations requiring numerous river crossings. (MSHTO, 1991)

d. Direct pollutant loadings away from bridge decks by diverting runoff waters to land for treatment.

Bridge decks should be designed to keep runoff velocities low and control pollutant loadings. Runoff waters should be conveyed away from contact with the watercourse and directed to a stable storm drainage, wetland, or detention pond. Conveyance systems should be designed to withstand the velocities of projected peak discharge.

e. Restrict the use of scupper drains on bridges less than 400 feet in length and on bridges crossing very sensitive ecosystems.

Scupper drains allow direct discharge of runoff into surface waters below the bridge deck. Such discharges can be of concern where the waterbody is highly susceptible to degradation or is an outstanding resource such as a spawning area or shellfish bed. Other sensitive waters include water supply sources, recreational waters, and irrigation systems. Care should be taken to protect these areas from contaminated runoff.

f. Site and design new bridges to avoid sensitive ecosystems.

Pristine waters and sensitive ecosystems should be protected from degradation as much as possible. Bridge structures should be located in alternative areas where only minimal environmental damage would result.

g. On bridges with scupper drains, provide equivalent urban runoff treatment in terms of pollutant load reduction elsewhere on the protect to compensate for the loading discharged off the bridge.

5. Effectiveness Information and Cost Information

Management Measures for Planning, Siting, and Developing Roads and Highways

Effectively controlling NPS pollutants such as road contaminants, fugitive dirt, and debris and preventing accidental spills from entering surface waters via bridge decks are necessary to protect wetlands and other sensitive ecosystems. Therefore, management practices such as minimizing the use of scupper drains and diverting runoff waters to land for treatment in detention ponds and infiltration systems are known to be effective in mitigating pollutant loadings. Tables 4-7 and 4-8 in Section II provide cost and effectiveness data for ponds, constructed wetlands, and filtration devices.

C. Management Measure for Construction Projects

(1) Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction and
(2) Prior to land disturbance, prepare and implement an approved erosion control plan or similar administrative document that contains erosion and sediment control provisions.

1. Applicability

This management measure is intended to be applied by States to new, replaced, restored, and rehabilitated road, highway, and bridge construction projects in order to control erosion and offsite movement of sediment from such project sites. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

2. Description

Erosion and sedimentation from construction of roads, highways, and bridges, and from unstabilized cut and fill areas, can significantly impact surface waters and wetlands with silt and other pollutants including heavy metals, hydrocarbons, and toxic substances. Erosion and sediment control plans are effective in describing procedures for mitigating erosion problems at construction sites before any land-disturbing activity begins. Additional relevant practices are described in Management Measures III.A and III.B of this chapter.

Bridge construction projects include grade separations (bridges over roads) and waterbody crossings. Erosion problems at grade separations result from water running off the bridge deck and runoff waters flowing onto the bridge deck during construction. Controlling this runoff can prevent erosion of slope fills and the undermining failure of the concrete slab at the bridge approach. Bridge construction over waterbodies requires careful planning to limit the disturbance of streambanks. Soil materials excavated for footings in or near the water should be removed and relocated to prevent the material from being washed back into the waterbody. Protective berms, diversion ditches, and silt fences parallel to the waterway can be effective in preventing sediment from reaching the waterbody.

Wetland areas will need special consideration if affected by highway construction, particularly in areas where construction involves grading, fill, dredging, or installing pilings. Highway development is most disruptive in wetlands since it may cause increased sediment loss, alteration of surface drainage patterns, changes in the subsurface water table, and loss of wetland habitat Highway structures should not restrict tidal flows into salt marshes and other coastal wetland areas because this might allow the intrusion of freshwater plants and reduce the growth of salt tolerant species. To safeguard these fragile areas, the best practice is to locate roads and highways with sufficient setback distances between the highway right-of-way and any wetlands or riparian areas. Bridge construction also can impact water circulation and quality in wetland areas, making special techniques necessary to accommodate construction. The following case study provides an example of a construction project where special considerations were given to wetlands.

CASE STUDY BRIDGING WETLANDS IN LOUISIANA

To provide protection for an environmentally critical wetland outside New Orleans, the Louisiana Department of Transportation and Development (DOTD) required a special construction technique to build almost 2 miles of twin elevated structures for the Interstate 310 link between 1-10 and U.S. Route 90. A technique known as end-on construction was devised to work from the decks of the structures, building each section of the bridge from the top of the last completed section and using heavy cranes to push each section forward one bay at a time. The cranes were also used to position steel platforms, drive in support pilings, and lay deck slabs, alternating this procedure between each bay. Without this technique, the Louisiana DOTD would not have been permitted to build this structure. The twin 9,200 foot bridges took 485 days to complete at a cost of $25.3 million (Engineering News Record, 1991).

3. Management Measure Selection

This management measure was selected because it supports FHWA's erosion and sediment control policy for all highway and bridge construction projects and is the administrative policy of several State highway departments and local governmental agencies involved in land development activity. Examples of erosion and sediment controls and NPS pollutant control practices are described in AASHTO guidelines and in several State erosion control manuals (AASHTO, 1991; North Carolina DOT, 1991; Washington State DOT, 1988). A detailed discussion of cost effective management practices is available in the urban development section (Section II) of this chapter. These example practices are also effective for highway construction projects.

4. Practices

Management Measures for Planning, Siting, and Developing Roads and Highways

As discussed more fully at the beginning of this chapter and in Chapter 1, the following practices are described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices set forth below have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measure described above.

Additional erosion and sediment control management practices are listed in the construction section (Section III) of this chapter.

a. Write erosion and sediment control requirements into plans, specifications, and estimates for Federal aid construction projects for highways and bridges (FHWA, 1991) and develop erosion control plans for earth-disturbing activities.

Erosion and sediment control decisions made during the planning and location phase should contract, plans, specifications, and special provisions provided to the construction contractor. This approach can establish contractor responsibility to carry out the explicit contract plan recommendations for the project erosion and the control practices needed

b. Coordinate erosion and sediment controls with FHWA, AASHTO, and State guidelines.

Coordination and scheduling of the project work with State and local authorities are major considerations in controlling anticipated erosion and sediment problems. In addition, the contractor should submit a general work schedule and plan that indicates planned implementation of temporary and permanent erosion control practices, including shutdown procedures for winter and other work interruptions. The plan also should include proposed methods of control on restoring borrow pits and the disposal of waste and hazardous materials.

c. Install permanent erosion and sediment control structures at the earliest practicable time in the construction phase.

Permanent or temporary soil stabilization practices should be applied to cleared areas within 15 days after final grade is reached on any portion of the site. Soil stabilization should also be applied within 15 days to denuded areas that may not be at final grade but will remain exposed to rain for 30 days or more. Soil stabilization practices protect soil from the erosive forces of raindrop impact and flowing water. Temporary erosion control practices usually include seeding, mulching, establishing general vegetation, and early application of a gravel base on areas to be paved. Permanent soil stabilization practices include vegetation, filter strips, and structural devices.

Sediment basins and traps, perimeter dikes, sediment barriers, and other practices intended to trap sediment on site should be constructed as a first step in grading and should be functional before upslope land disturbance takes place. Structural practices such as earthen dams, dikes, and diversions should be seeded and mulched within 15 days of installation.

d. Coordinate temporary erosion and sediment control structures with permanent practices.

All temporary erosion and sediment controls should be removed and disposed of within 30 days after final site stabilization is achieved or after the temporary practices are no longer needed. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary controls should be permanently stabilized to prevent further erosion and sedimentation (AASHTO, 1991).

e. Wash all vehicles prior to leaving the construction site to remove mud and other deposits. Vehicles entering or leaving the site with trash or other loose materials should be covered to prevent transport of dust, dirt, and debris. Install and maintain mud and silt traps.

f. Mitigate wetland areas destroyed during construction.

Marshes and some types of wetlands can often be developed in areas where fill material was extracted or in ponds designed for sediment control during construction. Vegetated strips of native marsh grasses established along highway embankments near wetlands or riparian areas can be effective to protect these areas from erosion and sedimentation (FHWA, 1991).

g. Minimize the area that is cleared for construction.

h. Construct cut and fill slopes in a manner that will minimize erosion.

Cut and fill slopes should be constructed in a manner that will minimize erosion by taking into consideration the length and steepness of slopes, soil types, upslope drainage areas, and groundwater conditions. Suggested recommendations are as follows: reduce the length of long steep slopes by adding diversions or terraces; prevent concentrated runoff from flowing down cut and fill slopes by containing these flows within flumes or slope drain structures; and create roughened soil surfaces on cut and fill slopes to slow runoff flows. Wherever a slope face crosses a water seepage plane, thereby endangering the stability of the slope, adequate subsurface drainage should be provided

i. Minimize runoff entering and leaving the site through perimeter and onsite sediment controls.

j. Inspect and maintain erosion and sediment control practices (both on-site and perimeter) until disturbed areas are permanently stabilized.

k. Divert and convey offsite runoff around disturbed soils and steep slopes to stable areas in order to prevent transport of pollutants off site.

l. After construction, remove temporary control structures and restore the affected area. Dispose of sediments in accordance with State and Federal regulations.

m. All storm drain inlets that are made operable during construction should be protected so that sediment-laden water will not enter the conveyance system without first being filtered or otherwise treated to remove sediment.

5. Effectiveness Information and Cost Information

The detailed cost and effectiveness information presented under the construction measure for urban development is also applicable to road, highway, and bridge construction. See Tables 4-15 and 4-16 in Section III.

D. Management Measure for Construction Site Chemical Control

1. Limit the application, generation, and migration of toxic substances;
2. Ensure the proper storage and disposal of toxic materials; and
3. Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface water.

1. Applicability

This management measure is intended to be applied by States to new, resurfaced, restored, and rehabilitated road, highway, and bridge construction projects in order to reduce toxic and nutrient loadings from such project sites. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published joindy by the U.S. Environmental Protection Agency EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

2. Description

The objective of this measure is to guard against toxic spills and hazardous loadings at construction sites from equipment and fuel storage sites. Toxic substances tend to bind to fine soil particles; however, by controlling sediment mobilization, it is possible to limit the loadings of these pollutants. Also, some substances such as fuels and solvents are hazardous and excess applications or spills during construction can pose significant environmental impacts. Proper management and control of toxic substances and hazardous materials should be the adopted procedure for all construction projects and

55

should be established by erosion and sediment control plans. Additional relevant practices are described in Management Measure IU.B of this chapter.

3. Management Measure Selection
This management measure was selected because of existing practices that have been shown to be effective in mitigating construction-generated NPS pollution at highway project sites and equipment storage yards. In addition, maintenance areas containing road salt storage, fertilizers and pesticides, snowplows and trucks, and tractor mowers have the potential to contribute NPS pollutants to adjacent watercourses if not properly managed (AASHTO, 1988, 1991a). This measure is intended to safeguard surface waters and ground water from toxic and hazardous pollutants generated at construction sites. Examples of effective implementation of this measure are presented in the section on construction in urban areas. Several State environmental agencies are using this approach to regulate toxic and hazardous pollutants (Florida DER, 1988; Puget Sound Basin, .1991).

4. Practices

As discussed more fully at the beginning of this Chapter and in Chapter 1, the following practices are described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location and climate. The practice set forth below have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measure described above.

The practices that are applicable to this management measure as described in Section III.B

5. Effectiveness Information and Cost Information

The detailed cost and effectiveness data presented in the Section III.A of this chapter describing NPS controls for construction projects in urban development areas are also applicable to highway construction projects.

E. Management Measure for Operation and Maintenance
Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

1. Applicability

This management measure is intended to be applied by States to existing, restored, and rehabilitated roads, highways, and bridges. Under the Coastal Zone Act Reuthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measures and will have some flexibility in doing so. The application of measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency(EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

2. Description

Substantial amounts are eroded material and other pollutants can be generated by operation and maintenance procedure for roads, highways, and bridges, and from sparsely vegetated areas, cracked pavements, potholes, and poorly operating urban runoff control structures. This measure is intended to ensure that pollutant loadings from roads, highways, and bridges are minimized by the development and implementation of a program and associated practices to ensure that sediment and toxic substance loadings from operation and maintenance activities do not impair coastal surface waters. The program to be developed, using the practices described in this management measure, should consist of and identify standard operating procedures for nutrient and pesticide management, road salt use minimization, and maintenance guidelines (eg., capture and contain plain chips and other particulates from bridge maintenance operations, resurfacing, and pothole repairs).

3. Management Measure Selection

This management measure for operation and maintenance was selected because (1) it is recommended by FHWA as a cost-effective practice (FHWA, 1991); (2) it is protective of the human environment (Puget Sound Water Quality Authority, 1989); (3) it is effective in controlling erosion by revegetating bare slopes (AASHTO, 1991b); (4) it is helpful in minimizing polluted runoff from roads pavements(Transportation Research Board,1991); and (5) both Federal (Richardson, 1974) and State highway agencies (Minnesota Pollution Control Agency, 1989; Pitt, 1973) advocate highway maintenance as an effective practice for minimizing pollutant loadings.

Maintenance of erosion and sediment control practices is of critical importance. Both temporary and permanent controls require frequent and periodic cleanout of accumulated sediment. Any trapping or filtrating device, such as silt fences, sediment basins, buffers, inlets, and check dams, should be checked and clean out when approximately 50 percent of their capacity is reached, as determined by the erodible nature of the soil, flow of velocity, and quantity of runoff. Seasonal and climatic differences may require more frequent cleanout of these structures. The sediments removed from these control devices should be deposited in permanently stabilized areas to prevent further erosion and sediment from reaching drainages and receiving streams. After periods of use, control devices may require replacement of deteriorated materials such as straw bales and silt fence fabrics, or restoration and reconstruction of sediment basins and riprap installations.

Permanent erosion controls such as vegetated filter strips, grassed swales, and velocity dissipators should be inspected periodically to determine 'heir integrity and continued effectiveness. Continual deterioration or damage to these controls may indicate a need for better design or construction.

4. Practices

As discussed more fully at the beginning of this chapter and in Chapter 1, the following practices &e described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices set forth below have been found by EPA to be representative of the types of practices that can be applied successfully apply to achieve 'he management measure described above.

a. Seed and fertilize, seed and mulch, and/or sod damaged vegetated areas and slopes.

b. Establish pesticide/herbicide use and nutrient management programs.

Refer to the Management Measure for Construction Site Chemical Control in this chapter.

c. Restrict herbicide and pesticide use in highway right-of-ways to applicators certified under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to ensure safe and effectWe application.

d. The use of chemicals such as soil stabilizers, dust palliatives, sterilants, and growth inhibitors should be limited to the best estimate of optimum application rates. All feasible measures should be taken to avoid excess application and consequent intrusion of such chemicals into surface runoff.

e. Sweep, vacuum, and wash residential/urban streets and parking lots.

f. Collect and remove road debris.

g. Cover salt storage piles and other deicing materials to reduce contamination of surface waters. Locate them outside the 100-year floodplain.

h. Regulate the application of deicing salts to prevent oversalting of pavement.

i. Use specially equipped salt application trucks.

j. Use alternative deicing materials, such as sand or salt substitutes, where sensitive ecosystems should be protected.

k. Prevent dumping of accumulated snow into surface waters.

58

Management Measures for Planning, Siting, and Developing Roads and Highways

l. Maintain retaining walls and pavements to minimize cracks and leakage.

u. Repair potholes.

n. Encourage litter and debris control management.

o. Develop an inspection program to ensure that general maintenance is performed on urban runoff and NPS pollution control facilities.

To be effective, erosion and sediment control devices and practices must receive thorough and periodic inspection checks. The following is a suggested checklist for the inspection of erosion and sediment controls (AASHTO Operating Subcommittee on Design, 1990):

Clean out sediment basins and traps; ensure that structures are stable.

Inspect silt fences and replace deteriorated fabrics and wire connections; properly dispose of deteriorated materials.

Renew riprapped areas and reapply supplemental rock as necessary.

Repair or replace check dams and brush barriers; replace or stabilize straw bales as needed.

Regrade and shape berms and drainage ditches to ensure that runoff is properly channeled.

Apply seed and mulch where bare spots appear, and replace matting material if deteriorated

Ensure that culverts and inlets are protected from siltation.

Inspect all permanent erosion and sediment controls on a scheduled, programmed basis.

p. Ensure that energy dissipators and velocity controls to minimize runoff velocity and erosion are maintained.

q. Dispose of accumulated sediment collected from urban runoff management and pollution control facilities, and any wastes generated during maintenance operations, in accordance with appropriate local, State, and Federal regulations.

r. Use techniques such as suspended tarps, vacuums, or booms to reduce, to the extent practicable, the delivery to surface waters of pollutants used or generated during bridge maintenance (e.g., paint, solvents, scrapings).

s. Develop education programs to promote the practices listed above.

Management Measures for Planning, Siting, and Developing Roads and Highways

5. Effectiveness Information and Cost Information

Preventive maintenance is a time-proven, cost-effective management approach. Operation schedules and maintenance procedures to restore vegetation, proper management of salt and fertilizer application, regular cleaning of urban runoff structures, and frequent sweeping and vacuuming of urban streets have effective results in pollution control. Litter control, clean-up, and fix-up practices are a low-cost means for eliminating causes of pollution, as is the proper handling of fertilizers, pesticides, and other toxic materials including deicing salts and abrasives. Table 4-30 presents summary information on the cost and effectiveness of operation and maintenance practices for roads, highways, and bridges. Many States and communities are already implementing several of these practices within their budget limitations. As shown in Table 4-30, the use of road salt alternatives such as calcium magnesium acetate (CMA) can be very costly. Some researchers have indicated, however, that reductions in corrosion of infrastructure, damage to roadside vegetation, and the quantity of material that needs to be applied may offset the higher cost of CMA. Use of road salt minimization practices such as salt storage protection and special salt spreading equipment reduces the amount of salt that a State or community must purchase. Consequently, implementation of these practices can pay for itself through savings in salt purchasing costs. Similar programs such as nutrient and pesticide management can also lead to decreased expenditures for materials.

CMA Eligible for Matching Funds

Calcium magnesium acetate (CMA) is now eligible for Federal matching funds under the Bridge Program of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. The Act provides 80 percent funding for use of CMA on salt-sensitive bridges in order to protect against corrosion and to extend their useful life. CMA can also be used to protect vegetation from salt damage in environmentally sensitive areas.

Table 4-30. Effectiveness and Cost Summary for Roads, Highways, and Bridges Operation and Maintenance Management Practices

	% Removal					
Management Practice	TSS	TP	TN	COD	Pb	Zn
MAINTAIN VEGETATION						
For Sediment Control						
Average:	90	NA	NA	NA	NA	NA
Reported Range:	50-100	NA	NA	NA	NA	NA
Probable Range:	80-100					
for Pollutant Removal						
Average:	60	40	40	50	50	
50						
Reported Range	0-100	0-100	0-70	20-80		0-100
50-60						

Probablle Range:	0-100	0-100	0-100	0-100	0-100	0-100
PESTICIDE/HERBICIDE USE MANAGEMENT						
Average:	NA					
Reported Range:	NA					
Probable Range:						
STREET SWEEPING						
Smooth Street, Frequent Cleaning (One or More Passes per Week)						
Average:	20	NA	NA	5	25	NA
Reported Range:	20	NA	NA	0-10	5-35	NA
Probable Range:	20-50	--	--	0-10	20-50	10-30
Infrequent Cleaning (One Pass Per Month or Less)						
Average:	NA	NA	NA	NA	5	NA
Reported Range:	NA	NA	NA	NA	0-10	NA
Probable Range:	20-50	--	--	0-10	20-50	0-10
LITTER CONTROL						
Average:	NA					
Reported Range:	NA					
Probable Range:						

Table 4-30(Continued)

Management Practice	Cost
MAINTAIN VEGETATION for Sediment Control	Natural succession allowed to occur- Avg: \$100/ac/year Reported Range: \$50-\$200/ac/year
for Pollutant Removal	Natural Sucession not allowed to occur- Avg: \$800/ac/year Reported Range: \$700-\$900/ac/year

61

PESTICIDE/HERBICIDE USE MANAGEMENT — Generally accepted as an economical Program to control excessive use

STREET SWEEPING — Avg: $20/curb mile
Smooth Street, Frequent Cleaning — Reported Range: $10-$30/curb mile
(One or More Passes per Week)

Infrequent Cleaning
(One Pass Per Month or Less)

LITTER CONTROL — Generally accepted as an econmical
approach

to control excessive use

Table 4-30(Continued)

Management Practice	TSS	% Removal TP	TN	COD	Pb	Zn	Cost
GENERAL MAINTENANCE Generally accepted (e.g., pothole and roadside repairs) economical preventive maintenance program by local and agencies							as an state
Average:	NA						
Reported Range:	NA						
Probable Range:							
CONTAIN POLLUTANTS with method GENERATED DURING of containment use BRIDGE MAINTENANCE							Varies
Average:	NA						
Reported Range:	NA						
Probable Range:	50-100						

F. Management Measure for Road, Highway, and Bridge Runoff Systems

62

Management Measures for Planning, Siting, and Developing Roads and Highways

Develop and Implement runoff management Systems for existing roads, highways, and bridges to reduce runoff pollutant concentrations and volumes entering surface waters.
(1) Identify priority and watershed pollutant reduction opportunities(e.g., improvements to existing urban runoff control structures; and

(2) Establish schedules for implementing appropriate controls.

1. Applicability

This management measure is intended to be applied by States to existing, resurfaced, restored, and rehabilitated roads, highways, and bridges that contribute to adverse effects in surface waters. Under the Coastal Zone Act Reauthorization Amendments of 1990, States are subject to a number of requirements as they develop coastal NPS programs in conformity with this management measure and will have some flexibility in doing so. The application of management measures by States is described more fully in Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, published jointly by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

2. Description

This measure requires that operation and maintenance systems include the development of retrofit projects, where needed, to collect NPS pollutant loadings from existing, reconstructed, and rehabilitated roads, highways, and bridges. Poorly designed or maintained roads and bridges can generate significant erosion and pollution loads containing heavy metals, hydrocarbons, sediment, and debris that run off into and threaten the quality of surface waters and their tributaries. In areas where such adverse impacts to surface waters can be attributed to adjacent roads or bridges, retrofit management projects to protect these waters may be needed (e.g., installation of structural or nonstructural pollution controls). Retrofit projects can be located in existing rights-of-way, within interchange loops, or on adjacent land areas. Areas with severe erosion and pollution runoff problems may require relocation or reconstruction to mitigate these impacts.

Runoff management systems are a combination of nonstructural and structural practices selected to reduce nonpoint source loadings from roads, highways, and bridges. These Systems are expected to include structural improvements to existing runoff control structures for water quality purposes; construction of new runoff control devices, where necessary to protect water quality; and scheduled operation and maintenance activities for these runoff control practices. Typical runoff controls for roads, highways, and bridges include vegetated filter strips, grassed swales, detention basins, constructed wetlands, and infiltration trenches.

3. Management Measure Selection

This management measure was selected because of the demonstrated effectiveness of retrofit systems for existing roads and highways that were constructed with inadequate nonpoint source pollution controls or without such controls. Structural practices for initigating polluted runoff from existing highways are described in the literature (Silverman, 1988).

4. Practices

As discussed more fully at the beginning of this chapter and in Chapter 1, the following practices are described for illustrative purposes only. State programs need not require implementation of these practices. However, as a practical matter, EPA anticipates that the management measure set forth above generally will be implemented by applying one or more management practices appropriate to the source, location, and climate. The practices set forth below have been found by EPA to be representative of the types of practices that can be applied successfully to achieve the management measure described above.

a. Locate runoff treatment facilities within existing rights-of-way or in medians and interchange loops.

b. Develop multiple use treatment facilities on adjacent lands (e.g., parks and golf courses).

c. Acquire additional land for locating treatment facilities.

d. Use underground storage where no alternative is available.

e. Maximize the length and width of vegetated filter strips to slow the travel time of sheet flow and increase the infiltration rate of urban runoff.

5. Effectiveness Information and Cost Information

Cost and effectiveness data for structural urban runoff management and pollution control facilities are outlined in Tables 4-15 and 4-16 in Section III and discussed in Section IV of this chapter and are applicable to determine the cost and effectiveness of retrofit projects. Retrofit projects can often be more costly to construct because of the need to locate the required structures within existing space or the need to locate the structures within adjacent property that requires purchase. However, the use of multiple use facilities on adjacent lands, such as diverting runoff waters to parkland or golf courses, can offset this cost. Nonstructural practices described in the urban section also can be effective in achieving source control. As with other sections of this document, the costs of loss of habitat, fisheries, and recreational areas must be weighed against the cost of retrofitting control structures within existing rights-of-way.

6. Pollutants of Concern

Management Measures for Planning, Siting, and Developing Roads and Highways

Table 4-31 lists the pollutants commonly found in urban runoff from roads, highways, and bridges and their sources. The disposition and subsequent magnitude of pollutants found in highway runoff are site-specific and are affected by traffic volume, road or highway design, surrounding land use, climate, and accidental spills.

The FHWA conducted an extensive field monitoring and laboratory analysis program to determine the pollutant concentration in highway runoff from 31 sites in 11 States (Driscoll et al., 1990). The event mean concentrations (MCs) developed in the study for a number of pollutants are presented in Table 4-32. The study also indicated that for highways discharging into lakes, the pollutants of major concern are phosphorus and heavy metals. For highways discharging into streams, the pollutants of major concern are heavy metals - cadmium, copper, lead, and zinc.

Table 4-31. Highway Runoff Constituents and Their Primary Sources

Constituents	Primary Sources
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorous	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exaust) tire wear(lead oxide filter material, lubricating oil and grease, bearing wear)
Zinc	Tire wear (filter material), motor oil(stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guard rails, bridges, etc.), moving engine parts
Cooper	Metal plating, bearing and brushing wear, moving engine parts, break lining wear, fungicides and insecticides
Cadmium	Tire wear (filter material), insecticide application
Chromium	Metal plating, moving engine parts, break lining wear
Nickel	Diesel fuel and gasoline (exhaust), lubricating oil, metal plating, bushing wear, break lining wear, asphalt paving
Manganese	Moving engine parts
Cyanide	Anticake compound (ferric ferrocyanide, sodium ferrocyanide, Yellow prussiate of soda) used to keep deicing salt granular
Sodium, Calcium, Chloride	Deicing salt
Sulphate	Roadway beds, fuel, deicing salt
Petroleum	Spills, leaks or blow-by of motor lubricants, antifreeze and

Hydraulic fluids, asphalt surface leachate

Table 4-32. Pollutant Concentrations in Highway Runoff (Driscoll et al., 1990)

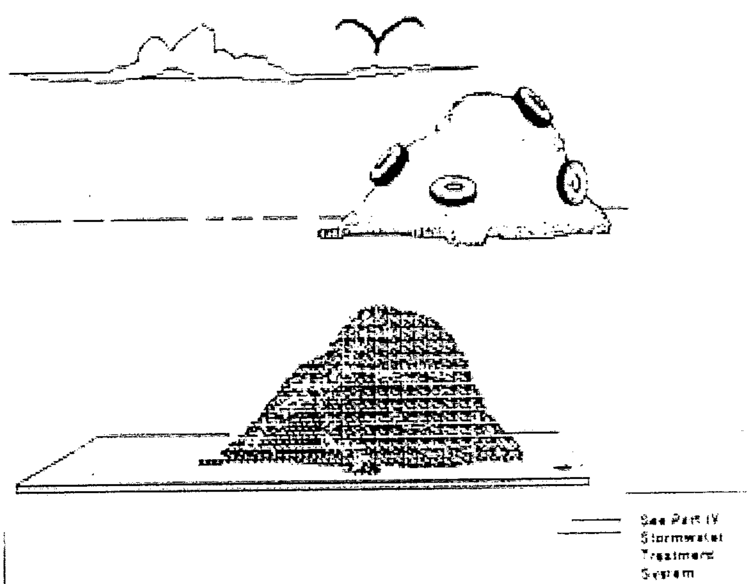
Pollutants	Event Mean Concentration For Highways with Fewer Than 30,000 Vehicles/Day (Mg/L)	Event Mean Concentration for Highways with More than 30,000 Vehicles/Day (Mg/L)
Total Suspended solids	41	142
Volatile Suspended Solids	12	39
Total Organic Carbon	8	25
Chemical Oxygen Demand	49	114
Nitrite and Nitrate	0.46	0.76
Total Kjeldahl Nitrogen	0.87	1.83
Phosphate Phosphorus	0.16	0.40
Copper	0.022	0.054
Lead	0.080	0.400
Zinc	0.080	0.329

Best Management Practice for:
Outside Storage of Raw Materials, Byproducts or Products

If the raw material, byproduct or product is a liquid, see AST and container BMPs. This BMP is for:
- Loose material such as gravel, sand, topsoil, compost, sawdust, wood chips;
- Lumber and other building materials
- Concrete and metal products

The business is to select one of the following BMPs appropriate to the type of material:
1. Build a covered area. The area upon which the materials is stored should be paved.
2. Or: place temporary plastic sheeting over the material as illustrated (see graphic field).
3. Or: pave the area and install a drainage system. Stormwater from the area shall be treated using a runoff treatment system.

Signs shall be painted on strom drain inlets to indicate that they are not to receive liquid or solid wastes.



Reference: Water Quality, Best Management Practices Manual for Commercial and Industrial Businesses, City of Seattle 1989

A Checklist of Water Conservation Ideas For

This checklist provides water conservation tips successfully implemented by industrial and commercial users. This list has been revised from the original copy first published and distributed by the Los Angeles Department of Water and Power and the Water Efficiency Manual by the North Carolina Department of Environment and Natural Resources.

START A WATER CONSERVATION PROGRAM

- Increase employee awareness of water conservation.
- Install signs encouraging water conservation in employee and customer restrooms.
- When cleaning with water is necessary, use budgeted amounts.
- Read water meter weekly to monitor success of water conservation efforts.
- Assign an employee to monitor water use and waste.
- Seek employee suggestions on water conservation; put suggestion boxes in prominent areas.
- Determine the quantity and purpose of water being used.
- Determine other methods of water conservation.
- Conduct contests for employees (e.g., posters, slogans, or conservation ideas).

PLANNING AND DESIGN

- Consider the following:
  - Physical conditions (drainage, soil type, sun/shade, etc.) and the use of the site (foot traffic, recreation, viewing, etc.)
  - Creating shade areas, which can be 20 degrees cooler than non-shaded areas, decreasing evaporation.
  - Grass areas only where needed; avoid small areas under 10 feet wide.
  - Permeable materials such as porous concrete or permeable paving methods.

  - Grading and directing surface run-off and rainfall gutters to landscaped areas as opposed to drainageways that exit the property.
- Incorporate high water demanding plants at the bottom of slopes, and maintain the use of existing trees, plants, and wildlife in the area during planning.
- Minimize the use of impermeable surfaces to lessen runoff and resulting stormwater pollution.
- Identify water source points.
- Develop a schematic of all water entry points (know where your faucets, time clocks, solenoids, booster pumps, sprinklers and bubblers are located).

- Identify capacity of each water-carrying unit and frequency of use.
- Determine specific use for each entry source.

ANALYZE AND IMPROVE SOIL CONDITIONS

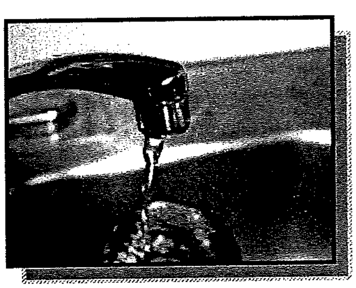
- Test the soil quality, nutrients and absorptive capacity, and then select plants based on findings. Adjust the pH level if necessary.
- Use organic matter (compost, mulch or manure) to increase the soil's water holding capacity. This helps improve water distribution and lowers levels of evaporation.
- When improving the soil of a given area, remember to treat a larger area around the planting to allow ample space for root systems.
- Prevent heavy construction equipment from compacting soil in areas around trees or other sensitive habitats.

PLANT SELECTION

- Choose native, climate-appropriate species.
- Consider plants' water demand, pest tolerance, soil nutrient and drainage requirements.

INTERIOR AREAS

- Discontinue continuous flow.
- Use ponded water where available.
- Adjust flows to reduce discharge of water.
- Install water-saving devices to decrease water consumption – restrooms (toilet dams and flappers), faucets (aerators), cooling systems.



    - Retrofit toilets with high efficiency models that use 1.28 gallons per flush or less.
    - Retrofit urinals with high efficiency models that use 0.5 gallons per flush.
    - Install showerheads with a flow rate of 1.5 gpm at 60 psi or less in all units.
    - Retrofit bathroom sink faucets with fixtures that do not exceed 1 gpm at 60 psi.
- Use recycling systems for chillers and cooling towers.
- Consider installing energy-and-water-efficient air conditioning equipment.

MAINTENANCE PROCEDURES

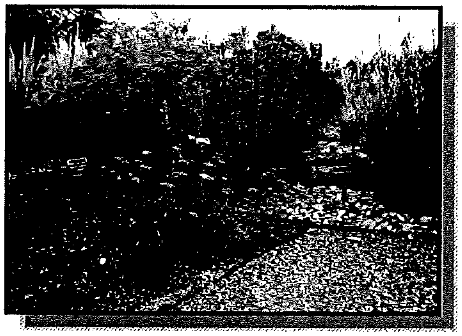
- Sweep materials from floor instead of washing down whenever possible.
- Instruct clean-up crews to use less water where appropriate.
- Check water supply system for leaks.
- Repair dripping faucets and continuously-running or leaking toilets.

DESIGN CRITERIA FOR TURF AND LANDSCAPE AREAS

- Contact the Department of Water Resources or your local water supplier about possible landscape water auditor classes for managers.
- Hire a landscape architect with water conservation and xeriscape experience.
- Use turf only where actually necessary: Immediate picnic areas/outside lunch areas and gold course target areas (greens, tees, landing areas).
- Turfgrass should be cut to the maximum recommended height for its type (generally a minimum of two inches to a maximum of four inches) for most efficient water use.
- Use only low-water use plant material in non-turf areas.

- Drip irrigation and microsprays place water at the base of the plant. This reduces evaporation and saves water by not soaking the entire ground surface. This works for trees, shrubs, and groundcovers.

- Use automatic irrigation systems monitored by moisture probes (i.e. tensiometers), and rain shut-off devices to cut power off during rain.



- Design dual watering systems with sprinklers for turf and low-volume irrigation for plants, trees, and shrubs. Operate sprinkler system before sunrise and after sunset. Amount of irrigation can be determined by the evapotranspiration rate, which DWR can help you determine.

- Use properly-treated waste water for irrigation where available.

EXTERIOR AREAS

- Regular aeration of clay soils will improve water holding capabilities and prevent runoff.

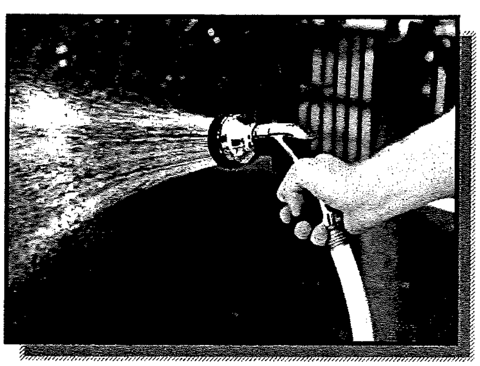
- Discontinue using water to clean sidewalks, tennis courts, pool decks, driveways, and parking lots.

- Make sure irrigation water does not run onto streets or into alleys. Adjust sprinklers to water only plants and not sidewalks or roads.

- Use the same size nozzle when replacement is needed. Sprinklers should be replaced with the same brand of sprinklers. Spray heads are aligned with grade.

- Replace worn spray nozzles.

- Regulate pressure properly for system demands.



- Make sure rotors or spray heads are mounted correctly. Replace with proper unit for the job.

- Post a current controller schedule inside the door of the controller.

- Check for leaking valves.

- Adjust the operating time (runtimes) of the sprinklers to meet appropriate seasonal or monthly requirements.

- Check plant leaves and take soil samples to confirm proper system functioning.

- Look into alternative sources for irrigation water (i.e. the use of wells as opposed to city water, water reuse operations from air conditioning condensate, storm water retention ponds, or cisterns, non-contact cooling water).

- Use dedicated water meters to monitor landscaping water use.

- Have a catchment/distribution uniformity test performed on-site to determine how evenly water is applied when sprinklers are in use.

For more information, contact:
Maui County Department of Water Supply
Water Resources and Planning Division
59 Kanoa Street Wailuku, HI 96793
Telephone: (808) 244-8550
FAX: (808) 244-6701

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

David Taylor, Director
Department of Water Supply
County of Maui
200 South High Street, Room No. 434
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mr. Taylor:

Thank you for your Department's letter, dated July 6, 2010, providing comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, Department of Public Works (DPW), we offer the following responses to your comments.

Source Availability and Consumption

The proposed project will not require potable water sources. However, we acknowledge that the Central Maui System currently has no additional source available according to system standards and that the County of Maui, Department of Water Supply (DWS) may delay issuance of meters until new sources are on line.

Non-potable water will be needed during construction and for long-term irrigation of the roadway landscaping. Construction water for dust control will utilize non-potable water from reclaimed water sources or irrigation water which is readily available near the project site. Long-term irrigation of the roadway landscaping will utilize non-potable water from Maui Tropical Plantation.

System Infrastructure

Thank you for the information on the Central Maui Water System infrastructure near the project area. We understand that DWS Engineering Division will need to review the construction plans, and as such, DPW will provide construction plans to DWS. We note and confirm that any water valve covers on East Waiko Road will be lifted to match the finish grade of the roadway.

305 High Street, Suite 104 · Wailuku, Hawaii 96793 · ph: (808)244-2015 · fax: (808)244-8729 · planning@mhplanning.com · www.mhplanning.com

Waikapu Stream Channel Alteration Permit

We understand that a Stream Channel Alteration Permit (SCAP) may be required for the Waikapu Stream crossing for the Waiale Road Extension. Coordination will be carried out with the Commission on Water Resource Management to determine if a SCAP will be required for the project.

Pollution Prevention

As suggested, Best Management Practices (BMPs) shall be implemented to reduce contaminants from roadways. Some examples of BMPs that will be implemented are:

1. During schematic design, the Waiale Road Extension will be design to avoid areas requiring excessive cut and fill.

2. Stormwater runoff on the Waikapu bridge crossing will be directed away from the bridge deck towards the drainage collection system to avoid stormwater runoff into Waikapu Stream. Furthermore, the Waikapu bridge crossing design parameters will allow a 1-hour 100-year storm event to pass under the bridge crossing.

3. An erosion and sediment control management plan will be created and implemented as part of the construction plans.

4. Erosion and sediment control measures will be installed at the earliest practicable time during the construction phase.

Road Maintenance

Majority of suggested BMPs related to landscaping will prevent ground and surface water contamination from road maintenance. DPW is not intending to provide long-term maintenance of landscaping of roadways. Long-term maintenance of landscaping will be provided by and along with the proposed Waikapu Country Town development.

Conservation

Conservation measures will be utilized during construction, such as, the use of non-potable water for dust control either by utilizing reclaimed water or irrigation water which is readily available near the project site.

Landscaping plans for the Waiale Road portion of the project will incorporate native Hawaiian plants adapted to the natural rainfall of the area. It is noted that the subject property area is located in Plant Zone 4. Furthermore, conservation measures for irrigated areas will be incorporated into the proposed project. Landscaping design will incorporate the plant's water requirements and be properly located to promote water conservation.

We appreciate the input from your office. A copy of the Draft EA will be provided to you for review and comment.

Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:lh
cc: David Goode, County of Maui, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
F:\DATA\COM\DPW WaialeExt\DWS.ecres.doc

JUN 02 2010

CHARMAINE TAVARES
Mayor

CHERYL K. OKUMA, Esq.
Director

GREGG KRESGE
Deputy Director

TRACY TAKAMINE, P.E.
Solid Waste Division

DAVID TAYLOR, P.E.
Wastewater Reclamation
Division

COUNTY OF MAUI
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 100
WAILUKU, MAUI, HAWAII 96793

May 27, 2010

Ms. Leilani Pulmano
Munekiyo & Hiraga, Inc.
305 High Street Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

SUBJECT: **PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS IN WAIKAPU**
EARLY CONSULTATION
TMK (2) 3-6-002:003 (POR.), WAIKAPU

We reviewed the subject application and have the following comments:

1. Solid Waste Division comments:

   a. None.

2. Wastewater Reclamation Division (WWRD) comments:

   a. There is not any County Wastewater Facilities within the existing or proposed road rights of way.

   b. Note that there is a private sewer force main within Waiko Road owned and operated by the Waiko Baseyard Subdivision.

If you have any questions regarding this memorandum, please contact Gregg Kresge at 270-8230.

Sincerely,

Cheryl K. Okuma

Cheryl K. Okuma, Director

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Kyle Ginoza, Director
Department of Environmental Management
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mr. Ginoza:

Thank you for your Department's letter, dated May 27, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

We acknowledge the following Wastewater Reclamation Divisions comments:

1. There is no County Wastewater Facilites within the existing East Waiko Road right-of-way or proposed Waiale Road right-of-way.

2. There is a private sewer force main within the East Waiko Road right-of-way that is owned and operated by the Waiko Baseyard Subdivision. As such, DPW will coordinate with the owners of Waiko Baseyard Subdivision during the design and construction phase of the project.

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We appreciate the input provided by your department. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
F:\DATA\COM\DPW WaialeExt\DEM.ecres.doc

MAY 26 2010

POLICE DEPARTMENT
COUNTY OF MAUI

CHARMAINE TAVARES
MAYOR

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

GARY A. YABUTA
CHIEF OF POLICE

CLAYTON N.Y.W. TOM
DEPUTY CHIEF OF POLICE

OUR REFERENCE

YOUR REFERENCE

May 24, 2010

Munekiyo & Hiraga, Inc.
Attn: Ms. Leilani Pulmano, Project Manager
305 High Street, Suite 104
Wailuku, HI 96793

Re: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Ms. Pulmano:

This is in response to your request dated May 12, 2010, requesting our review and early consultation comments on the proposed project for the above-referenced matter.

At this time, the department has no objections to the progression of the project. The only concern is the new access to East Waiko Road from Honoapiilani Highway. A traffic impact study would be the only means to assess the levels of service in current and future conditions. For your information, please see the attached memorandum from Acting Assistant Chief Jody Singsank.

If you have any questions, please do not hesitate to contact me.

Sincerely,

GARY A. YABUTA
Chief of Police

Enclosure
cc: Assistant Chief Danny Matsuura

7

(Signed) 05/24/10

KAY, NOTED FOR MUNEKIYO. TO MAY 5/24/10

TO : GARY YABUTA, CHIEF OF POLICE, COUNTY OF MAUI

VIA : CHANNELS

FROM : JODY SINGSANK, ACTING ASSISTANT CHIEF, UNIFORMED SERVICES BUREAU

SUBJECT : RESPONSE TO AN EARLY CONSULTATION REQUEST FOR THE PROPOSED WAIALE ROAD EXTENTION AND EAST WAIKO ROAD IMPROVEMENTS

This communication is submitted as a response to a request for pre-consultation comments by Munekiyo and Hiraga, Inc., Project Manager Leilani Pulmanol, regarding:

SUBJECT : EARLY CONSULTATION REQUEST FOR THE PROPOSED WAIALE ROAD EXTENTION AND EAST WAIKO ROAD IMPROVEMENTS

RESPONSE:

In review of the submitted documents, concerns from the police perspective are upon the safety of pedestrian and vehicular movement.

The only concern at this early stage is the new access to East Waiko Road from Honoapiilani Highway. A traffic impact study would be the only means to assess the levels of service in current and future conditions. There are no objections to the progression of the project at this time

Respectfully submitted,
Act. A/C J. Singsank 8467
Act. Asst. Chief Jody K.M. SINGSANK, E-8467
Patrol Division – Wailuku District
05/20/10 1125 hrs.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Gary A. Yabuta, Chief
Attention: Jody K.M. Singsank
Police Department
County of Maui
55 Mahalani Street
Wailuku, Hawaii 96793

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Chief Yabuta:

Thank you for your letter, dated May 24, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

A Traffic Impact Analysis Report (TIAR) will be conducted for the project and will be included in the Draft Environmental Assessment.

We appreciate the input provided by the Maui Police Department. A copy of the Draft Environmental Assessment will be submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LL

Leilani Pulmano
Progam Manager

LP:yp
cc: David Goode, Department of Public Works
Matt Nakamoto, Austin, Tsutsumi & Associates, Inc.

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MAY 20 2010

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8461

May 18, 2010

Ms. Leilani Pulmano, Project Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii, 96793

Subject: Waiale Road Extension and East Waiko Road Improvements – Early Consultation
Waiale Road Extension and East Waiko Road
Wailuku, Maui, Hawaii
Tax Map Key: (2) 2-4-006; (2) 2-4-018; (2) 2-4-022; (2) 2-4-034

Dear Ms. Pulmano,

Thank you for allowing us to comment on the Draft Environmental Assessment for the subject project.

In reviewing our records and the information received, Maui Electric Company has no objections at this time. We would highly encourage the customer's consultant to submit survey and civil plans to us as soon as practical to address and coordinate any possible relocation of our facilities. Should there be any electrical requirements for the project, we encourage the applicant's consultant to submit electrical drawings and a project time schedule as soon as practical so that service can be provided on a timely basis.

Should you have any questions or concerns, please call me at 871-2341.

Sincerely,

Kyle Tamori
Staff Engineer

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Kyle Tamori, Staff Engineer
Maui Electric Company, Ltd.
P. O. Box 398
Kahului, Hawaii 96733

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapu, Maui, Hawaii

Dear Mr. Tamori:

Thank you for your letter, dated May 18, 2010, providing early consultation comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

At the earliest practical time in the planning and design process, the DPW will submit civil plans and a survey to coordinate any possible relocation of affected electrical facilities. The DPW will also submit electrical drawings and a project timeline during the building permit process to ensure that services can be provided in a timely manner.

We appreciate the input provided by your organization. A copy of the Draft Environmental Assessment will submitted to your office for review and comment. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Department of Public Works
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OCT 04 2010

Waikapū Community Association

To enhance the quality of life for the residents of Waikapū through the preservation and appreciation of its history, natural environment, and values of its rural tradition.

Ms. Leilani Pulmano,
Project Manager
Munekiyo & Hiraga, Inc
305 High Street, Suite 104
Wailuku, HI 96793

September 29, 2010

SUBJECT: Early Consultation Request for the proposed Waiale Road Extension and East Waiko Road Improvements in Waikapū, Maui, Hawaii

Dear Ms. Pulmano,

The Waikapū Community Association appreciates this opportunity to provide early comments on this proposed Project.

The WCA Development Monitoring Committee met on September 22, 2010 to discuss the materials provided in your letter of May 12, 2010. We hope to be able to respond faster in the future, now that you have our current address.

The Committee has the following comments, based on the Waikapū Community Association's Statement of Values (attached):

1) Separated bikepaths and sidewalks should be included in the roadway design for the improvements of East Waiko Road and the entire length of Waiale Road, from the Honoapiilani Highway to the intersection with Kuhikahi Drive/Maui Lani Parkway(?). Developments planned for both ends of that entire corridor will be expected to bring stores, schools, churches, housing for the elderly and additional residential development to the area, which must be expected to generate a considerable amount of pedestrian and bicycle traffic along Waiale Road. Additionally, an effort underway under the auspices of the State Department of Health to develop a plan to integrate non-motorized transportation in individuals' daily routine, is looking at the Waiale Road corridor as a regional connector corridor for the Wailuku to Waikapū routes. It would make sense to incorporate the necessary design to support all these needs in this project.
2) Street lighting should be provided in the roadway design for the improvements of East Waiko Road and the entire length of Waiale Road, from the Honoapiilani Highway to the intersection with Kuhikahi Drive/Maui Lani Parkway(?). For the same reasons as cited above, street lights are a critical element of the safety

82

design for the pedestrian and bicycle traffic that must be expected along these corridors

3) Traffic signals must be places must be placed in three (3) locations:
   a. At the intersection of Waiale Road and Honoapiilani Highway
   b. At the intersection of Waiale Road and East Waiko Road
   c. Ath the intersection of Waiale Road and Haawi Street, to provide residents of the Waikapū Gardens subdivision a safe and reasonable opportunity to exit and enter that subdivision. The heavy traffic expected if this bypass meets its objectives, will make this traffic light a safety necessity for this subdivision's residents.
4) The stop sign on East Waiko Road at the entrance to the Rojac Baseyard must be relocated to face traffic exiting from the Rojac Baseyard, and provide the right of way to traffic on East Waiko Road.
5) Landscaping of drought resistant groundcover and suitable shade providing trees, preferably using species native to the Hawaii, should be included in the roadway design for the improvements of East Waiko Road and the entire length of Waiale Road, from the Honoapiilani Highway to the intersection with Kuhikahi Drive/Maui Lani Parkway(?). The Waikapū Community Association is involved in the Adopt-a-Highway program for a portion of Honoapiilani Highway; the Association will be willing to adopt the roadways in this project to provide cleanup of roadways and associated landscaping.
6) Drainage along East Waiko Road must be designed to accommodate large volumes of run-off in a short time, to improve safety during times of heavy rain. Storm drain grates or similar constructs to remove water from the swale into a drain system is recommended.

The Waikapū Community Association looks forward to continuing dialogue regarding this project. Please provide us with a copy of the Draft Environmental Assessment for additional review. The Development Monitoring Committee requests to be informed of any meetings regarding this project, s may need to be scheduled before any approving bodies.

Thank you again for this opportunity to provide early comments on this project.

Sincerely,

Jacob W. Verkerke
Waikapū Community Association Chair

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

February 18, 2011

Jacob W. Verkerke
Waikapū Community Association
P.O. Box 3046
Wailuku, Hawaii 96793

SUBJECT: Waiale Road Extension and East Waiko Road Improvement Environmental Assessment (EA) Early Consultation

Dear Mr. Verkerke:

Thank you for your letter, dated September 29, 2010, providing comments on the proposed Waiale Road Extension and East Waiko Road Improvement project. On behalf of the applicant, County of Maui, Department of Public Works (DPW), we offer the following information in response to the comments noted in your letter.

Bikepaths and Walkways

As part of the design for Waiale Road Extension, a separated path for bicyclist and pedestrians will be included. The path will be on the mauka side of the road. A bikepath and sidewalk will not be part of the DPW improvements planned for East Waiko Road. However, as adjacent property owners develop their lands for urban uses, they will be required to provide improvements such as, but not limited to, sidewalks.

Streetlights

In keeping with the character of the existing Waiale Road, streetlights are only envisioned to be at the intersections of Waiale Road Extension/Honoapiilani terminus and the Waiale Road/East Waiko Road.

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Traffic Signals

Traffic signals will be installed, when warranted, at the intersections of Waiale Road Extension/Honoapiilani Highway terminus and Waiale Road/East Waiko Road. The Traffic Impact Assessment Report (TIAR) did not recommend a traffic light at Haawi Street, but recommended acceleration and deceleration lanes at the three (3) intersections for Waikapu Gardens subdivision. The implementation of these intersections will be completed as master-planned communities come on-line and as recommended by their respective TIARs.

Stop Sign on East Waiko Road

The DPW is working to acquire the land underlying the East Waiko Road corridor which includes the area where the stop sign is located on East Waiko Road. Once the portion of East Waiko Road is acquired, the DPW will be removing the stop sign to provide the right of way for vehicles on East Waiko Road.

Landscaping

Landscaping is included in the design of the Waiale Road Extension. As recommended, drought resistant groundcover and suitable shade trees will be installed. We appreciate your willingness to adopt the Waiale Road Extension as part of the Adopt-a-Highway program.

Drainage

A drainage system will be provided to handle the incremental increase of a 50-year 1-hour storm event using retention/detention basins.

We appreciate the input provided by your organization and will include a copy of your letter in the Draft Environmental Assessment for the project. Should you have any questions or further comments, please contact me at 244-2015.

Sincerely,

LPL

Leilani Pulmano
Project Manager

LP:tn
cc: David Goode, Department of Public Works
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X. AGENCIES CONSULTED DURING THE PREPARATION OF THE FINAL ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED DURING THE 30-DAY PUBLIC COMMENT PERIOD; AND RESPONSES TO SUBSTANTIVE COMMENTS

X. AGENCIES CONSULTED DURING THE PREPARATION OF THE FINAL ENVIRONMENTAL ASSESSMENT; LETTERS RECEIVED DURING THE 30-DAY PUBLIC COMMENT PERIOD; AND RESPONSES TO SUBSTANTIVE COMMENTS

A Draft Environmental Assessment for the subject project was filed and published in the Office of Environmental Quality Control's The Environmental Notice on March 8, 2011.

Comments on the Draft EA were received during the 30-day public comment period. Comments, as well as responses to substantive comments, are included in this chapter.

1. Ranae Ganske-Cerizo, Soil Conservationist
   Natural Resources Conservation Service
   U.S. Department of Agriculture
   77 Hookele Street, Suite 202
   Kahului, Hawaii 96732

2. Mike Johanns, Secretary of Agriculture
   U.S. Department of Agriculture
   Office of the Secretary
   Administration Building, Rm. 240W
   14th Street & Independence Avenue, S.W.
   Washington, D.C. 20250

3. George Young
   Chief, Regulatory Branch
   U.S. Department of the Army
   U.S. Army Engineer District, Honolulu
   Regulatory Branch
   Building 230
   Fort Shafter, Hawaii 96858-5440

4. Wayne Nastri, Regional Administrator
   U.S. Environmental Protection Agency
   Region 9
   75 Hawthorne Street
   San Francisco, California 94105

5. Loyal A. Mehrhoff, Field Supervisor
   U. S. Fish and Wildlife Service
   300 Ala Moana Blvd., Rm. 3-122
   Box 50088
   Honolulu, Hawaii 96813

6. Patricia Port
   U. S. Department of Interior
   Regional Environmental Officer
   Environmental Policy and Compliance
   Oakland Region
   Jackson Center One
   1111 Jackson Street, Suite 520
   Oakland, California 94607

7. Cynthia Burbank, Associate Administrator
   U.S. Department of Transportation
   Planning, Environment and Realty
   Federal Highway Administration
   400 7th Street, S.W.
   Washington, D.C. 20590-9898

8. Bruce Coppa, Director
   Department of Accounting and General Services
   1151 Punchbowl Street, #426
   Honolulu, Hawaii 96813

9. Russell Kokubun, Chair
Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

10. Richard C. Lim, Director
State of Hawaii
Department of Business, Economic Development & Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

11. Alapaki Nahale-a, Chairman
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

12. Director of Department of Health
State of Hawaii
Department of Health
919 Ala Moana Blvd., Room 300
Honolulu, Hawaii 96814

13. Alec Wong, P.E., Chief
Clean Water Branch
State of Hawaii
Department of Health
919 Ala Moana Blvd., Room 300
Honolulu, Hawaii 96814

14. Patti Kitkowski
Acting District Environmental Health Program Chief
State of Hawaii
Department of Health
54 High Street
Wailuku, Hawaii 96793

15. William J. Aila, Jr., Chairperson
State of Hawaii
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

16. Administrator of State Historic of Preservation Division
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
601 Kamokila Blvd., Room 555
Kapolei, Hawaii 96707

17. Morgan Davis
Department of Land and Natural Resources
State Historic Preservation Division
130 Mahalani Street
Wailuku, Hawaii 96793

18. Glenn Okimoto, Director
State of Hawaii
Department of Transportation
869 Punchbowl STreet
Honolulu, Hawaii 96813

19. Clyde Nāmu`o, Administrator
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

20. Jesse Souki, Director
State of Hawaii
Office of Planning
P. O. Box 2359
Honolulu, Hawaii 96804

21. Dan Davidson, Executive Officer
State of Hawaii
State Land Use Commission
P.O. Box 2359
Honolulu, Hawaii 96804

22. Joseph Souki, Representative
House of Representatives
Hawaii State Capitol, Room 433
415 S. Beretania Street
Honolulu, Hawaii 96813

23. Alan Arakawa, Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

24. Anna Forest, Officer Management Officer
Maui Civil Defense Agency
200 South High Street
Wailuku, Hawaii 96793

25. Jeffrey A. Murray, Fire Chief
County of Maui
Department of Fire and Public Safety
200 Dairy Road
Kahului, Hawaii 96732

26. Jo-Ann Ridao, Director
County of Maui
Department of Housing and Human Concerns
One Main Plaza
2200 Main Street, Suite 546
Wailuku, Hawaii 96793

27. Glenn Correa, Director
County of Maui
Department of Parks and Recreation
700 Halia Nakoa Street, Unit 2
Wailuku, Hawaii 96793

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

29. Gary Yabuta, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

30. Kyle Ginoza, Director
County of Maui
Department of Environmental Management
One Main Plaza
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

31. Jo Anne Johnson, Director
County of Maui
Department of Transportation
200 South High Street
Wailuku, Hawaii 96793

32. David Taylor, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawaii 96793

33. Councilmember Michael Victorino
Maui County Council
200 South High Street
Wailuku, Hawaii 96793

34. **Hawaiian Telcom**
60 South Church Street
Wailuku, Hawaii 96793

35. Dan Takahata, Manager Engineering
Maui Electric Company, Ltd.
P. O. Box 398
Kahului, Hawaii 96733

36. Jacob W. Verkerke, Chair
Glenn M. Adolpho, Development Monitoring Committee Chair
Waikapu Community Association
P.O. Box 3046
Wailuku, Hawaii 96793

37. **Wailuku Community Association**
40 Hoauna Street
Wailuku, Hawaii 96793

38. Joseph G. Blackburn II
Waiolani Community Association
P.O. Box 1067
Wailuku, Hawaii 96793

39. **Waikapu Gardens Homeowners Association**
67 East Waiko Road
Wailuku, Hawaii 96793

40. **Consolidated Baseyard**
c/o Frampton & Ward, LLC
2073 Wells Street, Suite 101
Wailuku, Hawaii 96793

41. **Rojac Trucking**
150 Pakana Street
Wailuku, Hawaii 96793

42. Jocelyn Perreira, Executive Director
Wailuku Main Street Association
1942 Main Street, Unit 101
Wailuku, Hawaii 96793

43. Scott Nunokawa
P. O. Box 946
Wailuku, Hawaii 96793

44. **Maui Tropical Plantation**
1670 Honoapiilani Highway
Wailuku, Hawaii 96793

45. **Spencer Homes**
67 East Waiko Road
Wailuku, Hawaii 96793

46. Mike Atherton
1132 Norman Drive
Mantela, California 95336

47. Grant Chun
A&B Properties, Inc.
11 Puunene Avenue
Kahului, Hawaii 96732

48. Albert Kanno
ABC Development Co., LLC
815 Waikamilo Road
Honolulu, Hawaii 96817

49. Roderick Fong
495 Hukilike Street, Bay 4
Kahului, Hawaii 96732

APR 25 2011

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

April 21, 2011

Regulatory Branch **File No. POH-2010-00147**

Leilani Pulmano, Program Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Dear Ms. Pulmano:

This is in response to your March 4, 2011 letter acting as agent for the Department of Public Works, County of Maui. and requesting a Department of the Army (DA) permit review and comments for the proposed Waiale Road Extension and East Waiko Road Improvements Project located at Waikapu, Maui, Island (esp.TMKs 235002014 and 236002003).

The proposed project was reviewed pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States (U.S.), prior to conducting the work (33 U.S.C. 403). Navigable waters of the U.S. are those waters subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or other waters identified as navigable by the Honolulu District. In addition, a Section 10 permit is required for structures or work outside this limit if they affect the course, location, or condition of the waterbody as to its navigable capacity.

Section 404 requires that a DA permit be obtained for the placement or discharge of dredged and/or fill material into waters of the U.S., including wetlands, prior to conducting the work (33 U.S.C. 1344). For regulatory purposes, the U.S. Army Corps of Engineers (Corps) defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The area of Corps jurisdiction under Section 404 extends to the Mean Higher High Tide Line (MHHTL) or to the Ordinary High Water Mark (OHWM) for navigable waters other than the Pacific Ocean, and to the upland boundary of any adjacent wetlands.

Based on our review of the information furnished, we have determined that the proposed location of the new Waikapu Stream Bridge to extend Waiale Road will require consultation with our office. The schematic in the EA, as described and located, does not provide sufficient detail to determine that the temporary or permanent placement of fill and/ or dredged material will likely occur or not occur. There are no navigable waters of the U.S. under Section 10 at the proposed new bridge location/stream crossing. An approved JD for Waikapu Stream is provided (Attachment).

If you object to this determination, you may request an Administrative Appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. We have enclosed a Notification of Appeal Process and Request For Appeal (NAP/RFA) form for Waikapu Stream. If you request to appeal the jurisdictional determination you must submit a completed NAP/RFA form to the Corps' Pacific Ocean Division office at the following address:

Thom Lichte, Appeals Review Officer
U.S. Army Corps of Engineers
Pacific Ocean Division, ATTN: CEPOD-PDC
Building 525
Fort Shafter, HI 96858-5440

In order for an NAP/RFA to be accepted by the Corps, the Corps must determine that the RFA is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division office within 60 days of the date of the NAP/RFA sheet. If you decide to submit an NAP/RFA form, it must be received at the above address by June 21, 2011. It is not necessary to submit an NAP/RFA form to the Division office if you do not object to the determination in this letter. You may contact Mr. Lichte at (808) 438-0397.

This jurisdictional determination is valid for a period of five (5) years from the date of this letter unless new information warrants revision of the delineation before the expiration date.

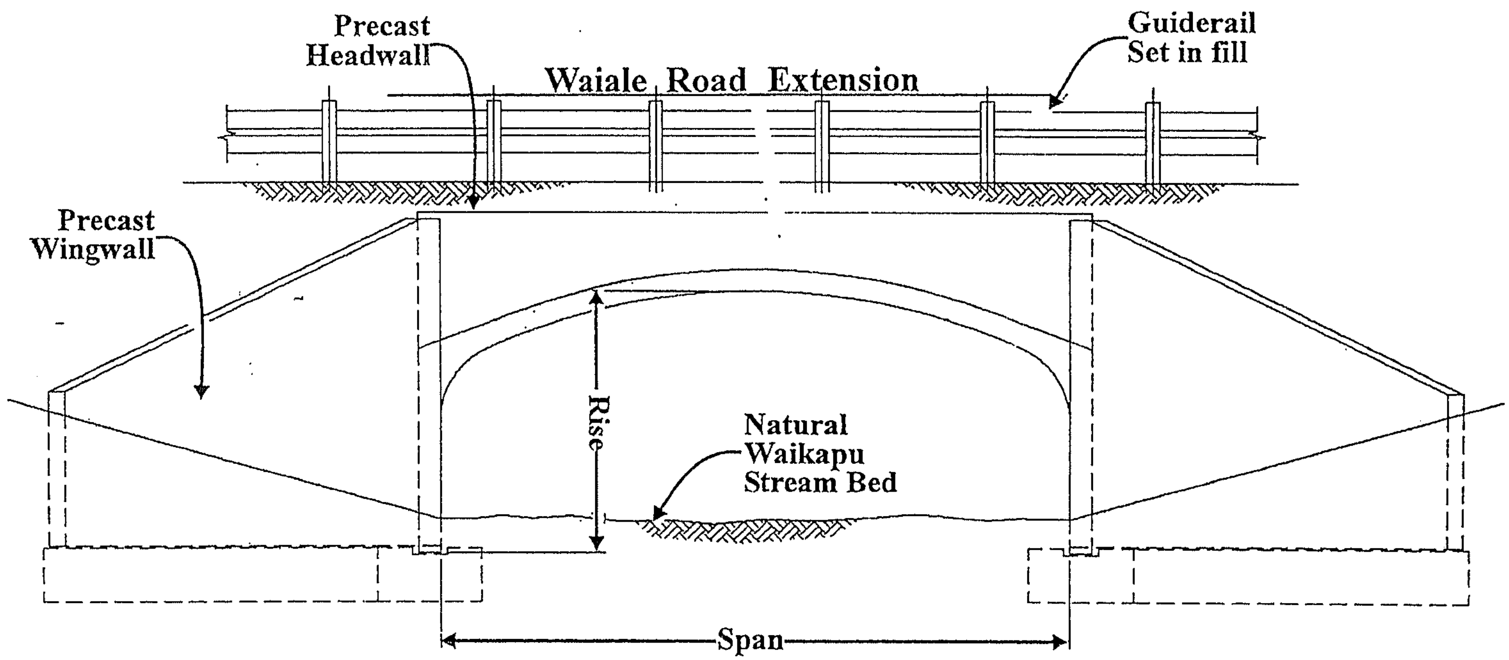
Thank you for giving us the opportunity to review this draft Environmental Assessment and for your cooperation with our regulatory program. Please be advised you can provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at http://per2.nwp.usace.army.mil/survey.html.

Should you have any questions, please contact Mr. Farley Watanabe of this office at the above address, by telephone 808-438-7701 (FAX: 808-438-4060), or by E-Mail at Farley.K.Watanabe@usace.army.mil. Please refer to File No. POH-2010-00147 in all future communications with this office regarding this or other projects at this location.

Sincerely,

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

Attachments
Proposed Project Location
Jurisdictional Determination
Flowchart
NAP/RFA



Source: Con Span Bridge Systems

Figure 5

Proposed Waiale Road Extension and East Waiko Road Improvements

Schematic Waikapu Bridge Section

NOT TO SCALE

Prepared for: County of Maui, Dept. Of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\EISPN\schematic

3

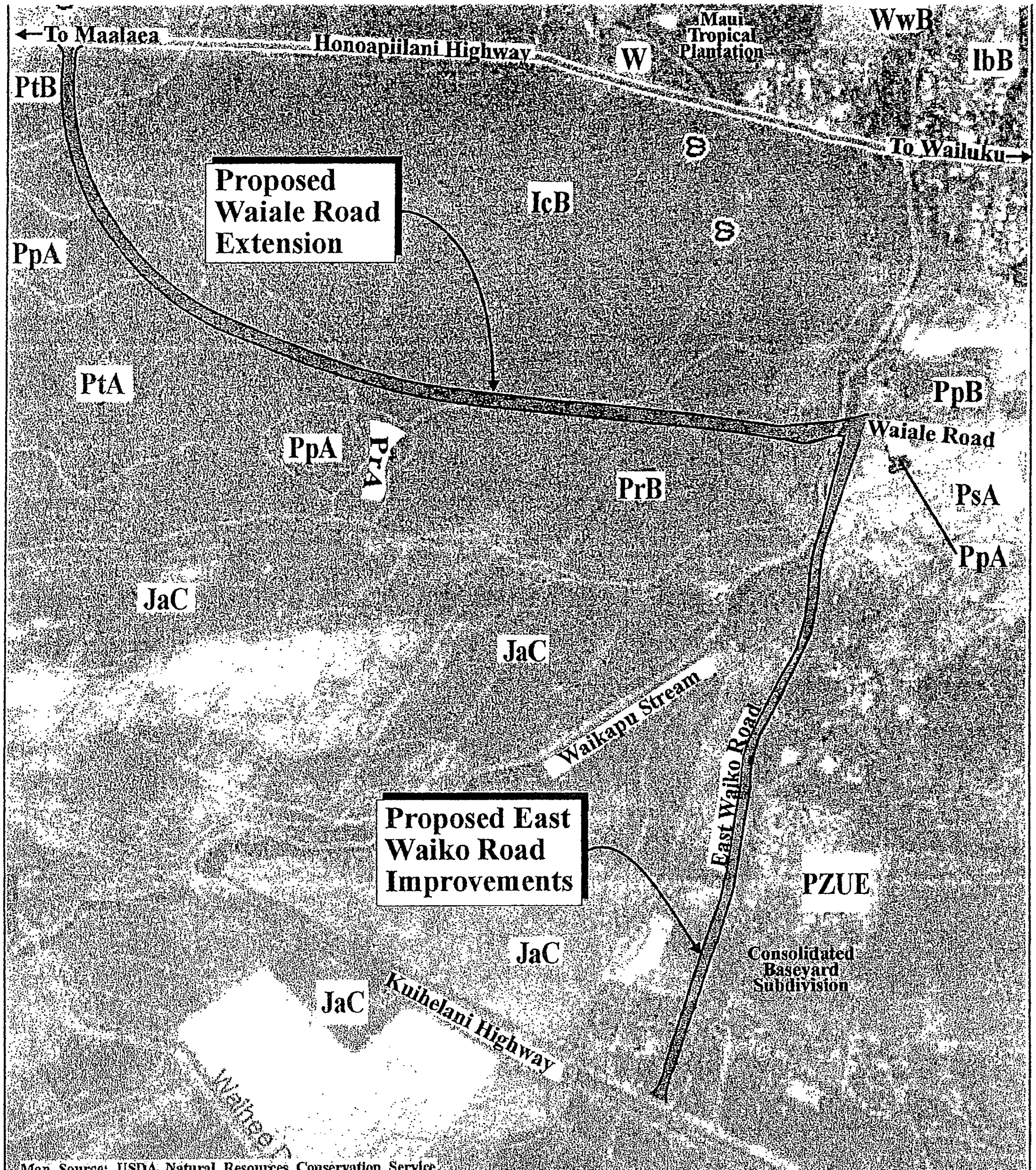


Figure 11 Proposed Waiale Road Extension and East Waiko Road Improvements

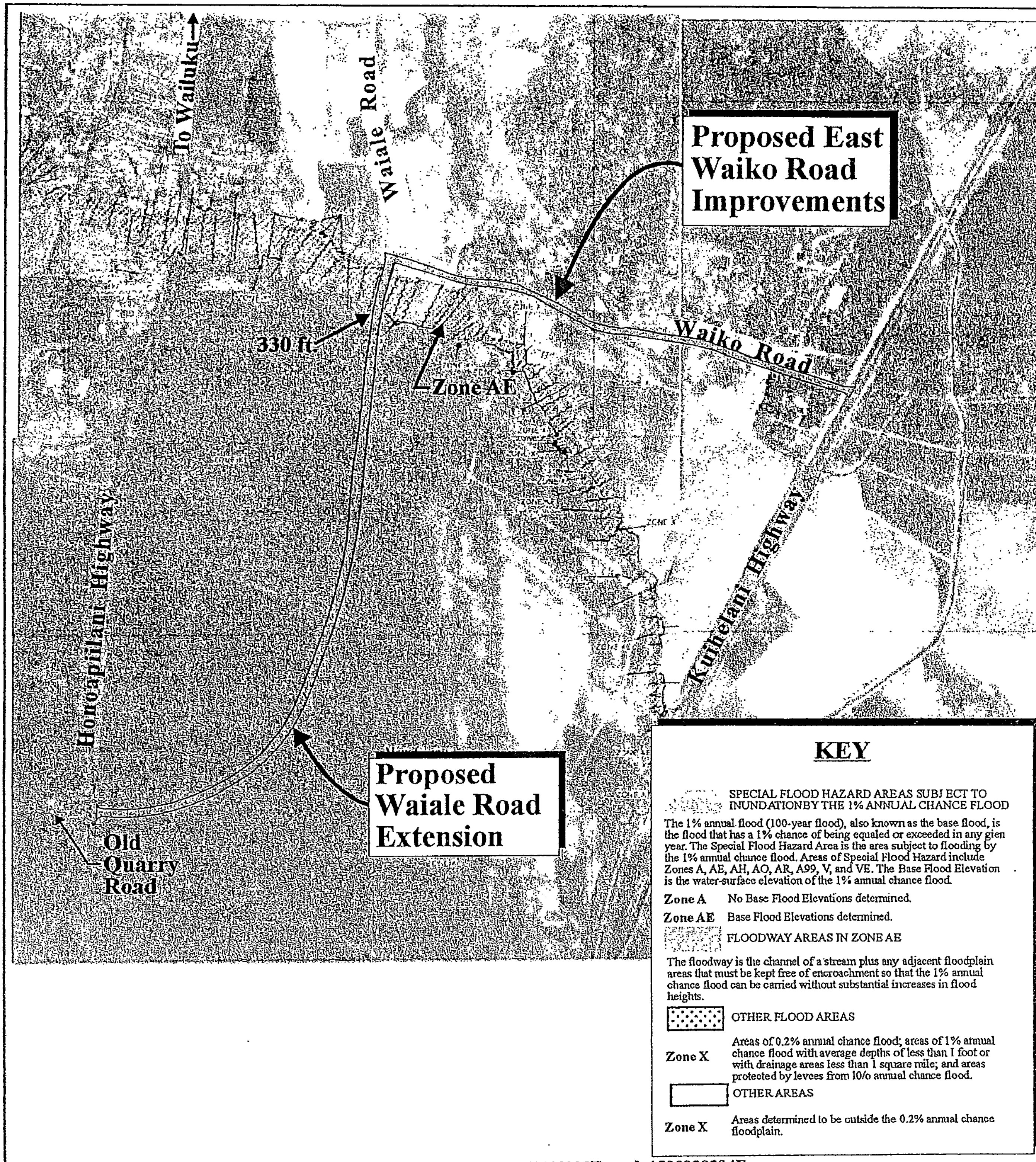
Soils Classification Map

NOT TO SCALE

Prepared for: County of Maui, Dept. Of Public Works

MUNEKIYO & HIRAGA, INC.

COM\DpwWaiale\DraftEA\soilsclass



Source: Federal Emergency Management Agency, FIRM Nos. 150003093E and 1500030394E

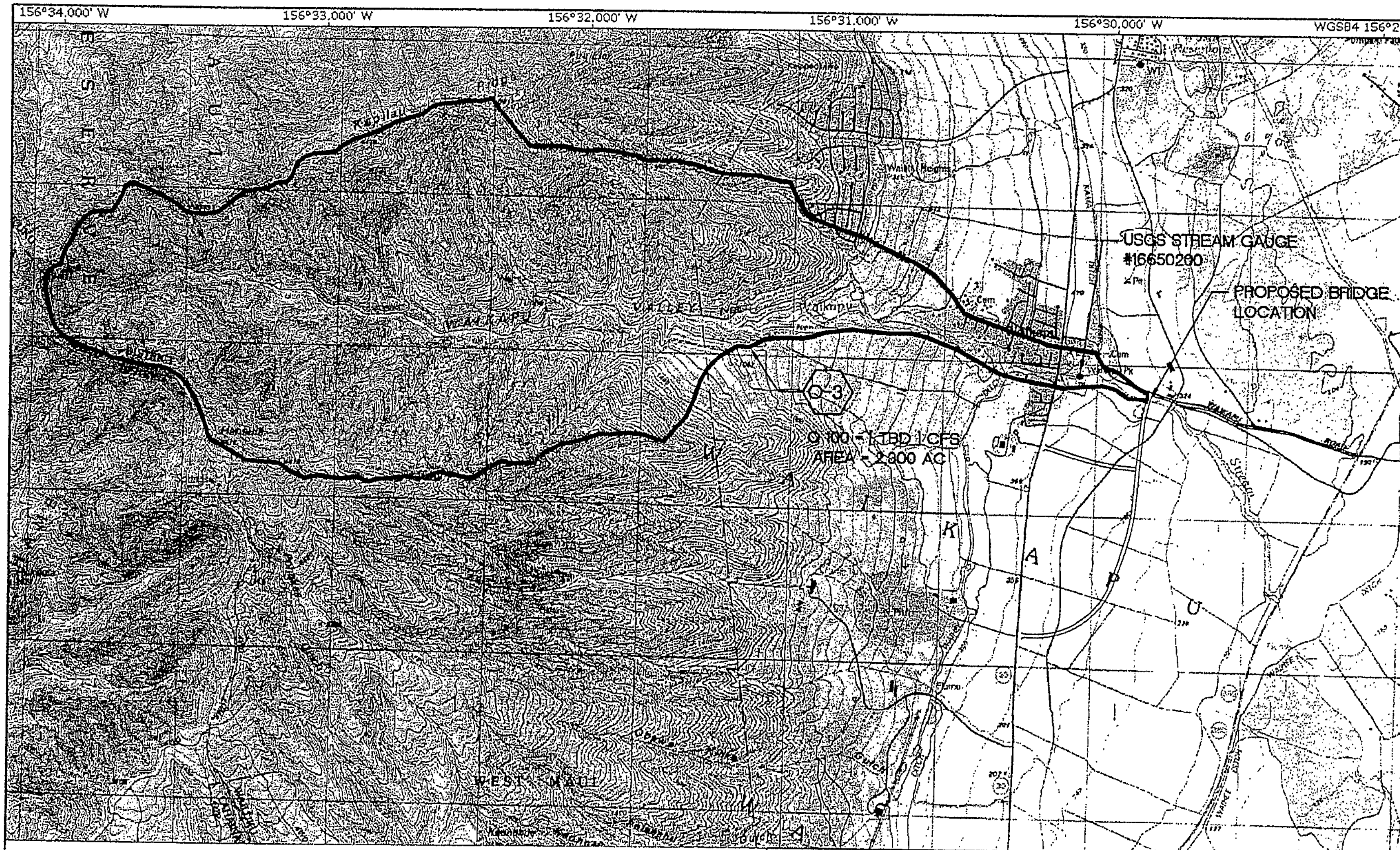
Figure 12 Proposed Waiale Road Extension and East Waiko Road Improvements
Flood Insurance Rate Map

NOT TO SCALE

Prepared for: County of Maui, Dept. Of Public Works

MUNEKIYO & HIRAGA, INC.

COM/DPW WaialeExt/DraftEA/FIRM



PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII

WAIKAPU STREAM DRAINAGE MAP

EXHIBIT
6

APRIL 2010

JOB NO. M-08-557
Z:\2008\08-557\REPORT\PER\EXH6-OFFSITE DRAINAGE MAP.DWG

6

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): 20 Apr 2011

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:Proposed New Waikapu Stream Bridge Project, POH-2010-00147, Waikapu, Maui Island

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:HI County/parish/borough: Honolulu City: Maui
Center coordinates of site (lat/long in degree decimal format): Lat. 20.85206° N, Long. -156.49811° W.
Universal Transverse Mercator:
Name of nearest waterbody: Waikapu Streams

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): WAIKAPU, 6001, COWRM
☒ 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: 20 Apr 2011
☐ 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: 200 linear feet: 100width (ft) and/or 0.46 acres.
      Wetlands: 0.0 acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not established at this time.**
      Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

---

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

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

1. **TNW**
   Identify TNW: .

   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: 60.8 **square miles**
   Drainage area: 60.8 **square miles**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☒ Tributary flows directly into TNW.
   ☐ Tributary flows through **3** tributaries before entering TNW.

   Project waters are **2-5** river miles from TNW.
   Project waters are **1 (or less)** river miles from RPW.
   Project waters are **5-10** aerial (straight) miles from TNW.
   Project waters are **1 (or less)** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: Iao Valley to Waikapu Stream to Kealia Pond to TNW.
   Tributary stream order, if known: 3.

[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: ag use.

Tributary properties with respect to top of bank (estimate):
Average width: 50 feet
Average depth: 10 feet
Average side slopes: **Vertical (1:1 or less).**

Primary tributary substrate composition (check all that apply):

☒ Silts ☐ Sands ☐ Concrete
☒ Cobbles ☒ Gravel ☐ Muck
☒ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

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

(c) Flow:
Tributary provides for: **Seasonal flow**
Estimate average number of flow events in review area/year: **2-5**
Describe flow regime: flashy.
Other information on duration and volume: .

Surface flow is:. **Discrete and confined.** 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: reservoir is artificial wetland.

(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: 2

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: water and sediment retention.

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:NON-RPW has capacity to carry pollutants(ag pesticides/herbicides) and suspended nutrients and organic carbon in flood waters to TNW (Pacific Ocean) or to reduce same to TNW: Discernible surface connection to `Opae`ula Stream to Pacific Ocean .

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: DAR, DLNR & COWRM classifications.
   ☐ 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: artificial impoundment has potential to release excess waters to RPW tributaries.

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

☒ Tributary waters: **200** 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: linear feet width (ft).

☐ Other non-wetland waters: **1** acres.

Identify type(s) of waters: .

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

☐ 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: .

---

[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.***

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: 15acres. List type of aquatic resource: none.
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

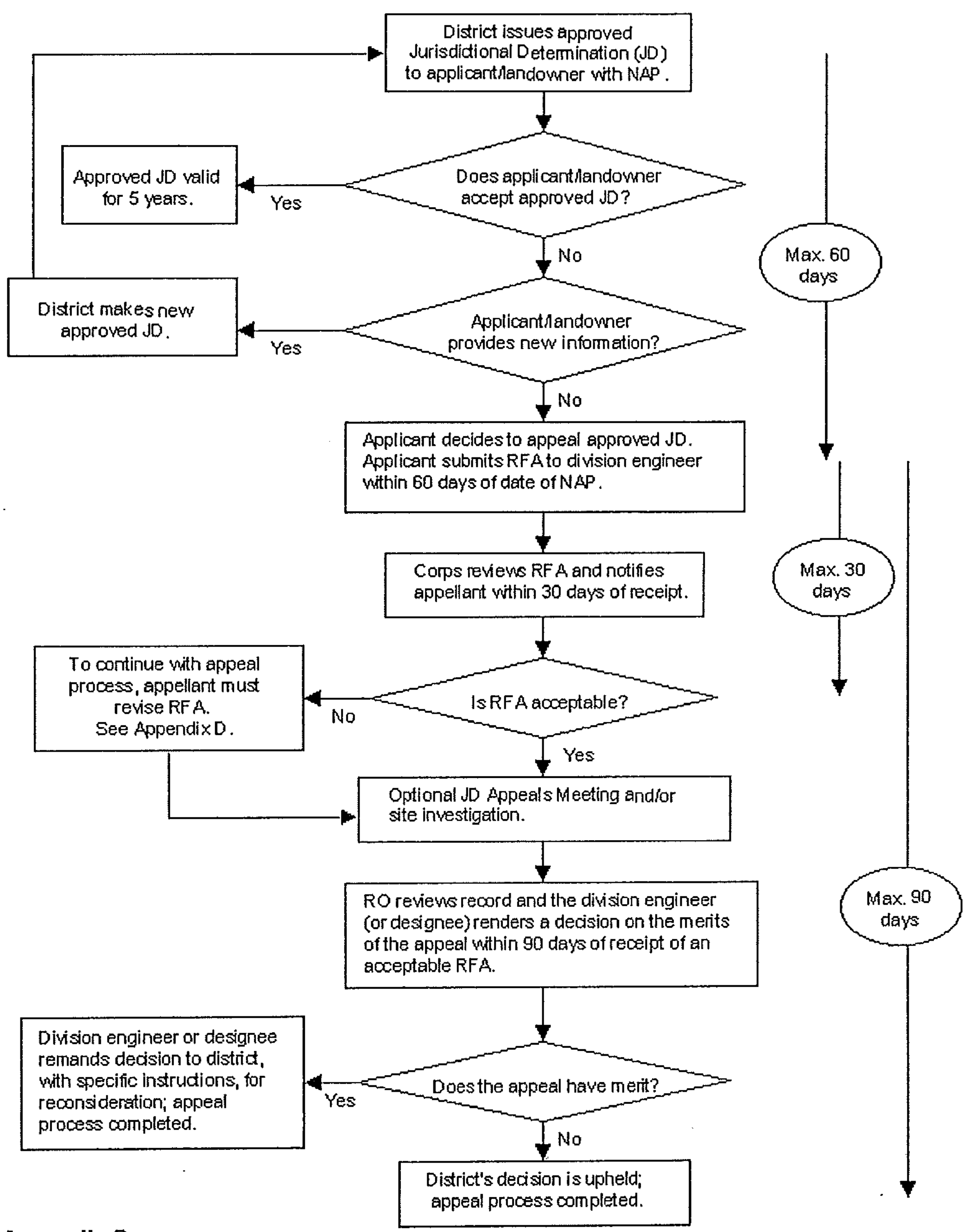
A. **SUPPORTING DATA. Data reviewed for JD (check all that apply** - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: .
☐ Data sheets prepared/submitted 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:1:24000.
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:TIG GIS Layer.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☐ Photographs: ☒ Aerial (Name & Date):Google Aerial, 2010.
or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☒ Applicable/supporting scientific literature:DAR & COWRM, DLNR.
☐ Other information (please specify): .

B. **ADDITIONAL COMMENTS TO SUPPORT JD:** .

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

Administrative Appeal Process for Approved Jurisdictional Determinations



Appendix C

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Dept. Public Works, County of Maui.		File Number: POH-2010-00147	Date: 20 Apr 2011
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, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. 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 engineer. Your objections must be received by the district engineer 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 engineer 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 engineer 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, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. 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 engineer. This form must be received by the division engineer 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 engineer. This form must be received by the division engineer 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 engineer. This form must be received by the division engineer 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:	If you only have questions regarding the appeal process you may also contact:
Farley.K.Watanabe@usace.army.mil/808-438-7701	Thom Lichte (808) 438-0397

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers 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:

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

George P. Young, P.E.
Chief, Regulatory Branch
Department of Army
U. S. Army Corps of Engineers
Honolulu District
Fort Shafter, Hawaii 96858-5440

SUBJECT: POH-2010-00147 - Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii, (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021 (por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)) (EAC 2011/0004)

Dear Mr. Young:

Thank you for your letter of April 21, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information, in response to your comments.

We have reviewed and acknowledge the jurisdictional determination the Department of Army (DA) has made regarding this project. The DPW does not object to this determination.

To summarize the project permitting requirements based on the DA jurisdictional determination, the DPW confirms that a Section 10 DA Permit will not be required for the project. However, the bridge crossing over Waikapu Stream will require further consultation with your office in regards to permit requirements for a Section 404 DA Permit. The DPW confirms that upon development of more detailed design drawings for the Waikapu Stream crossing, coordination will be done with your office to determine specific Section 404 DA Permit requirements.

environment planning government

305 High Street, Suite 104 • Wailuku, Hawaii 96793 • ph: (808)244-2015 • fax: (808)244-8729 • planning@mhplanning.com • www.mhplanning.com

George P. Young, P.E.
Chief, Regulatory Branch
November 4, 2011
Page 2

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:tn
Cc: David Goode, Director, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
K:\DATA\COM\DPW WaialeExt\Army DEAres.ltr.doc

APR 11 2011

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

TAKE PRIDE® IN AMERICA

In Reply Refer To:
2011-TA-0186

APR 06 2011

Ms. Leilani Pulmano
Program Manager
Munekiyo and Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Subject: Technical Assistance for the Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui

Dear Ms. Pulmano:

We received your letter on March 7, 2011, requesting review of the proposed extension of Waiale Road and improvements to East Waiko Road. The proposed project involves extending Waiale Road 8,600 feet from its current terminus at East Waiko Road southward to the Honoapiilani Highway. In addition, the East Waiko Road will receive improvements extending 4,600 feet near the intersection with Waiale Road east of Waikapu, Maui.

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, three species protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) may frequent the area and could be in the vicinity of the proposed project. To assist you with minimization and avoidance of impacts to these species, we offer the following recommendations:

- The endangered Hawaiian goose (*Branta sandvicensis*, nene) has been observed in the vicinity of Waiko Road and Honoapiilani Highway. We recommend scheduling road construction activities outside of the nene breeding season, December through April. If road construction must be conducted during the nene breeding season, then we recommend nest searches by a biologist familiar with the nesting behavior of nene should be completed. Nest searches are recommended not only prior to the initiation of any work, but also after any subsequent delay in work of three or more days (during which birds may attempt nesting). If a nest is discovered, work should cease immediately and our office contacted for further guidance. Furthermore, all on-site project personnel should be apprised that nene may be in the vicinity of the project. If any nene appears within 100 feet (30.5 meters) of ongoing work, all activity should be temporarily suspended until the animal leaves the area on its own accord.

- The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) will roost in both exotic and native woody vegetation and, while foraging, 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, woody plants greater than 15 feet (4.6 meters) tall should not be removed or trimmed from May 15 to August 15.

- The Draft Environmental Assessment states on page 35 that surveys for the endangered Blackburn's sphinx moth (*Manduca blackburni*) have been conducted and no adult moths or larvae were found within the project footprint. However, the Biological Resources Survey document (appendix D in the Draft Environmental Assessment) prepared by Robert Hobdy, states the surveys were conducted during June and July of 2009, and that *Nicotiana glauca*; a species commonly used by Blackburn's sphinx moth larvae as a host plant, is present within the project corridor. To ensure Blackburn's sphinx moth larvae were not overlooked due to dry conditions in the months of June and July, we recommend you have a biologist familiar with the life history of the Blackburn's sphinx moth survey the project area for host plants and emergent larvae during the wettest portion of the year, which is usually November through April. Adult sphinx moth food sources include beach morning glory (*Ipomoea pes-caprae*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*). Larvae have been shown to feed upon non-native tree tobacco (*Nicotiana glauca*) as well as native aiea (*Nothocestrum latifolium*). Other solanaceous plants including non-native commercial tobacco (*Nicotiana tabacum*), eggplant (*Solanum melongena*), tomato (*Lycopersicon esculentum*), jimson weed (*Datura stramonium*), sweet and chili pepper (*Capsicum* spp.), ornamental plants (*Cestrum* spp. *and Lycium* spp.), tomarillo (*Cymphomandra* spp.), petunia (*Petunia* spp.), tomatillo and ground cherry (*Physalis* spp.), *Solandra* spp., and *Solanum* spp. (potato, eggplant, nightshade) may be utilized as larval host plants as well.

We hope this information assists you in minimizing and avoiding impacts to listed species. If you have questions regarding the implementation of the recommendations included in this letter, please contact Ian Bordenave, Fish and Wildlife Biologist, at (808) 792-9400 for further assistance.

Sincerely,

FOR

Loyal Mehrhoff
Field Supervisor

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Loyal Mehrhoff, Field Supervisor
Fish and Wildlife Service
U. S. Department of Interior
300 Ala Moana Boulevard, Room 3-122
Box 50088
Honolulu, Hawaii 96850

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004) (Reference No. 2011-TA-0186)

Dear Mr. Mehrhoff:

Thank you for your letter of April 6, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. We acknowledge your comment that the endangered Hawaiian goose (*Branta sandvicensis, nene*) has been observed in the vicinity of Waiko Road and Honoapiilani Highway. The construction of the proposed improvements is anticipated to be undertaken in one (1) phase and will take approximately 24 to 36 months. It would be difficult to stop construction during the period from December through April, once it has started. Therefore, part of the construction protocol during this period will be to incorporate nest searches by biologists familiar with the nesting behavior of nene to ensure the proposed work will not adversely impact the nene. The DPW will commit to this undertaking during the construction phase and will incorporate these requirements into the construction bid documents for this project.

2. We acknowledge your comment that the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) will roost in both exotic and native woody vegetation. The project area is currently under sugar cane cultivation and the only area of woody vegetation is along the Waikapu Stream channel. The project

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environment planning government

will occupy a small area of the stream channel for the Waiale Road Extension crossing right-of-way. Nevertheless, to avoid the risk that young bats could inadvertently be harmed or killed, the DPW will commit to not removing or trimming any trees greater than 15 feet during the period from May 15 through August 15. This requirement will be incorporated into the contract documents requiring specific actions by the contractor.

3. We acknowledge your comment that although the fauna survey did not indicate the presence of the Blackburn's sphinx moth (*Manduca blackburni*), the field surveys were conducted during the drier months of the year. We note the Service's recommendation that investigation of potential host plants such as Nicotiana glaucca, a species commonly used by the Blackburn's sphinx moth larvae to feed upon, should be surveyed during the wettest portion of the year (usually November to April) when the emergent larvae are feeding. The survey indicated the majority of the project area is in sugar cane cultivation and most likely will remain in sugar cane cultivation until project construction is initiated. The areas not in sugar cane cultivation are in the vicinity of East Waiko Road and Waikapu Stream channel crossing. In this area, the DPW will commit to incorporating a survey by a qualified biologist familiar with the habitat and life cycle of the Blackburn's sphinx moth, prior to construction to avoid adverse impacts to this species.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

LLP

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Director, Department of Public Works
K:\DATA\COM\DPW WaialeExt\USFWSdeares.ltr.doc

APR 21 2011

NEIL ABERCROMBIE
GOVERNOR

BRUCE A. COPPA
COMPTROLLER

RYAN T. OKAHARA
DEPUTY COMPTROLLER

(P)1083.1

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

APR 20 2011

Mr. Nolly Yagin, Project Manager
Department of Public Works
County of Maui
200 South High Street
Wailuku, Maui, Hawai'i 96793

Dear Mr. Yagin:

Subject: Draft Environmental Assessment (EA) for
Proposed Waiale Road Extension and East Waiko Road Improvements
Waikapu, Maui, Hawai'i
TMK: Various

Thank you for the opportunity to provide comments for the subject document. The subject project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please call me at (808) 586-0400 or have your staff call Ms. Gayle Takasaki of the Public Works Division at (808) 586-0584.

Sincerely,

BRUCE A. COPPA
State Comptroller

c: Ms. Leilani Pulmano, Munekiyo & Hiraga, Inc.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Bruce A. Coppa, State Comptroller
Department of Accounting and General Services
P. O. Box 119
Honolulu, Hawaii 96810-0119

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Mr. Coppa:

Thank you for your letter of April 20, 2011, responding to our request for comments on the Draft Environmental Assessment (EA) for the proposed project. We appreciate your review of the document and your conveying confirmation that the Department has no comment at this time.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:tn
Cc: David Goode, Director, Department of Public Works
K:\DATA\COM\DPW WaialeExt\DAGS DEAres.ltr.doc

MAR 22 2011

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
INTERIM DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

March 21, 2011

TO: Nolly Yagin
County of Maui, Department of Public Works

FROM: Jeffrey M. Eckerd, Acting Program Manager
Indoor and Radiological Health Branch

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements Project, Waikapu, Maui, Hawaii

Our comments should be printed as follows:

"Project activities shall comply with the Administrative Rules of the Department of Health:

- Chapter 11-46 Community Noise Control

Should there be any questions, please contact me at 586-4701.

cc: Leilani Pulmano, Munekiyo & Hiraga, Inc.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Jeffrey M. Eckerd, Acting Program Manager
Indoor and Radiological Health Branch
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801-3378

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004)

Dear Mr. Eckerd:

Thank you for your memorandum of March 21, 2011, providing your comment on the Draft Environmental Assessment on the proposed Waiale Road Extension and East Waiko Road Improvements Project.

We appreciate your review of the document confirming that the construction activities of the project shall comply with the Department of Health Administrative Rules, Chapter II-46 regarding Community Noise Control. Coordination will be done with the Department of Health to determine the applicability of a Community Noise Control permit for the project.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

LL

Leilani Pulmano
Program Manager

LP:me
cc: Nolly Yagin, Department of Public Works
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.
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APR 06 2011

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

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

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

In reply, please refer to:
File:

April 5, 2011

Nolly Yagin
Project Manager
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Nolly Yagin:

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii
TMK: (2) 3-5-002:014 (por.), 018 (por.), 888 (por.)

Thank you for the opportunity to comment on this project. We have the following comments:

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

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

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

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

Sincerely,

Patti Kitkowski

Patti Kitkowski
District Environmental Health Program Chief

c Leilani Pulmano

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Patti Kitkowski, Program Chief
Maui District
Department of Health
54 High Street
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Ms. Kitkowski:

Thank you for your letter of April 5, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. We note that noise created during the construction phase of the project may exceed the maximum allowable levels set forth in Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control". Prior to construction, coordination will be done with the Department of Health to determine if a Community Noise Control permit will be required for the project.

2. We note a National Pollutant Discharge Elimination System (NPDES) will be required for this project since grading will be more than one (1) acre. As such a NPDES permit will be obtained from the Department of Health prior to construction.

3. Standard comments found on the Department's website, as applicable, has been incorporated into the EA.

305 High Street, Suite 104 • Wailuku, Hawaii 96793 • ph: (808)244-2015 • fax: (808)244-8729 • planning@mhplanning.com • www.mhplanning.com

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:tn
Cc: David Goode, Director, Department of Public Works
K:\DATA\COM\DPW WaialeExt\DOHMaui DEAres.ltr.doc

APR 07 2011

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 6, 2011

Munekiyo & Hiraga, Inc.
305 High Street Suite 104
Wailuku, Hawaii 96793

Attention: Ms. Leilani Pulmano

Ladies and Gentlemen:

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements Project

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

Other than the comments from Division of Aquatic Resources, Commission on Water Resource Management, Engineering Division, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0414. Thank you.

Sincerely,

Marlene E. Unoki

for Russell Y. Tsuji
Administrator

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

-D

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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LAND DIVISION

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

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POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

March 9, 2011

MEMORANDUM

TO: **DLNR Agencies:**
x_Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x_Engineering Division
x_Div. of Forestry & Wildlife
__Div. of State Parks
x_Commission on Water Resource Management
_Office of Conservation & Coastal Lands
__Land Division –
x_Historic Preservation

DAR 3712

RECEIVED MAR 10 2011

Charlene

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Draft Environmental Assessment for proposed Waiale Road Extension and East Waiko Road Improvements project
LOCATION: Island of Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of the County of Maui, Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 4, 2011.

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

Attachments

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

Signed: [signature]
Date: 3/17/11

RECEIVED
Maui
MAR 17 2011
Div. of Aquatic Resources

31

DIVISION OF AQUATIC RESOURCES - MAUI
DEPARTMENT OF LAND & NATURAL RESOURCES
130 Mahalani Street
Wailuku, Hawai'i 96793
March 16, 2011

To: Alton Miyasaka, Aquatic Biologist

From: Skippy Hau, Aquatic Biologist

Subject: Draft Environmental Assessment for Waiale Road Extension and East Waiko Road Improvements Project (DAR 3712) (Due April 4, 2011 Charlene Unoki, Land)

I reviewed the draft environmental assessment and have questions on the preliminary drainage plan.

(P.50) The proposed roadways will be very difficult to enforce a "20-mph speed limit" unless speed humps or bumps are established or slopes can be leveled. Removing the lone stop sign on East Waiko Road will likely increase the number of speeding vehicles.

In Appendix C, the amount of drainage allowed to flow into Waikapu Stream and what amounts will be directed to offsite retention/recharge basins is unclear. Exhibit 3A shows runoff flow direction. The proposed drainage plan estimates assumes that farming sugar will be continued. If sugar cane is not continued, will the plan insure that vegetation or landscaped areas are required? These "agriculturally zoned lands" should not be allowed to lay fallow or go unplanted. Water recharge should be optimized as much as possible for this project.

How will the 100-year floodplain of Waikapu Stream be maintained? After the past year's flooding events, shrubs and trees should be removed from the stream corridor.

What is the status of the Waihe'e irrigation ditch? Can the ditch handle increased flows? Will leaks be repaired? What is the direction of flow in the ditch? Does the ditch flow to sugar cane fields or a reservoir? The proposed development projects continue to increase impervious surfaces and will likely increase the total amount of drainage runoff in the watershed.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
LAND DIVISION
2011 MAR 21 P 2:51

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 9, 2011

2011 MAR 10 AM 8:01

MEMORANDUM

TO: DLNR Agencies:
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x ~~Commission on Water Resource~~ Management
__Office of Conservation & Coastal Lands
__Land Division –
x Historic Preservation

FR:
to:

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Draft Environmental Assessment for proposed Waiale Road Extension and East Waiko Road Improvements project
LOCATION: Island of Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of the County of Maui, Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 4, 2011.

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

Attachments

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

Signed: RChong
Date: 3/15/11

Stream Channel Alteration Permit (SCAP) required for bridge work in Waikapu Stream.

FILE ID: RFD.2862.6
DOC ID: 7556

33

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

RECEIVED
LAND DIVISION
2011 APR -5 P 2:15
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

'11 MAR 09 PM03:56 ENGINEERING

March 9, 2011

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
__Land Division –
x Historic Preservation

Charlene

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Draft Environmental Assessment for proposed Waiale Road Extension and East Waiko Road Improvements project
LOCATION: Island of Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of the County of Maui, Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 4, 2011.

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

Attachments

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

Signed: [signature]
Date: 4/4/11

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Charlene Unoki
Ref.: DEAforProposedWaialeRoadExtension&EastWaikoRoadImprovementsProject
Maui.001

COMMENTS

(X) **We confirm that part of the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone AE. The National Flood Insurance Program does regulate developments within Zone AE as indicated in bold letters below.**

(X) **Please take note that the remainder of the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone X. The National Flood Insurance Program (NFIP) does not regulate developments within Zone X.**

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

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

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

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

( ) Mr. Carter Romero at (808) 961-8943 of the County of Hawaii, Department of Public Works.

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

( ) Ms. Wynne Ushigome at (808) 241-4890 of the County of Kauai, Department of Public Works.

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

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

( ) Additional Comments: ______________________

( ) Other: ______________________

Should you have any questions, please call Mr. Dennis Imada of the Planning Branch at 587-0257.

Signed: ______________________
CARTY S. CHANG, CHIEF ENGINEER

Date: 4/4/11

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Russell Y. Tsuji, Administrator
Land Division
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)); (EAC 2011/0004)

Dear Mr. Tsuji:

Thank you for your letter of April 6, 2011, providing comments from the Division of Aquatic Resources, Commission on Water Resource Management and the Engineering Division on the proposed project. On behalf of the Department of Public Works (DPW), we wish to provide the following information in response to your comments.

Response to Division of Aquatic Resources Comments

1. Posted speed limits are enforced by the Maui Police Department. Although speed limit control may be difficult to enforce, the County does not have plans to install speed bumps on East Waiko Road to control speeding.

2. Pursuant to the "Rules for the Design of Storm Drainage Facilities in the County of Maui", any increase in stormwater runoff generated from a development must be retained on site. In the Draft Environmental Assessment (EA) it is noted that the Waiale Road Extension is expected to generate a post development runoff of 61 cubic feet per second (cfs) for a 50-year 1-hour storm. The existing runoff at the site is approximately 17 cfs. Therefore, the proposed Waiale Road extention is anticipated to generate approximately 44 cfs. This runoff amount will be retained within the project limits by retention/detention basins. The East Waiko Road improvement is expected to generate a post-development runoff increase of 9 cfs. As noted, the increase in storm water runoff will be retained in an retention/detention basin. Various methods of stormwater retention will be studied further during the project design phase.

3. Sugar cane production and any future agricultural use or change in use will be the responsibility of the landowner. The DPW's responsibility for the proposed project is limited to the area within the proposed right-of-way. The DPW has control of property within the right-of-way, but does not have jurisdiction over adjacent areas outside the right-of-way. The landscaping proposed for the project will be limited to the western side of the Waiale Road Extension right-of-way. The landscaping will use non-potable water for irrigation and will be maintained by the proposed Waikapu Country Town development.

4. The Waikapu Stream crossing will be designed to safely pass the 100-year storm stream flow and as noted in the EA, the bridge or culvert crossing will be designed to minimize alteration of the natural stream bed. A Stream Channel Alteration Permit (SCAP) approval will be required from the Commission on Water Resource Management. During the SCAP application process, appropriate stream channel modifications will be discussed. If the Commission on Water Resource Management requires the shrubs and vegetation along the stream corridor within the limits of the project, to be removed as part of the SCAP approval, the DPW will comply with this requirement.

5. The Waihee Irrigation Ditch runs upland in a north to south direction upslope of Honoapiilani Highway. See **Exhibit "A"** attached hereto. The irrigation ditch is outside the scope of the proposed project. The proposed project will not affect or be affected by the Waihee Irrigation Ditch.

   As noted previously, any post-development increase in stormwater runoff generated from the proposed project will be retained on site.

Response to Commission on Water Resource Management (CWRM) Comments

1. The DPW acknowledges that a SCAP will be required for the Waikapu Stream crossing. Coordination will be carried out with the CWRM during the SCAP application process.

Response to Engineering Division Comments

1. As noted in the Draft EA, a portion of the project site is located in the Flood Zone AE while the majority of the project site is located in Flood Zone X.

2. The project will comply with the rules and regulations of the National Flood Insurance Program (NFIP) as set forth in Title 44 of the Code of Federal

Regulations (44CFR). In addition, the project will comply with Maui County's flood zone rules and regulations.

As noted in the Draft EA, the crossing of Waikapu Stream will be designed to safely pass the 100-year storm stream flow and will not interfere with the natural drainage characteristics of the Waikapu Stream. In order to address the portion of the existing East Waiko Road right-of-way within Zone AE, an evaluation will be done during the design phase of the proposed project, to determine if the existing berm may need to be raised to contain the flow within the Waikapu Stream.

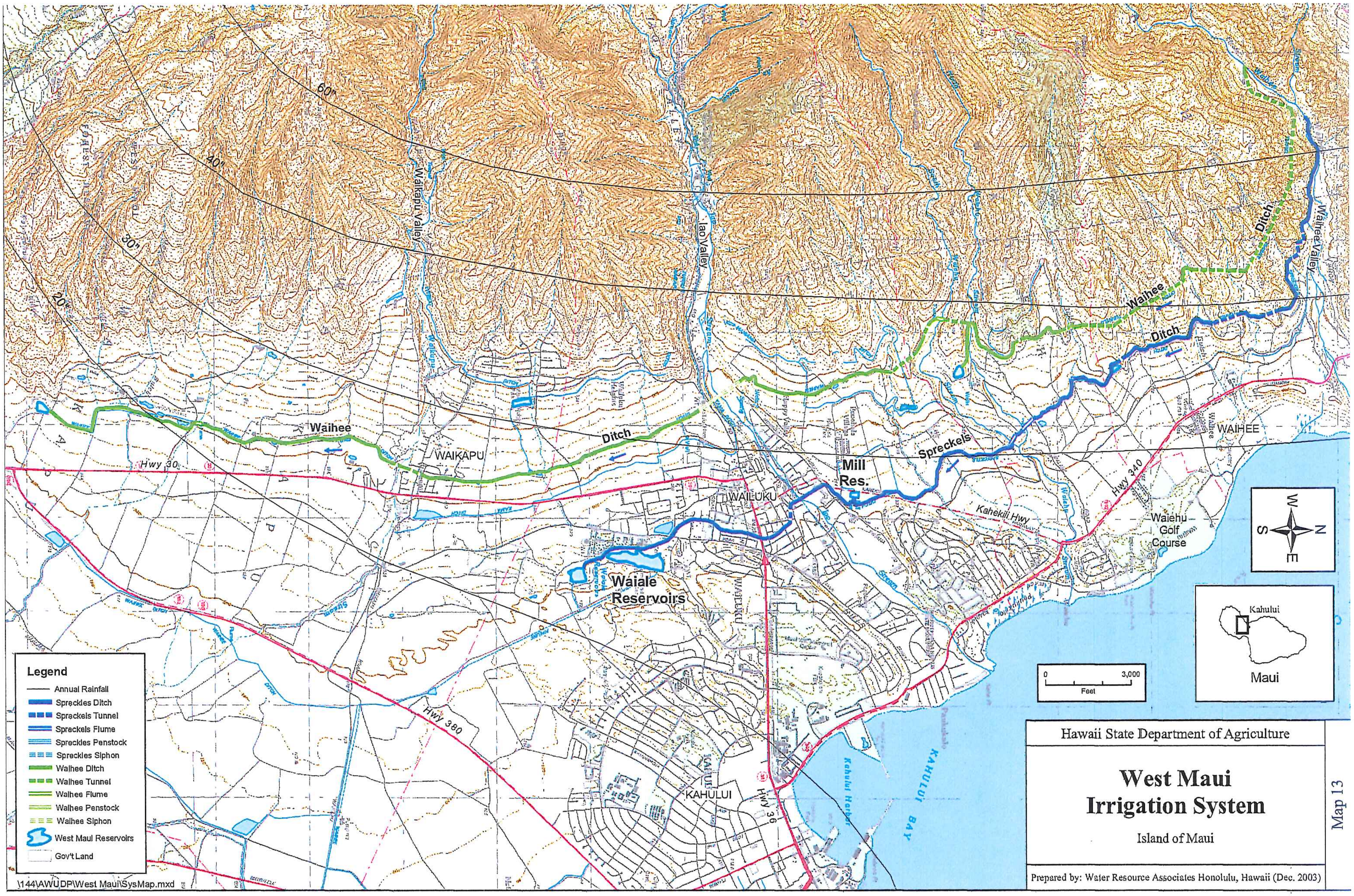
Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:lh
Enclosure
cc: David Goode, Director, County of Maui, Department of Public Works (w/enclosure)
Trang Nguyen, Austin, Tsutsumi & Associates, Inc.

F:\DATA\COM\DPW WaialeExt\DLNRdearesponse.ltr


Hawaii State Department of Agriculture
West Maui
Irrigation System
Island of Maui
Map 13
Prepared by: Water Resource Associates Honolulu, Hawaii (Dec. 2003)
Legend
Annual Rainfall
Spreckles Ditch
Spreckels Tunnel
Spreckels Flume
Spreckles Penstock
Spreckles Siphon
Waihee Ditch
Waihee Tunnel
Waihee Flume
Waihee Penstock
Waihee Siphon
West Maui Reservoirs
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Iao Valley
Waikapu Valley
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WAILUKU
WAIHEE
KAHULUI
Waiale
Reservoirs
Hwy 30
Hwy 380
Hwy 36
Hwy 340
Kahekili Hwy
Waiehu
Golf
Course
KAHULUI BAY
Kahului Harbor
60"
40"
30"
20"

EXHIBIT "A"

39

APR 26 2011

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

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

April 20, 2011

Nolly Yagin, Project Manager
County of Maui, Department of Public Works
200 South High Street
Wailuku, Hawaii 96793

LOG NO: 2011.0625
DOC NO: 1103MD75
Archaeology

Dear Ms. Yagin:

SUBJECT: National Historic Preservation Act (NHPA) Section 106 Review – Draft Environmental Assessment, Proposed Waiale Road Extension and East Waiko Road Improvements Project
Waikapū Ahupuaʻa, Wailuku District, Island of Maui
TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003 & 3-8-005:999

Thank you for the opportunity to comment on the aforementioned draft environmental assessment (DEA). This project qualifies as a Federal undertaking subject to Section 106 review as one of the approving agencies will be the Federal Highway Administration.

The County of Maui has proposed to construct an extension of Waiale Road from its current terminus at East Waiko Road, southward to meet Honoapiilani Highway. The proposed extension is approximately 8,600 lineal feet of length within an 80' right-of-way and will be designed with two 12' travel lanes, 6' shoulders, 6' grass swales, and a 10' bike/pedestrian path on the west side of the roadway. Additional improvements would be made to East Waiko Road from the intersection with Waiale Road to Kuihelani Highways. These improvements are approximately 4,600 lineal feet in length within the existing 60' right-of-way and include: upgrading the existing pavement section to two 12' travel lanes, 6' shoulders, and asphalt concrete swales.

The areas indicated in the preceding paragraph constitute the area of potential effect (APE) for this project. An archaeological inventory survey was conducted for the APE (Perzinski and Dega 2010), which identified one historic property: State Inventory of Historic Places (SIHP) 50-50-04-6668, an historic-era boulder terrace which may have functioned as a water feature along the south bank of Waikapū Stream. This site was determined to be significant under NRHP/HRHP Criterion "d" and SHPD determined that no further work was required (*Log No. 2010.0589, Doc No. 1003NM21*). Archaeological monitoring was recommended for those areas of Waiko Road which contain sand substrates.

We concur that a system of appropriate precautionary monitoring will result in no effect to historic properties pursuant to CFR 36 § 800. An archaeological monitoring plan (AMP) has not yet been received by our office; an AMP should be submitted to SHPD for review and approval pursuant to HAR §13-279 prior to the start of any ground-altering activities.

If you have questions about this letter please contact Morgan Davis at (808) 243-5169 or via email to: morgan.c.davis@hawaii.gov.

Aloha,

Theresa K. Donham
Deputy State Historic Preservation Officer
Historic Preservation Division

cc: Ms. Leilani Pulmano, Munekiyo & Hiraga, Inc., Wailuku, Hawaii 96793

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Theresa K. Donham
Deputy State Historic Preservation Officer
State Historic Preservation Division
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

SUBJECT: National Historic Preservation Act Section 106 Review Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004), (DOC NO: 1103MD75)

Dear Ms. Donham:

Thank you for your letter of April 20, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed Waiale Road Extension and East Waiko Road improvements. On behalf of the County of Maui, Department of Public Works (DPW) we offer the following information in response to your comments.

We note that no further work was required for SIHP 50-50-04-6668 which was a historic-era boulder terrace.

We thank you for the concurrence that a system of appropriate precautionary monitoring will result in no effect to historic properties pursuant to CFR 36 § 800.

The DPW will submit an archaeological monitoring plan to State Historic Preservation Division (SHPD) for review and approval prior to the commencement of construction.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:lh
cc: David Goode, Director, County of Maui, Department of Public Works
Michael Dega, Scientific Consultant Services, Inc.
K:\DATA\COM\DPW WAIALEEXT\SHPD DEARES.DOC

MAY 11 2011

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
FORD N. FUCHIGAMI
JAN S. GOUVEIA
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
DIR 0282
STP 8.0417

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

May 3, 2011

Mr. David Goode
Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Goode:

Subject: Waiale Road Extension and East Waiko Road Improvements
Draft Environmental Assessment (DEA)

The State Department of Transportation (DOT) previously commented on the subject case during the early consultation period in its letters STP 8.0208 dated September 1, 2010 and STP 8.0133 dated June 16, 2010 (see Section X of the DEA)).

The DOT Highways Division Planning Branch is still reviewing the DEA and Traffic Impact Analysis Report (TIAR). Until this review is completed, DOT's prior comments remain valid.

DOT appreciates the opportunity to provide comments. If there are any other questions, including the need to meet with DOT Highways Division staff, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at (808) 831-7976.

Very truly yours,

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

EKT:km

bc: HWY-P, -M, STP(ET)

c: Leilani Pulmano, Munekiyo & Hiraga, Inc.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Glenn M. Okimoto, Ph.D., Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004) (DIR 0282 STP 8.0417)

Dear Mr. Okimoto:

Thank you for your letter of May 3, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed Waiale Road Extension and East Waiko Road improvements. On behalf of the County of Maui, Department of Public Works (DPW) we offer the following information in response to your comments.

We note that the Department of Transportation Highways Division, Planning Branch is still reviewing the Draft EA and Traffic Impact Analysis Report (TIAR). While the Draft EA is under review we note that the previous comments provided by the Department on September 1, 2010 and June 16, 2010 are still valid and we confirm the earlier comments have been addressed in the Draft EA and TIAR.

environment
planning
government

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:lh
cc: David Goode, Director, County of Maui, Department of Public Works
Keith Niiya, Austin, Tsutsumi & Associates, Inc.

K:\DATA\COM\DPW WAIALEEXT\SDOT DEARES.DOC

NEAL ABERCROMBIE
Governor of Hawai'i

Telephone (808) 586-4185
Facsimile (808) 586-4186
Electronic Mail:
oeqc@doh.hawaii.gov

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

Department of Health
235 South Beretania Street
Leiopapa A Kamehameha, Suite 702
Honolulu, Hawai'i 96813

GARY HOOSER
Director

516 RUSH

DEPT. OF PUBLIC WORKS

	INFO	ACTION	SEE ME	COMMENTS	COPY	FILE
DIRECTOR	✓					
DEPUTY DIR.	✓					
PERS.						
DSA						
ENGR.	✓			✓		
HWY.						
SECTY.						
Leilani Pulmano	✓			✓		4/15

Return to ______ Due ______
By: ______

April 12, 2011

David Goode, Director
Department of Public Works
Attn: Engineering Division
200 South High Street
Wailuku, Hawai'i 96793

Subject: DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS, WAIKAPU, MAUI, HAWAI'I

Dear Mr. Goode:

The subject document was published in the March 8, 2011 issue of The Environmental Notice, with a comments due date of April 6, 2011. The proposed action is to address traffic in the Waikapu-Wailuku area Honoapi'ilani Highway. It is consistent with the Maui General Plan and the Wailuku-Kahului Community Plan. The Office of Environmental Quality Control offers these comments:

1. Please ensure that the "process water basin" referenced on page 29 does not contain pollutants/contaminants before percolating into the ground.

2. Please take precautionary measures to mitigate probable flooding from heavy sheet flow, as was the case in Kihei within the last year where heavy rains created heavy sheet flow and mud that crossed over Kihei Road.

3. Finally, please ensure that all substantive comments on the draft EA are addressed in your final EA.

Feel free to contact our office at (808) 586-4185 if you have further questions.

Sincerely,

Herman Tuiolosega

HERMAN TUIOLOSEGA
OEQC Planner

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Herman Tuiolosega, Planner
Office of Environmental Quality Control
Department of Health
235 South Beretania Street
Leiopapa A Kamehameha, Suite 702
Honolulu, Hawaii 96813

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Mr. Tuiolosega:

Thank you for your letter of April 12, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the applicant agency, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. The Final EA will be amended to clarify that the processed water basin will be in compliance with the National Pollutant Discharge Elimination System and designed and regularly inspected by DPW maintenance crews to remove pollutants and contaminants before percolating into the ground.

2. The drainage system for the proposed improvements will be designed in conformance with "Rules for the Design of Storm Drainage Facilities in the County of Maui." The storm water runoff from the roadway and shoulders will be collected by drainage inlets within paved swales and channeled to a drainage retention/detention basin where it will percolate into the ground. The drainage system will handle the increase in post-development runoff.

   The roadway drainage system will be designed to handle storm water runoff and sheet flow generated by a 50-year, 1-hour storm. Currently there is no evidence of problems with mud carried by stormwater runoff in the project area. The roadway grade will be designed at an elevation, in relation to surrounding lands, to minimize sheet flow and mud from flowing over and across the roadway.

305 High Street, Suite 104 • Wailuku, Hawaii 96793 • ph: (808)244-2015 • fax: (808)244-8729 • planning@mhplanning.com • www.mhplanning.com

3. We confirm that all substantive comments on the EA have been included and addressed in the Final EA.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Director, Department of Public Works
K:\DATA\COM\DPW WaialeExt\OEQCdeares.ltr.doc

APR 06 2011

PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD11/4141C

March 31, 2011

Leilani Pulmano, Program Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Re: Draft Environmental Assessment
Waiale Road Extension and East Waiko Road Improvements Project
Waikapu, Island of Maui

Aloha e Leilani Pulmano,

The Office of Hawaiian Affairs is in receipt of your March 4, 2011 request for comments on a draft environmental assessment (DEA) for the proposed construction of a new segment of Waiale Road extending 8,600 linear feet to an intersection with the Honoapiilani Highway (Waiale Extension) and 4,600 linear feet of improvements within the right-of-way of the existing East Waiko Road to its intersection with the Kuihelani Highway (East Waiko Improvements). The Waiale Extension and East Waiko Improvements hereinafter are referred to collectively as the "project", which is proposed by the County of Maui-Department of Public Works (County).

The DEA is a primary support document for the use of County lands and funds and State of Hawai'i (State) lands (for the intersections with the Honoapiilani and Kuihelani Highways). The DEA may also serve as a support document for applicable State and County permits and approvals (DEA, Chapter 9) the project will require. The County is also pursuing funding from the U.S. Department of Transportation-Federal Highways Administration (FHWA), triggering the requirements of the National Historic Preservation Act (NHPA), National Environmental Policy Act (NEPA) and the Department of Transportation Act (DTA). A U.S. Army Corps of Engineers permit may be required for a section of the Waiale Road which will cross the Waikapu Stream.

The need for the Waiale Extension is identified Maui Long Range Land Transportation Plan (MLRLTP), as it will serve to improve traffic flow within and around Waikapu Village and provide an alternative route between the urban areas of Wailuku and Kahului (DEA, Chapter 1.B.). We note that the DEA table of contents references additional discussion on the MLRLTP in Chapter 4.I., but it appears this section of the DEA has been omitted. We request clarification on this issue.

While we recognize the existing need for this project, it is important to note that it will be a supporting component of future regional growth in Waikapu and Wailuku. The project area is situated on lands within the State Land Use Agricultural District and zoned "agricultural" by the County. The Wailuku-Kahului Community Plan designates the project area "agriculture" and does identify the Waiale Extension as an objective (DEA, Chapter 4). The majority of the Waiale Extension will be constructed on lands classified as "Prime" within the Agricultural Lands of Importance to the State of Hawai'i system and rated "A or B" by the Overall Productivity Rating developed by the University of Hawai'i Land Study Bureau (DEA, Chapter 3.A.3.). With this in mind, we are cautious in considering the future regional growth that may occur in the immediate vicinity of the project.

The Waiale Extension will be constructed through lands owned by Waikapu partners, LLC which were historically and are currently used for intensive sugar cane cultivation. An archaeological inventory survey (AIS) was conducted for the project (DEA, Appendix E). The AIS identified one historic property within the Wailae Extension right-of-way (ROW), identified as an historic terrace near the Waikapu Stream. No further work or mitigation for this identified historic property was recommended. Sub-surface testing (testing) which involved the excavation of 64 trenches was conducted. Testing results within the Waiale Extension ROW confirm the presence of sols previously and repeatedly disturbed during agricultural activities. Testing results within the East Waiko Improvements ROW indicate the presence of disturbed and in situ sand deposits which the AIS describes (page 26) as the southern extent of a sand dune system (system) which stretches throughout Central Maui. Numerous Hawaiian burials have been identified in portions of this system north of the project area. The AIS recommends archaeological monitoring of ground disturbing activities during the East Waiko Improvements portion of the project. By letter dated March 10, 2010 (DEA, Appendix E-1) the Department of Land Natural Resources-State Historic Preservation Division (SHPD) accepted the AIS and concurred with the proposal for archaeological monitoring.

OHA concurs with the proposal for archaeological monitoring of ground disturbing activities during the East Waiko Improvements portion of the project where sand deposits have been identified. In the event iwi kūpuna (human skeletal remains) are identified during any activity within the project area, all work must immediately stop in the area of the discovery and the appropriate agencies notified pursuant to Chapter §6E 43.6 Hawaii Revised Statutes.

The statement that "*no specific suggestions for further contact or interviews were received from the Office of Hawaiian Affairs…and Native Hawaiian Historic Preservation Council*" (DEA, Chapter 3.A.9. and Appendix F) during the preparation of a cultural impact assessment (CIA) for the project is incorrect. By letter dated February 23, 2009 to the CIA preparer, OHA (after consulting with our Native Hawaiian Historic Preservation Council) did provide suggested individuals and organizations that should be consulted. Please take immediate action to correct this incorrect statement in the DEA.

We appreciate that the County-Department of Water Supply recommended the use of native plant species adapted to the climate of the project area in their July 10, 2010 letter to you (DEA, Chapter 10). This is certainly an appropriate recommendation which we completely support and we are pleased to see that you have confirmed adapted native plant species will be used in project landscaping.

The Waiale Extension will cross the Waikapu Stream and construction of a bridge will be required. The Waikapu Stream eventually feeds into Kealia Pond which is within the Kealia National Wildlife Refuge, which we recognize is 4.5 miles from the project area. We will rely on the assurances in the DEA that the bridge will be designed and constructed to allow the natural flow of the stream to continue, which will accommodate for the life cycle of native fish and invertebrate species and that best management practices will be employed during bridge construction (DEA, Chapter 3.A.6.). Project designs and plans include a drainage system and retention/detention basins to accommodate storm water (DEA, Chapter 3.D.4.).

We have no objections to your significance criteria assessments and the "finding of no significant impact" determinations within the DEA which has been prepared to meet the requirements of Chapter 343, Hawaii Revised Statutes (HRS) and NEPA.

The DEA is also intended to meet the requirements of Section 106 of the NHPA (Section 106). While OHA sees the preparation of a DEA to meet the requirements of Chapter 343, HRS and NEPA as generally acceptable, the statement that "*the Section 106 consultation will be integrated with the State of Hawai'i environmental review process*" (DEA, Chapter 10.B.) is concerning. Chapter 343, HRS allows for adverse impacts to historic properties to be identified but does not require that the mitigation for these impacts be completed prior to acceptance or approval of a final environmental assessment or impact statement. Federal agencies are encouraged to coordinate compliance with NEPA and Section 106, but development of alternatives and proposed mitigation measures that might avoid, minimize or mitigate any adverse impacts on identified historic properties must be described in the NEPA documentation (36 CFR §800.8). OHA sees this and the definition of a "historic property" as the critical differences between Chapter 343, HRS and NEPA in mitigating the adverse effects of undertakings on historic properties. When the Section 106 and NEPA processes are coordinated, Native Hawaiian Organizations and consulting parties are afforded an opportunity to challenge the adequacy of resolution of the adverse effects to historic properties and there is a process to resolve these objections.

With the history of land use within this specific project area (intensive agricultural cultivation and the existing East Waiko Road ROW) and the results of the SHPD accepted AIS in mind, we are agreeable to acknowledging that no historic properties (as defined by 36 CFR §800.16) of traditional cultural or religious significance to the Native Hawaiian people have been identified in the project area at this time. In a situation where historic properties had been identified within the project area, we would be adamantly object to the statement that by letter dated May 12, 2010 Section 106 consultation had been initiated and that the "*...Office of Hawaiian Affairs (OHA) was also consulted, but comments were not received by OHA*" (DEA, Chapter 10.B.). We do acknowledge receipt of and not responding to your May 12, 2010 letter, but the letter in no way initiates or completes the Section 106 consultation process as it only requests "*early consultation comments on the proposed project*". We respectfully ask that you consider our comments on this issue and use caution when coordinating Chapter 343, HRS, NEPA and Section 106 requirements in the future.

At this juncture, the use of federal funds through the FHWA is only a possibility. Once the use of FHWA funds is confirmed, they shall have the overall responsibility for ensuring that this DEA has met the applicable requirements of both the NEPA and Section 106. Furthermore, while the DEA (Chapter 10.A.) determines that a Section 4(f) evaluation pursuant to the DTA is not required for this project, OHA asserts that this is another issue which the FHWA has the overall responsibility for as Section 4(f) findings cannot be delegated below the federal level.

Thank you for the opportunity to provide comments. We look forward to seeing the planning for this project to continue to move forward. Should you have any questions or concerns, please contact Keola Lindsey at 594-0244 or keolal@oha.org.

ʻO wau iho nō me ka ʻoiaʻiʻo,

Clyde W. Nāmuʻo
Chief Executive Officer

C: OHA- Maui COC

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Clyde W. Nāmu'o
Chief Executive Officer
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004) (Reference No. HRD11/4141C)

Dear Mr. Nāmu'o:

Thank you for your letter of March 31, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. The Maui Long Range Land Transportation Plan section in Chapter IV.I of the Draft EA was in the data file, but unfortunately it was omitted in the printing of the Draft EA document and did not get picked up during our review of the Draft EA before publication. Thank you for bringing this matter to our attention. We confirm the section will be included in the Final EA. The section is reproduced in full below for your reference.

   MAUI LONG RANGE LAND TRANSPORTATION PLAN

   The proposed Waiale Road Extension with a terminus at the Maui Tropical Plantation was identified in the Maui Long Range Land Transportation Plan in 1997 by the SDOT in consultation with the County of Maui. The plan serves as a "*guide for development of the major surface transportation facilities ... to be implemented within the County of Maui ... of an integrated inter-modal transportation system that facilities the efficient movement of people and goods.*" The proposed project was recognized as a long range strategy (to the Year 2020) to improve traffic flow within and around Waikapu Village and provide an alternate route between the urban areas of Kahului and Wailuku. During the corridor alignment review with the DPW and Department of Planning, it was decided the preferred alternative would be to locate the terminus further west of the Old Quarry Road intersection. DPW will coordinate with State of Hawaii, Department of Transportation to incorporate the preferred Waiale Road extension alignment into the Maui Long Range Land Transportation Plan and State Transportation Improvement Program.

2. We note Office of Hawaiian Affairs' (OHAs') caution in considering the future regional growth that may occur in the immediate vicinity of the project due to its land classification system rating as "Prime" in the Agricultural Lands of Importance to the State of Hawaii and the its rating as "A" or "B" by the University of Hawaii Land Study Bureau. There are many steps involved in converting agricultural land to urban uses. In this regard, the County of Maui is currently undergoing a General Plan update. A component of the update is the adoption of the Maui Island Plan by the County Council. This document identifies a number of future urban growth areas which will accommodate the long term needs of Maui County for housing, industrial and commercial growth and future infrastructure requirements. The proposed projects planned for residential development around the Waiale Road Extension and East Waiko Road Improvement areas are in the early stages of planning and will go through a full entitlement process to change the use from agricultural to urban uses. At the time of the land entitlement applications for the proposed projects surrounding the Waiale Road Extension and Waiko Road Improvements, the impacts the proposed projects will have on agriculture will be assessed by the reviewing agencies.

3. We note that OHA concurs with the recommendation for archaeological monitoring during ground altering activities. The DPW confirms that an Archaeological Monitoring Plan will be submitted to the State Historic Preservation Division (SHPD) for review and approval. The DPW further confirms that archaeological monitoring will be carried out during ground altering activities in accordance with the approved Archaeological Monitoring Plan. In the event that iwi kupuna (human skeletal remains) are identified during any ground altering activities, work will immediately stop in the area of discovery and the appropriate agencies will be notified.

4. We acknowledge that OHA sent a response on February 23, 2009, to Scientific Consultant Services, Inc. (SCS) (the preparers of the Cultural Impact Assessment) providing names of knowledgeable individuals whom may be contacted for a cultural interview, and that OHA takes exception to the comment

in the Draft EA which states: "no specific suggestions for further contact or interviews were received from the Office of Hawaiian Affairs and Native Hawaiian Historic Preservation Council". (Draft EA, Chapter 3.A.9 and Appendix F). We followed up SCS to address your recommendation for cultural interviews. According to SCS, initial letters of inquiries were sent to the individuals and organizations listed in your letter but no responses were received. We also confirm the statement in Chapter 3.A.9 (Draft EA) will be amended in the Final EA, to reflect that recommendations for cultural interviews were received from OHA.

5. We note that OHA is in support of the use of native plant species in the project landscaping.

6. The DPW confirms that the crossing of the Waikapu Stream will be designed and constructed to allow the natural flow of the stream to continue and to accommodate the life cycle of native fish and invertebrate species in the stream. An application for a Stream Channel Alteration Permit will be submitted to the Commission on Water Resource Management for the stream crossing. During the application review process, it is anticipated that the natural flow of the stream will be addressed to ensure that the project will not adversely impact the natural flow of the stream. Project review by the U.S. Fish and Wildlife Service will also be done to ensure that the stream channel will be able to accommodate the life cycle of native fish and invertebrate species. In addition, we confirm that best management practices will be utilized during bridge construction and stormwater will be handled by retention/detention basins.

7. We note that OHA has no objection to the significance criteria assessments and the "finding of no significant impact" (FONSI) for the proposed project. The DPW appreciates OHA's concurrence on the FONSI determination for the EA document.

8. We note OHA finds that preparation of an EA document to meet both the requirements of Chapter 343, Hawaii Revised Statutes (HRS) and the National Environmental Protection Act (NEPA) are generally acceptable, however, OHA has concern with the statement that "the Section 106 consultation will be integrated with the State of Hawaii environmental review process". We agree with OHA's assessment regarding the critical difference between the definition of a "historic property" in Chapter 343, HRS and NEPA and how the avoidance, minimization and mitigation of the adverse effects of undertakings on historic properties are dealt with in the two (2) EA processes. We also agree with the statement that when Section 106 and NEPA processes are coordinated, Native

Hawaiian Organizations and consulting parties are afforded the opportunity to challenge the adequacy of resolution of the adverse effects to historic properties and there is a process to resolve these objections. The statement that the Section 106 consultation will be integrated with the State of Hawaii environmental review process was made in the EA to inform the agencies and public that the EA document will serve both the Chapter 343 and NEPA requirements. Specifically, when a joint Chapter 343 and NEPA document is being prepared by our firm, the transmittals to the SHPD and native organizations and agencies, such as OHA, are being requested in the context of the NEPA and Section 106 to determine if there are potential impacts to historic properties that will require a Section 106 consultation. We confirm that the purpose of the EA document is to disclose and identify the potential impact to historic and cultural resources, but does not replace the Section 106 process that is required to be carried out by the federal agency to determine avoidance, minimization and mitigation requirements of the project. We appreciate OHA's clarification on these processes and in the future will take note of clarifying the requirements when coordinating Chapter 343, HRS, NEPA and Section 106.

9. We note and agree with OHA's statement that the federal agency, is responsible for the determination on the NEPA EA, Section 106 review and Section 4(f) findings and they cannot be delegated below the federal level. The EA document will be reviewed and processed by the Federal Highway Administration pursuant to the NEPA requirements.

Thank you again for your participation in the Chapter 343, HRS review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Director, Department of Public Works
Michael Dega, Scientific Consultant Services, Inc.
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DEPARTMENT OF
HOUSING AND HUMAN CONCERNS
HOUSING DIVISION
COUNTY OF MAUI

ALAN M. ARAKAWA
Mayor
JO-ANN T. RIDAO
Director
JAN SHISHIDO
Deputy Director

35 LUNALILO STREET, SUITE 102 • WAILUKU, HAWAII 96793 • PHONE (808) 270-7351 • FAX (808) 270-6284

April 1, 2011

Ms. Nolly Yagin
Project Manager
County of Maui, Department of Public Works
200 S High Street
Wailuku, HI 96793

Dear Ms. Yagin:

**Subject: Draft Environmental Assessment for the proposed Waiale Road Extension and East Waiko Road Improvements Project located in Waikapu, Maui, Hawaii.
TMK: (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.); (2) 3-5-027:021 (por.); (2) 3-6-002:003 (por.); and (2) 3-8-005:999 (por.).**

The Housing Department has reviewed the Draft Environmental Assessment for the above subject project. Based on our review, we have determined that the subject project is not subject to Chapter 2.96, Maui County Code. The Department has no additional comments to offer at this time.

Please call Mr. Buddy Almeida of our Housing Division at 270-5746 if you have any questions.

Sincerely,

Wayde T. Oshiro

WAYDE T. OSHIRO
Housing Administrator

cc: Director of Housing and Human Concerns
✓Leilani Pulmano, Munekiyo & Hiraga, Inc.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Wayde T. Oshiro, Housing Administrator
Department of Housing and Human Concerns
County of Maui
35 Lunalilo Street, Suite 102
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004)

Dear Mr. Oshiro:

Thank you for your letter of April 1, 2011 providing comments on the Draft Environmental Assessment (EA) for the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the County of Maui, Department of Public Works (DPW) we offer the following information in response to your comments.

We appreciate your review of the document and your conveying confirmation that the Department has determined that the project is not subject to Chapter 2.96 Maui County Code.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

LP

Leilani Pulmano
Program Manager

LP:lh
cc: David Goode, Director, County of Maui, Department of Public Works
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ALAN M. ARAKAWA
Mayor

MAR 21 2011
GLENN T. CORREA
Director

PATRICK T. MATSUI
Deputy Director

(808) 270-7230
FAX (808) 270-7934

DEPARTMENT OF PARKS & RECREATION
700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

March 16, 2011

Nolly Yagin, Project Manager
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

SUBJECT: Draft Environmental Assessment for the Proposed Waiale Road Extension and East Waiko Road Improvements Waikapu, Maui, Hawai'i

Dear Mr. Yagin:

Thank you for the opportunity to review and comment on the subject project. The Department of Parks & Recreation has no comments at this time, and looks forward to reviewing the Environmental Assessment when it is available.

Please feel free to contact me or Robert Halvorson, Chief of Parks Planning and Development, TA, at 270-7931, should you have any questions.

Sincerely,

GLENN T. CORREA
Director of Parks & Recreation

GTC: RH:ca

cc: Leilani Pulmano, Munekiyo & Hiraga, Inc.
Robert Halvorson, Chief of Parks Planning and Development, TA

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ALAN M. ARAKAWA
Mayor

WILLIAM R. SPENCE
Director

MICHELE CHOUTEAU McLEAN
Deputy Director

MAR 2 8 2011

COUNTY OF MAUI

DEPARTMENT OF PLANNING

March 24, 2011

Ms. Leilani Pulmano
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Pulmano:

SUBJECT: COMMENTS ON A DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO RAOD IMPROVEMENTS PROJECT, LOCATED IN WAIKAPU, MAUI, HAWAII; TMK(S): (2) 3-5-002:014 (POR.), 018 (POR.), AND 888 (POR.), (2) 3-5-027:021 (POR.), (2) 3-6-002:003 (POR.), AND (2) 3-8-005:999 (POR.) (EAC 2011/0004)

The Department of Planning (Department) is in receipt of the above-referenced request for comments on the Draft EA for the above-referenced project. The Department understands the proposed action includes the following:

- The Applicant is the County of Maui Department of Public Works (DPW);
- The properties required for this project are currently owned by Waikapu Partners, LLC, Waiko Baseyard, LLC, Wailuku Agribusiness, State of Hawaii, and the County of Maui. The County of Maui will be acquiring all privately owned properties for completion of this project;
- The project will consist of extending Waiale Road, approximately 8,600 lineal feet in a southerly direction, from the existing Waiale Road and East Waiko Road intersection; and
- The project will also include road improvements to East Waiko Road, from the Waiale Road and East Waiko Road intersection extending eastward to Kuihelani Highway.

Based on the foregoing, the Department provides the following comments on the Draft EA:

1. The land use designations for the project area are as follows:
    - State Land Use: Agricultural
    - Paia-Haiku Community Plan: Agriculture
    - County Zoning: Agricultural
    - Other: Outside the Special Management Area (SMA)

61

2. The Department concurs that the determining agency on the Final EA for this project is the DPW, and the anticipated issuance of a Findings of No Significant Impact (FONSI) is appropriate; and

3. Please provide the Department with one (1) hard copy and one (1) electronic copy of the Final EA.

Thank you for the opportunity to comment. Should you require further clarification, please contact Staff Planner Danny Dias by email at danny.dias@mauicounty.gov or by phone at (808) 270-7557.

Sincerely,

CLAYTON I. YOSHIDA, AICP
Planning Program Administrator

for WILLIAM SPENCE
Planning Director

xc: Danny A. Dias, Staff Planner
Nolly Yagin, Department of Public Works
Wendy Kobashigawa, Department of Public Works
EAC File
General File

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MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

William Spence, Director
Department of Planning
Attention: Danny Dias, Staff Planner
250 South High Street
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004)

Dear Mr. Spence:

Thank you for your letter of March 24, 2011 providing comments on the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the applicant, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. We acknowledge the land use designation for the subject project provided in your letter. We note the Wailuku-Kahului Community Plan (not Paia-Haiku Communiy Plan) land use designation is "Agriculture".

2. DPW acknowledges the Planning Department's concurrence that the DPW is the determining agency for the Environmental Assessment (EA) pursuant to the Title II, Chapter 200-4, Environmental Impact Statement Rules. We also acknowledge the Planning Department's concurrence that an anticipated Finding of No Significant Impact is appropriate for the Draft EA.

3. We confirm one (1) hard copy and an electronic file of the Final EA will be transmitted to the Department of Planning.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

for

Leilani Pulmano
Program Manager

LP:me
cc: David Goode, Director, Department of Public Works
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APR 11 2011

POLICE DEPARTMENT

COUNTY OF MAUI

ALAN M. ARAKAWA
MAYOR

OUR REFERENCE

YOUR REFERENCE

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

GARY A. YABUTA
CHIEF OF POLICE

CLAYTON N.Y.W. TOM
DEPUTY CHIEF OF POLICE

April 5, 2011

Ms. Leilani Pulmano
Program Manager
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Pulmano:

SUBJECT: Proposed Waiale Road Extension and East Waiko Road Improvements

This is in response to the request for comments on the above subject.

We have reviewed the information submitted for this project and have submitted our comments and/or recommendations. Thank you for giving us the opportunity to comment on this project.

Very truly yours,

AC D. Matsuura

Assistant Chief Danny Matsuura
for: Gary A. Yabuta
Chief of Police

c: William Spence, Planning Department
Nolly Yagin, County Dept. of Public Works

TO : GARY YABUTA, CHIEF OF POLICE, COUNTY OF MAUI

VIA : CHANNELS

4/5/11

FROM : MARK VICKERS, SERGEANT, VISITOR ORIENTED POLICE

SUBJECT : RESPONSE FOR DRAFT ENVIRONMENTAL ASSESSMENT: PROPOSED WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS PROJECT

This communication is submitted as a response to a request for review and comment for an environmental assessment from Leilani Pulmano, Program Manager of Munekiyo & Hiraga, Inc., regarding:

PROJECT	:	Proposed Waiale Road Extension and East Waiko Road Improvements
TMK #	:	(2) 3-5-:002:014 (por.), 018 (por.), and 888 (por.); (2) 3-5-027:021 (por.), (2) 3-6-002:003 (por.); and (2) 3-8-005:999 (por.)
APPLICANT	:	County of Maui, Department of Public Works
CONSULTANT	:	Munekiyo & Hiraga, Inc.

<u>RESPONSE:</u>

In review of the submitted documents, concerns from the police perspective are upon the safety of pedestrian and vehicular movement.

The specified project's location is on several properties as provided by the TMK Numbers above which encompass both projects of the proposed Waiale Road Extension and the East Waiko Road improvement.

In regards to the East Waiko Road Imrovements Project, making this roadway wider and re-striping lane markings will increase the safety for vehicular movement. Upgrading the existing pavement section to two 12-ft. travel lanes, 6-ft. shoulders and asphalt concrete swales will also hopefully eliminate or reduce roadway curvature thus reducing the current limited visibility at sections of this roadway. This roadway's use has significantly increased with the population rise of nearby residential neighborhoods in the Waikapu/Wailuku areas and improvements to this roadway will have a positive impact on vehicular movement with consideration to the applicable speed limits.

However, it is noted that this area has been known to be a dumping area for derelict vehicles, household appliances and other various trash articles. Although this problem has been greatly reduced, consideration should be given to provide sufficient lighting during dark hours as well and any other type of preventive measure should be considered in order to deter this type of criminal activity.

In regards to the Proposed Waiale Road Extension, it is understood that the selection of the terminus location at the Old Quarry Road was preferred as the traffic flow would follow the proposed Urban Growth Boundary and bypass the proposed Waikapu Country Town's internal roadway network. As stated, this roadway would:

1) Increase the viability of Waiale Road as an alternative route to Honoapi'ilani Highway and Kuihelani Highway through the Waikapu area;
2) Improve regional access to Honoapi'ilani Highway and Kuihelani Highway for existing and future growth within the Waikapu and Wailuku areas; and
3) Reduce turning movements to and from Honoapi'ilani Highway from Kuikahi Drive and East Waikko Road, which would otherwise serve as the only means of accessing Honoapi'ilani Highway within the area.

For this project, concerns are addressed in regards to pedestrian and vehicular movement as well as crime prevention and deterrence. For vehicular movement, this proposed roadway would provide an alternate means for traffic to flow into and out of the respective Waikapu/Wailuku areas without having a negative impact on traffic in Waikapu Village. It would also provide an alternate route for vehicular movement should roadway closures be necessary along another route into Wailuku along Honoapi'ilani Highway. For pedestrian traffic, providing a Bike/Pedestrian Path along the West side of the roadway would encourage this type of traffic and having an 18 foot separation from this path to the vehicular travel lane appears adequate for pedestrian/bike safety.

In regards to indirect effects, this project is expected to increase vehicular traffic along Waiale Road for traffic movement as the current route via Kuikahi and Honoapi'ilani appears to draw the majority of the traffic flow through this area (Traffic Impact Assessment Report). The recommendations within the TIAR, providing median acceleration and deceleration lanes along Waiale Road for the intersections with Kokololio Street, Haawi Street and Nokekula Street also appear sufficient at this time. The neighborhoods that utilize these roadways are confined to the use of these three access points to Waiale Road and significant expansion in this area does not seem likely.

Although it was determined that this project (when completed) would not affect the service area of police, any time a new road or area is developed, the actual accessible areas requiring police service are increased even though the geographical area may already be provided with police service. As this road will extend to the outer areas without current residential or business properties, consideration must be given to crime prevention and deterrence. The most notable aspect for this concern is lighting during evening, late night and early morning hours. Congregation of the unlawful element, whether it be by status offense or by criminal offense tend to occur in poorly lit areas that are easily accessible and away from the populace. This type of congregation usually leads to offenses such as Curfew Violations, Underage Drinking, Drug offenses, Littering and Criminal Property Damage. Although this concern would fall upon police services, by providing adequate lighting and minimizing the opportunities for this type of behavior to occur would not only benefit the police, but the county as a whole as damages to these areas would be expected to be less than if these areas had inadequate lighting. For these reasons, it is strongly suggested that proper lighting for this new road be provided in order for not only the safety of vehicular movement but for crime prevention and deterrence as well.

CONCLUSION:

There are no objections to the progression of this project at this time, from the police standpoint, in regards to pedestrian and vehicular movement. However, consideration is requested for sufficient lighting to be installed for not only the safety of vehicular movement, but for crime prevention and deterrence as well.

For approval w/ recommendations

4/6/11

Respectfully Submitted,

Sgt. Mark MK Vickers 10046
Visitor Oriented Police
April 5, 2011 @ 1200 Hours

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Assistant Chief Danny Matsuura
Maui Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Assistant Chief Matsuura:

Thank you for your letter of April 5, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the applicant agency, Department of Public Works (DPW), we offer the following information, which addresses the comments provided by Sergeant Vickers in the order listed in your letter.

1. The DPW acknowledges the Maui Police Department's comment that the East Waiko Road use has significantly increased with the population rise of the nearby residential neighborhoods in the Waikapu/Wailuku areas and improvements to East Waiko Road will have a positive impact on vehicular movements with consideration to the applicable speed limits.

2. In regards to the comments on lighting on East Waiko Road, the current plan is for only the intersection of East Waiko Road and Waiale Road to be illuminated with street lighting. The lighting will be shielded and directed downward to avoid adverse impacts to seabirds in their nightly migrations. DPW will maintain the shoulders of the roadway and trim vegetation within the right-of-way to provide more visibility to the public and law enforcement personnel. Greater visibility will help to discourage illegal activities and dumping of refuse.

3. We acknowledge your comments on the Waiale Road Extension in connection with pedestrian and vehicular movement, as well as concerns regarding crime prevention and deterrence. The DPW appreciates your concurrence that the Waiale Road Extension will provide an alternate route to and from Wailuku and Kahului and not adversely impact traffic in Waikapu Village. Your comment noted that the Waiale Road Extension would also offer an alternate route if roadway closures are necessary along the parallel portion of Honoapiilani Highway into Wailuku. We also note the Department's concurrence that the pedestrian and bicycle route is adequate from a safety standpoint.

4. We acknowledge the Department's comments on the indirect effects of the project and the increase in traffic on Waiale Road. Of concern to the DPW was the proposed mitigation of traffic impacts and increased safety to the residents at Waikapu Gardens subdivision. The DPW acknowledges that the Police Department considers the median acceleration and deceleration lanes that will be provided at the intersections with Kokololio Street, Haawi Street and Nokekula Street appears sufficient at this time. The Traffic Impact Assessment Report (TIAR) concluded that traffic signals were not warranted in the near term and recommended these roadway improvements to maintain the level of service and provide vehicular safety improvements at these intersections. DPW will continue to monitor the service levels at the Waiale Road intersections with Waikapu Gardens subdivision to determine when traffic warrants will be met to justify installation of traffic signals.

5. Thank you for bringing to our attention the fact that, although the service area of the police department may not be expanded by the project, the project may create conditions for unlawful activities thereby increasing police surveillance requirements. As noted above, the DPW will be illuminating the intersection areas only and limiting street lights along the roadways in order to preserve the night sky. However, the DPW will be maintaining the roadways and keeping the shoulder areas clear of overgrown vegetation which will improve visibility and aid in crime prevention.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes (HRS) review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Director, Department of Public Works
K:\DATA\COM\DPW WaialeExt\MPDdeares.ltr.doc

ALAN M. ARAKAWA
Mayor

KYLE K. GINOZA, P.E.
Director

MICHAEL M. MIYAMOTO
Deputy Director

JUN 03 2011

TRACY TAKAMINE, P.E.
Solid Waste Division

Wastewater Reclamation Division

COUNTY OF MAUI
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 100
WAILUKU, MAUI, HAWAII 96793

June 1, 2011

Mr. Nolly Yagin
County of Maui
Department of Public Works
Engineering Division
200 South High Street
Wailuku, Hawaii 96793

SUBJECT: WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS DRAFT ENVIRONMENTAL ASSESSMENT TMK (2) 3-5-002:014 (POR.), 018 (POR.), AND 888 (POR.); (2) 3-5-027:021 (POR.); (2) 3-6-002:003 (POR.); AND (2) 3-8-005:999 (POR.), WAIKAPU, MAUI, HAWAII

We reviewed the subject application and have the following comments:

1. Solid Waste Division comments:

   a. None.

2. Wastewater Reclamation Division (WWRD) comments:

   a. None. There is no County wastewater system in the vicinity of the subject project.

If you have any questions regarding this memorandum, please contact Michael Miyamoto at 270-8230.

Sincerely,

KYLE K. GINOZA, P.E.
Director of Environmental Management

xc: Ms. Leilani Pulmano
Munekiyo & Hiraga, Inc.

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Kyle Ginoza, P. E., Director
Department of Environmental Management
County of Maui
2200 Main Street, Suite 100
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii; (TMK Nos. (2)3-5-002:014(por.), 018(por.) and 888(por.), (2)3-5-027:021(por.), (2)3-6-002:003(por.), and (2)3-8-005:999(por.)); (EAC 2011/0004)

Dear Mr. Ginoza:

Thank you for your letter of June 1, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed Waiale Road Extension and East Waiko Road Improvements. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information in response to your comments.

We appreciate your review of the document and your conveying confirmation that the Solid Waste Division has no comments and the Wastewater Reclamation Division confirmation that there are no County wastewater systems in the vicinity of the subject project. The DPW confirms the project will not generate wastewater flow and will not require wastewater disposal.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:lh
cc: David Goode, Director, County of Maui, Department of Public Works
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environment
planning
government

MAR 23 2011

ALAN M. ARAKAWA
Mayor

JO ANNE JOHNSON WINER
Director
MARC I. TAKAMORI
Deputy Director
Telephone (808) 270-7511

DEPARTMENT OF TRANSPORTATION

COUNTY OF MAUI
200 South High Street
Wailuku, Hawaii, USA 96793-2155

March 15, 2011

Ms. Leilani Pulmano
Munekiyo & Hiraga Inc.
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements Project

Dear Mrs. Pulmano,

Thank you for the opportunity to comment on this project. We have no comments to make at this time.

Please feel free to contact me if you have any questions.

Sincerely,

Jo Anne Johnson Winer

Jo Anne Johnson Winer
Director

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8461

MAR 10 2011

March 8, 2011

Mr. Nolly Yagin, Project Manager
County of Maui, Dept. of Public Works
200 South High Street
Wailuku, Hawaii, 96793

Subject: Proposed Waiale Road Extension and East Waiko Road Improvements – Draft Environmental Assessment
Waiale Road Extension and East Waiko Road
Wailuku, Maui, Hawaii
Tax Map Keys: (2) 3-5-002:014(por.), 018(por.), 888(por.);
(2) 3-5-027:021(por.); (2) 3-6-002:003(por.);
(2) 3-8-005:999(por.)

Dear Mr. Yagin,

Thank you for allowing us to comment on the Draft Environmental Assessment for the subject project.

In reviewing our records and the information received, Maui Electric Company has no additional comments to the subject project at this time.

Should you have any questions or concerns, please call me at 871-2341.

Sincerely,

Kyle Tamori
Staff Engineer

c: Munekiyo & Hiraga, Inc. - Ms. Leilani Pulmano

APR 0 6 2011

Waikapū Community Association

Mr. Nolly Yagin,
Project Manager
Dept. of Public Works,
County of Maui
200 South High Street
Wailuku, HI 96793

April 5, 2011

SUBJECT: Draft Environmental Assessment, Proposed Waiale Road Extension and East Waiko Road Improvements in Waikapū, Maui, Hawaii

Dear Mr. Yagin,

The Waikapū Community Association wishes to present the following comments on the Draft EA for this proposed Project.

The WCA Development Monitoring Committee met on March 28, 2011 to discuss the Draft Environmental Assessment and the letter of February 18, 2011, received from your consultant Leilani Pulmano of Munekiyo & Hirage.

The Committee has the following comments:

1) <u>The Waikapū Community Association strongly disagrees with the finding in the Draft EA that traffic signals at Waiale Road in front of the Waikapū Gardens subdivision are not recommended</u>. The experience of current Waikapū Gardens subdivision residents with the present levels of traffic on Waiale Road is one of great frustration when attempting to merge from the subdivision onto Waiale Road using a left turn.

   The proposed median acceleration and deceleration lanes on Waiale Road at Kokololio, Haawi, and Nokekula Streets will create, through their proximity to one another, a confusing picture of traffic lining up in visually hard to distinguish lanes of turning and through traffic, that should be expected to block a clear view of the actual traffic movements.

Residents from the Waikapū Gardens will now have to deal with at least two lanes of traffic approaching on Waiale Road (the deceleration and the through lane) in attempting to make a left turn on Waiale Road. With the observed speeds well in excess of the posted limits, that will be a daunting task.

Furthermore, the projected increase in traffic volume from the stated purpose of the extension to increase the viability of Waiale Road as an alternative to Honoapiilani and Kuikahi Highways through the Waikapū area, will only serve to exacerbate the problems experienced by the residents of Waikapū gardens.

Clearly, the only reasonable and, to the residents, acceptable solution is to require that traffic lights be placed at Waiale Road in front of the Waikapū Gardens subdivision. This will be the only way to effectively prevent the serious accident(s) that are bound to occur as a result of poor traffic mitigation planning such as found in the Draft EA.

2) <u>Separated</u> bikepaths and sidewalks should be included in the roadway design for the improvements of Waiale Road, from Honoapiilani Highway to the intersection with Kuhikahi Drive/Maui Lani Parkway(?). As a member of the Steering Committee for the Non-Motorized Access Plan Project, you should be aware of the likely designation of the Waiale Road corridor as a regional connector route for bicycle and pedestrian users.

   <u>Separate bike and pedestrian paths, separated from motorized traffic are likely to be a key recommendation in the plan to promote safe opportunities for non-motorized traffic</u>. Developments planned for both ends of that entire corridor will be expected to bring stores, schools, churches, housing for the elderly and additional residential development to the area, which must be expected to generate a considerable amount of pedestrian and bicycle traffic along Waiale Road.

   The Draft EA suggests that a '10-ft. bike/pedestrian path on the west side of the roadway' be provided. This apparent combined use has shown to create safety conflicts between bicyclists and pedestrians, and will likely result in underutilization of this path. Again, in anticipation of the recommendations in the Non-Motorized Access Plan, the Waikapū Community Association strongly urges you to provide separate paths for bicyclists and pedestrians. There is no shame in being forward looking in projects such as these!

The Waikapū Community Association looks forward to continuing dialogue regarding this project. The Development Monitoring Committee requests to be informed of any meetings regarding this project, as may need to be scheduled before any approving bodies.

Thank you again for this opportunity to provide comments on this project.

Sincerely,

Jacob W. Verkerke
Waikapū Community Association Chair

cc: Ms. Leilani Pulmano, Project Manager, Munekiyo & HIraga
Mr. Mike Victorino, Council Member, County of Maui

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Jacob W. Verkerke, Chair
Waikapu Community Association
P. O. Box 3046
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Mr. Verkerke:

Thank you for your letter of April 5, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of the County of Maui, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

1. The DPW notes the Waikapu Community Association's strong disagreement with the finding of the Draft EA that traffic signals at Waiale Road in front of the Waikapu Gardens subdivision are not recommended. The Traffic Impact Analysis Report (TIAR) contained in the Draft EA included an investigation of the levels of service along the project corridor at a number of intersections including the three (3) roadways providing access to the Waikapu Gardens subdivision off of Waiale Road, namely Kokololio Street, Haawi Street and Nokekula Streets. The traffic mitigation recommendation for the intersections along Waiale Road and the Waikapu Gardens subdivision is based on the projected levels of traffic taking into account, the known and planned development projects in the area up to the planning horizon year of 2030. Three (3) alternatives were evaluated in the TIAR for the intersections. The alternatives included: (1) a left turn pocket and traffic signal at one of the intersection; (2) construction of a mini-roundabout; and (3) construction of deceleration and median acceleration lanes along Waiale Road. The left-turn lane and traffic signal was not recommended at this time since the projected levels of traffic did not meet the traffic warrant threshold for signalization. Generally, traffic signals are installed when federal guidelines contained in the Manual of Uniform Traffic Control Devises (MUTCD) have been met. As referenced in the MUTCD it is important that the signals meet a certain

305 High Street, Suite 104 • Wailuku, Hawaii 96793 • ph: (808)244-2015 • fax: (808)244-8729 • planning@mhplanning.com • www.mhplanning.com

threshold, "in part due to the fact that vehicular delay and the frequency of some types of crashes are sometimes greater under traffic control than under stop control". (MUTCD, 2009, Page 435.) The mini-roundabout was not recommended because the projected future traffic capacity would exceed the handling capacity of the mini-roundabout. As such, the left-turn median acceleration and deceleration lanes option was recommended, at this time. This option would allow those vehicles turning left from the Waikapu Gardens subdivision onto Waiale Road to cross the single lane of oncoming traffic and enter the refuge lane and wait before entering the vehicle travel lane on Waiale Road. Although traffic signals are not recommended at this time, the DPW will monitor the traffic conditions on Waiale Road as the area gets built out and the need for signalization of the intersections to the Waikapu Gardens subdivision will be re-evaluated at that time. Therefore, continued consultation and coordination with the Waikapu Gardens Homeowners Association, and the Waikapu Community Association and DPW will be done to monitor the traffic conditions along Waiale Road to determine if and when traffic signalization would be warranted.

The construction of the deceleration and median acceleration lanes will be designed to DPW Highway roadway standards. The vehicles exiting the Waikapu Gardens subdivision will only be crossing one lane of traffic and then would be able to safely enter the refuge lane before entering the vehicular travel lane on Waiale Road. The DPW will check and confirm there is enough distance between the driveway entrances for the median acceleration and deceleration lanes to ensure driver safety.

DPW will coordinate with the Maui Police Department to monitor the speeding along Waiale Road to address the high speed traffic concerns expressed in your letter.

2. We appreciate receiving your association's comments regarding pedestrian and bicycle safety, as safety issues are important when DPW designs any new roadway improvement. Currently the plans are to have a shared 10-foot (ft.) wide bicycle/pedestrian path along the west side of the Waiale Road Extension. We note there are no sidewalks along the Waiale Road fronting the Waikapu Gardens subdivision and beyond to Kuikahi Drive. However, there is a wide grass strip between the roadway and subdivision property line which pedestrians can use. There is also a striped bicycle lane on both sides of Waiale Road.

   The DPW notes the association's comment regarding the width of the pedestrian/bicycle path and the desire to have a separate bicycle pathway. The

10-ft. wide shared pedestrian and bicycle lane would enable both non-motorized modes of transportation to use the shared facility. The shared pedestrian and bicycle lane will be striped to separate the bicycles and pedestrian use to ensure safety for the uses.

3. The DPW confirms it will keep the Waikapu Community Association apprised of future public informational meetings on the Waiale Road Extension project and will continue to coordinate with the association as the project moves forward and other projects in the area are implemented.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
cc: David Goode, Director, Department of Public Works
Keith Niiya, Austin, Tsutsumi & Associates, Inc.
K:\DATA\COM\DPW WaialeExt\WCAdeares.ltr.doc

APR 06 2011

April 4, 2011

WS

Leilani Pulmano
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, HI 96793

SUBJECT: Waiale Road Extension Environmental Assessment

Dear Ms. Pulmano:

This letter is in response to your correspondence dated February 18, 2011, to the Waikapu Community Association, regarding the extension of Waiale Road.

As the Homeowners Association for the Waikapu Gardens subdivision, we would like to express some concerns with the current plans for the extension of Waiale Road and the significant impacts that this will have on our residents, the most important issue being traffic. Our Waikapu Gardens Association is **very concerned that the current plans do not include traffic light signals in front of our subdivision. This is a safety issue that will help mitigate the anticipated increase of traffic and allow our residents of Waikapu Gardens to enter and exit our subdivision safely.**

Waikapu Gardens subdivision includes 411 homes immediately fronting Waiale Road. We have approximately 800 homeowners and make up just under half of the total population of the Waikapu community. Waiale Road is the only entrance and exit from our subdivision. Based on an average of 2 vehicles per home (some homes have 3 or more vehicles), that would average out to approximately 822 trips per day on Waiale Road from our subdivision alone.

Looking down the road, there are proposed plans being discussed in the Waikapu community to develop residential housing that will significantly increase traffic on Waiale Road: A&B's Waiale project at 1,555 units, Waikapu Country Town at 1,210 units, Ohana Kai Village project at approximately 1,100 homes. While these projects are still in their conceptual stages of planning, it is important to take into account the potential traffic impact that will be generated by them in the future.

On the Wailuku side of our Waikapu Gardens subdivision, the Emmanuel Lutheran Church will also be building a school campus, church, multipurpose building, recreational facilities, and possibly a high school on their 25 acre property. Per consultation with their representative, all traffic from their project will exit and enter from Waiale Road (there are no exits or entrances from Honoapiilani Highway).

Valley Isle Fellowship Church also have plans to build a church and possible elderly housing on their property located on the immediate Wailuku side of our Waikapu Gardens subdivision. This will add to the increase of traffic on Waiale.

There are also commercial businesses on Waiko road and others presently under construction that currently use, or will be using Waiale Road in the future. This, added to the fact that the extension of Waiale Road, when completed, will become a major bypass for traffic heading to and from Wailuku from districts such as: West Maui (Kaanapali, Lahaina & Olowalu), South Maui (Makena, Wailea and Kihei), Maalaea area, as well as traffic heading to these districts from central Maui (Waihee, Wailuku and Kahului,) raises some very serious concerns.

In your letter, you also mentioned that bike paths and pedestrian walkways will be included as part of the design for the Waiale Road extension, and that they will be located on the mauka side of the road. This implies that the bike paths and walkways will be constructed on the same side of Waiale Road where our Waikapu Gardens subdivision is located, and that they would run along the front of our subdivision. **We feel this creates another safety issue and further validates the need for traffic lights in front of our Waikapu Gardens subdivision.**

Based on the above and anticipating what is being proposed for the future, we kindly request the following:

1. That **traffic lights** in front of Waikapu Gardens subdivision be included as part of the plans to extend Waiale Road. **Again, this is a safety concern for our residents as well as other commuters who will be using Waiale Road.** Traffic lights will help mitigate the impacts of traffic and allow our residents of the Waikapu Gardens subdivision to get in and out of their neighborhood **safely.** Preliminary discussions have already taken place with one of the developers and he has agreed to help with putting up traffic lights in front of the Waikapu Gardens subdivision as a condition of approval for his proposed project.
2. We request that copies of the current design plans for the extension of Waiale Road, specifically plans fronting the Waikapu Gardens subdivision, be forwarded to our Homeowners Association at the address listed below.
3. That the Waikapu Gardens Homeowners Association be notified and included in all future planning and consultation meetings regarding the extension of Waiale Road. **This project will have a significant impact on our residents and neighborhood and we respectfully ask to be included in these discussions.**

Thank you for allowing our Homeowners Association this opportunity to express our concerns regarding the plans for the extension of Waiale Road. **Our goal is to work together on**

solutions that will ensure the safety of our Waikapu Gardens' residents and neighborhood, while planning responsibly for growth in the future.

Sincerely,

Frank Fiorentino

Frank Fiorentino 4/5/11
President
Waikapu Gardens Homeowners Association
1498 Lower Main Street, Suite A #2
Wailuku, HI 96793

cc: David Goode
Director of Public Works
County of Maui
200 South High Street
Kaulana O Maui Bldg, 4th Floor
Wailuku, HI 96793

MUNEKIYO & HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

November 4, 2011

Frank Fiorentino, President
Waikapu Gardens
Homeowners Association
1498 Lower Main Street, Suite A #2
Wailuku, Hawaii 96793

SUBJECT: Response to Draft Environmental Assessment Comment Letter Regarding Proposed Waiale Road Extension and East Waiko Road Improvements, Waikapu, Maui, Hawaii (TMK Nos. (2) 3-5-002:014 (por.), 018 (por.), and 888 (por.), (2)3-5-027:021 (por.), (2)3-6-002:003 (por.), and (2)3-8-005:999 (por.)) (EAC 2011/0004)

Dear Mr. Fiorentino:

Thank you for your letter of April 4, 2011, providing comments on the Draft Environmental Assessment (EA) for the proposed project. On behalf of County of Maui, Department of Public Works (DPW), we offer the following information, which addresses your comments in the order listed in your letter.

The DPW acknowledges that the Waikapu Gardens Homeowners Association has concerns with the current plans for the Waiale Road Extension due to anticipated impacts resulting from the future increase in traffic along Waiale Road. The DPW understands the Waikapu Garden subdivision residents are concerned about the safety of entering and exiting the subdivision and would like to see the installation of traffic signals in front of the subdivision.

1. A Traffic Impact Analysis Report (TIAR) was carried out by Austin, Tsutsumi & Associates, Inc. to assess the traffic impacts of the proposed Waiale Road Extension and the Waiko Road Improvements. In compiling the background traffic growth the traffic study used the year of 2030 to forecast future traffic conditions. The projections indicated significant growth by 2030 along this corridor from development projects currently planned or under construction. In total, the future growth in traffic represents approximately 4,850 new dwelling units, as well as commercial, industrial, park, school, and other ancillary land uses. The TIAR also included an investigation of the levels of service (LOS) along the project corridor at a number of intersections including the three (3) roadways providing access to the Waikapu Gardens subdivision off of Waiale

Road, namely Kokololio Street, Haawi Street and Nokekula Streets. The traffic mitigation measures that were investigated at these intersections included: (a) left-turn lane on Waiale Road and median lanes; (b) left-turn lane on Waiale Road and traffic signal; and (3) mini-roundabout. The left-turn lane and traffic signal measures were not recommended at this time since it did not meet the traffic warrant threshold for signalization. Traffic signals are generally installed when federal guidelines contained in Manual of Uniform Traffic Control Devises (MUTCD) have been met in part due to the fact that "vehicular delay and the frequency of some types of crashes are sometimes greater under traffic control than under stop control" (MUTCD, 2009, page 435). The mini-roundabout was not recommended since the projected future traffic capacity would exceed the handling capacity of the mini-roundabout. As such, the left-turn median acceleration and deceleration lanes mitigation option on Waiale Road at the Waikapu Gardens subdivision roadways was recommended. This would allow those vehicles turning left onto Waiale Road to enter a refuge lane to enable safe access onto Waiale Road travel lane. However, as noted in the TIAR, future signalization of the intersections to the Waikapu Gardens subdivision should be re-evaluated as traffic increases along Waiale Road and future planned projects are developed. Therefore, DPW will commit to continued consultation and coordination with the Waikapu Gardens Homeowners Association and to continuously monitor the traffic conditions along Waiale Road, to determine if and when traffic signalization would be warranted.

2. We appreciate receiving your association's concern regarding pedestrian and bicycle safety, as safety issues are important to DPW's design of the new roadway improvements. Currently the plans are to have a shared 10-foot (ft.) wide bicycle/pedestrian path along the west side of Waiale Road Extension. We note there are no sidewalks along the Waiale Road fronting Waikapu Gardens subdivision and beyond to Kuikahi Drive. However, there is a wide grass strip between the roadway and subdivision property line which pedestrians can use. There is also a striped bicycle lane on both sides of Waiale Road. In order for the sidewalks to be installed along the Waikapu Gardens subdivision, the DPW will have to evaluate the situation and budget the cost for the capital improvement as well as discuss cost-sharing of the sidewalk with adjacent landowners. Currently, there is insufficient funding for this improvement and other funding sources would need to be sought.

   The MUTCD signal warrant guidelines are based on the number of pedestrians crossing the road versus the number of vehicles per hour along the main road. Pedestrian counts taken at the Waiale Road/Kuikahi Drive intersection indicate the number of pedestrians crossing Waiale Road will not meet the MUTCD requirement justifying a pedestrian signal crossing. However, as noted above, future traffic conditions could change from the projections and DPW would re-evaluate the need for pedestrian traffic signal as traffic along the corridor increases. The DPW will continue to monitor the traffic growth along this corridor and meet with the association, as requested, to provide traffic information and review traffic safety concerns.

3. As requested, the DPW will send copies of the current plans for the extension of Waiale Road to your association. Detailed plans for the Waiale Road Improvements fronting the Waikapu Gardens subdivision have not been designed at this time, however, enclosed with this letter the conceptual left-turn acceleration and deceleration median lane layout for your review and comment. See **Exhibit "A"**.

4. The DPW confirms it will keep the Waikapu Gardens Homeowners Association apprised of future public informational meetings regarding the Waiale Road Extension project and will continue to coordinate with the association as the project moves forward.

Thank you again for your participation in the Chapter 343, Hawaii Revised Statutes review process. A copy of your letter will be included in the Final EA.

Sincerely,

Leilani Pulmano
Program Manager

LP:yp
Attachment
cc: David Goode, Director, Department of Public Works (w/attachment)
Keith Niiya, Austin, Tsutsumi & Associates, Inc. (w/attachment)
K:\DATA\COM\DPW WaialeExt\WGHAdeares.ltr.doc

Median acceleration and deceleration lanes along Waiale Road at its intersections with Kokololio Street, Haawi Street, and Nokekula Street.

Note:
For Illustrative Purposes Only.
Do not use for Design.

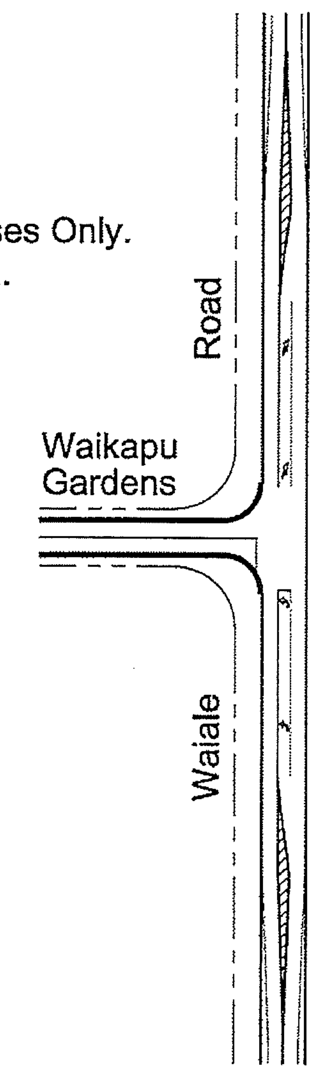

EXHIBIT "A"

XI. REFERENCES

XI. REFERENCES

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APPENDIX A.

Traffic Impact Assessment Report

TRAFFIC IMPACT ANALYSIS REPORT WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS

Waikapu, Maui, Hawaii

FINAL

May 29, 2010

Prepared for:

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TRAFFIC IMPACT ANALYSIS REPORT
WAIALE ROAD EXTENSION AND
EAST WAIKO ROAD IMPROVEMENTS

Waikapu, Maui, Hawaii

FINAL

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Civil Engineers • Surveyors
Honolulu • Wailuku • Hilo, Hawaii

May 29, 2010

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

TABLE OF CONTENTS

TABLE OF CONTENTS
Cont'd

TABLE OF CONTENTS
Cont'd

Page

TABLES

TABLE OF CONTENTS
Cont'd

Page

FIGURES

TABLE OF CONTENTS
Cont'd

TABLE OF CONTENTS
Cont'd

TABLE OF CONTENTS
Cont'd

APPENDICES

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

KENNETH K. KUROKAWA, P.E.
TERRANCE S. ARASHIRO, P.E.
DONOHUE M. FUJII, P.E.
STANLEY T. WATANABE
IVAN K. NAKATSUKA, P.E.
ADRIENNE W. L. H. WONG, P.E., LEED AP

FINAL

TRAFFIC IMPACT ASSESSMENT REPORT WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS Wailuku, Maui, Hawaii

I. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from:

1. Waiale Road Extension (WRE) – The proposed extension of Waiale Road southward from its existing terminus at East Waiko Road, ultimately to connect with Honoapiilani Highway. The proposed alignment will establish 80 feet of Right-of-Way (ROW) throughout the length of the WRE. Two alternatives will be studied:

    a. Alternative 1: Waiale Road is extended southward by approximately 8,600 lineal feet and ultimately bends slightly westward to intersect Honoapiilani Highway across of the old Quarry Road. See Figure 1 for plan.

    b. Alternative 2: Waiale Road is extended southward by approximately 2,000 lineal feet, and bends westward – bifurcating the proposed Waikapu Country Town (WCT) development as "Road 1" to intersect Honoapiilani Highway across of the Maui Tropical Plantation (MTP) Access. See Figure 2 for plan.

REPLY TO:
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OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII
HILO, HAWAII

2. East Waiko Road Improvements ("EWRI") – The upgrading of approximately 4,600 feet of East Waiko Road between Waiale Road and Kuihelani Highway as follows:

   a. Widen its pavement width to 36 feet within the existing 60-foot ROW; the existing pavement width is 20 feet.

   b. Construct swales for drainage.

   c. Preserve the existing 60 feet ROW.

As required by the National Environmental Policy Act (NEPA), this report will also discuss the viability of Transportation Systems Management (TSM) and Mass Transit as alternatives to roadway infrastructure.

The WRE and EWRI shall hereinafter collectively be referred to as the "project". See Figures 1 and 2 for the alignments of the planned Alternatives 1 and 2.

A. Background and Location

The project is situated within Waikapu, a primarily residential area with some industrial and commercial uses which in recent years has experienced significant growth.

B. Project Need

Based on Maui County's current Urban Growth Boundary, future development within the Waikapu area is anticipated to exceed the existing roadway capacity.

It is the project's intent to improve traffic flow within and around Waikapu Village and provide an alternate route between the urban areas of Kahului and Wailuku.

C. Study Methodology

This study will address the following:

1. Assess existing traffic operating conditions at key locations within the study area.

2. Project Base Year 2030 traffic (without improvements) including traffic generated by the Maui Travel Demand Forecasting Model (MTDFM).

3. Identify planned improvements and potential traffic mitigative measures for the Base Year 2030 Traffic.

4. Reassign traffic with the new and improved roadways proposed in the project.

5. Recommend roadway improvements or other mitigative measures, as appropriate when the EWRI and WRE, Alternatives 1 and 2 are considered.

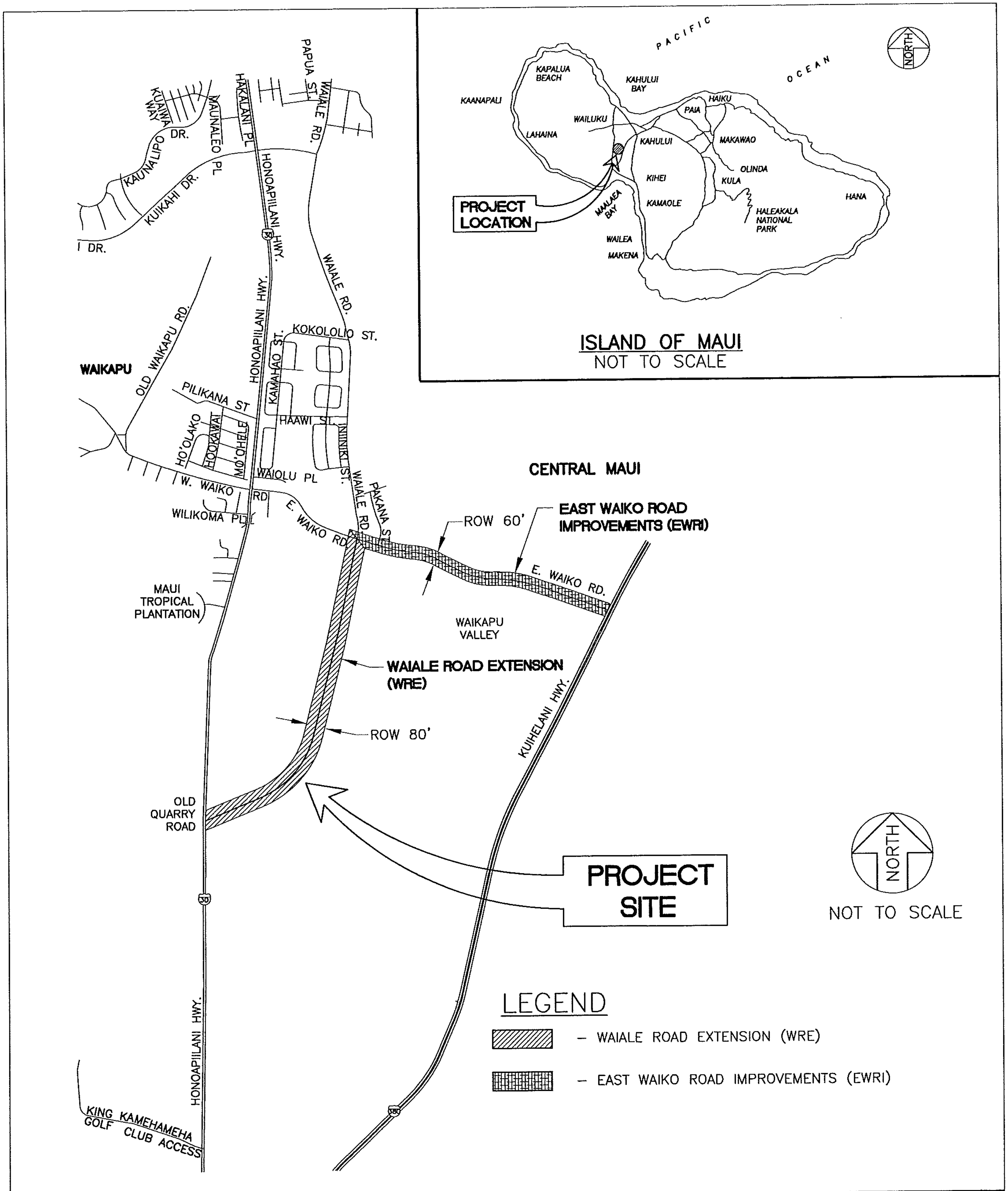
D. Definitions

- **Base Year 2030** – describes scenario where vehicular traffic volumes for the year 2030 are projected without the improvements proposed by the project.

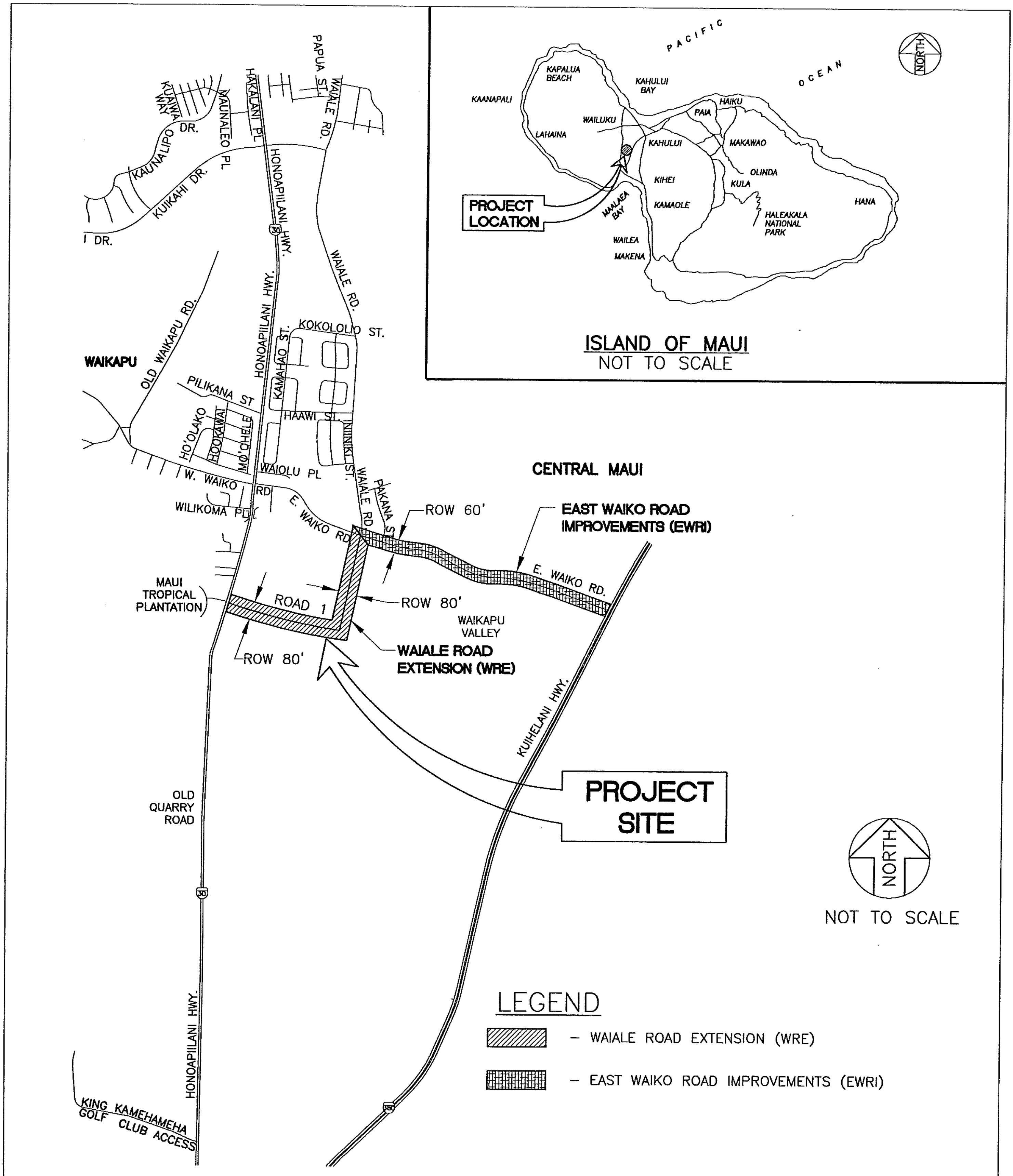
- **High, or Heavy Turning Movement Volume** – a subjective term that for this report, shall be used to describe conditions where the turning movement volume forms a significant component of the traffic processed through the intersection, and noticeably reduces capacity along the main arterial. This term can apply to a single heavy turning movement, or the collective effect of all turning movements.

- **Level-of-Service (LOS)** – as based on The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, LOS is a qualitative measure used to describe the conditions of traffic flow at intersections. Values range from LOS A (minimal delay) to LOS F (congested).

- **Trips** – for the purposes of this report, vehicular trips traversing the roadway network. Note that this term can also signify other modes of transportation, however vehicular trips will be the only trips considered in this report.



WAIALE ROAD EXTENSION	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	PROJECT LOCATION - ALTERNATIVE 1	1



WAIALE ROAD EXTENSION

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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PROJECT LOCATION - ALTERNATIVE 2

FIGURE 2

II. EXISTING CONDITIONS

A. Roadway System

West Waiko Road

West Waiko Road is an east-west, two-way, two-lane undivided collector road with a posted speed limit of 20 mph. West Waiko Road begins approximately 4,500 feet west of Honoapiilani Highway in an established residential neighborhood, and extends eastward towards its terminus at its intersection with Honoapiilani Highway and East Waiko Road.

East Waiko Road

East Waiko Road is an east-west, two-way, two-lane, undivided collector road with a posted speed limit of 20 mph. East Waiko Road currently serves residential and industrial land uses, while also providing connectivity (via Waiale Road) to the Waikapu Gardens subdivision and areas further north of it, including Wailuku. Through the Waikapu region, the 20-foot wide East Waiko Road is currently narrow and winding; the road appears to offer limited sight distance around some of its curves, and is stop-controlled approximately 650 feet east of its intersection with Waiale Road.

Currently, East Waiko Road is the only continuous road that provides direct access between Honoapiilani Highway and Kuihelani Highway.

Waiale Road

Waiale Road is a north-south, two-way, two-lane, undivided collector road with a posted speed limit of 20 mph. To the north, Waiale Road serves as the extension of Lower Main Street – wherefrom it extends southward past the Maui Community Correctional Center and residential areas, and eventually terminates at its intersection with East Waiko Road.

Between Kuikahi Drive and East Waiko Road, Waiale Road serves as the sole access to the residents of the Waikapu Gardens Subdivision. Each of the Wakapu Gardens' three existing accesses intersect with Waiale Road as "tee-" intersections, with single-lane approaches.

Honoapiilani Highway

Honoapiilani Highway is a north-south, two-way, two-lane, undivided arterial with posted speed limits ranging between 30 mph and 45 mph in the vicinity of the Project. Honoapiilani Highway begins as the continuation of South High Street near Kahookele Street, and continues southward through Waikapu, Maalaea, and wraps around the "Pali" towards West Maui.

Channelization is provided at all of its major intersections within the vicinity of the project.

Kuihelani Highway

Kuihelani Highway is a north south, two-way, four-lane, divided arterial with a posted speed limit of 55 mph in the vicinity of the Project. Kuihelani Highway begins to the north in Kahului at its intersection with Puunene Avenue and Dairy Road. The road extends southward along the eastern border of the Maui Lani Development, intersects with East Waiko Road, and ultimately terminates at its signalized intersection with Honoapiilani Highway to the south near Maalaea.

Kuikahi Drive

Kuikahi Drive is an east-west, two-way, two-lane, undivided collector road with a posted speed limit of 30 mph. Kuikahi Drive begins approximately 1.2 miles west of Honoapiilani Highway within the Wailuku Heights Development – eventually extending eastward to intersect with Honoapiilani Highway, and terminating at Waiale Road. As will be mentioned in Section III.A, this road will eventually be extended eastward to intercept Maui Lani Parkway, thereby providing connectivity to Kuihelani Highway, Kaahumanu Avenue (via Maui Lani Parkway), and the Maui Lani Subdivision.

Pilikana Street

Pilikana Street is an east-west, two-way, two-lane undivided collector road with a posted speed limit of 20 mph. Pilikana Street serves as sole access to Waiolani Mauka and intersects Honoapiilani Highway approximately 4,700 feet south of Kuikahi Drive/Honoapiilani Highway intersection.

Maui Tropical Plantation (MTP) Access

The MTP Access is an east-west, two-way, two-lane driveway providing access to the MTP via Honoapiilani Highway.

B. Existing Traffic Volumes

Manual turning movement traffic counts and field observations were conducted at the following study intersections on Tuesday, January 27, 2009 and Wednesday, January 28, 2009:

- Kuikahi Drive/Honoapiilani Highway (Signalized)
- Pilikana Street/Honoapiilani Highway (Signalized)
- East Waiko Road/West Waiko Road/Honoapiilani Highway (Signalized)
- MTP Access/Honoapiilani Highway (Unsignalized)
- Kuikahi Drive/Waiale Road (Unsignalized)
- East Waiko Road/Waiale Road (Unsignalized)
- East Waiko Road/Kuihelani Highway (Signalized)

Based on the count data, it was determined that the weekday AM peak hour of traffic occurs between 7:15 AM and 8:15 AM and the weekday PM peak hour of traffic occurs between 4:00 PM and 5:00 PM. The turning movement count data is included in Appendix A.

C. Existing Traffic Conditions

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, methods for calculating volume to capacity ratios, delays and corresponding Levels of Service were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix B.

Methodology

Analysis for the study intersections was performed using Synchro and RODEL. Synchro is an analysis program that is capable of preparing reports consistent with HCM methodology. These reports contain control delay results, based on intersection lane geometry, signal timing inputs, and hourly traffic volume.

RODEL is a British program designed for estimating operating conditions at roundabouts. This program estimates delay based upon empirical correlations with geometric factors.

Both programs assign a LOS based on delay (see Appendix B) as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis for the recommendations outlined in this report.

Regional Analysis

Honoapiilani Highway and Kuihelani Highway serve as the primary arterials through the Waikapu area. While the former generally serves traffic originating from or destined towards Wailuku, the latter serves traffic originating from or destined towards Kahului, Hana, or Upcountry. During the AM peak hour of traffic, congestion occurs along Honoapiilani Highway headed towards Wailuku; the northbound queue extends to near Kehalani Mauka Parkway, which is situated approximately 0.8 miles south of Main Street. No congestion was observed to occur along Kuihelani Highway within the study area.

Waiale Road, in addition to its service as a collector road for Waikapu Gardens and the nearby industrial areas, currently provides an alternate north-south route between east Wailuku and Waikapu. However, its ability to process traffic is limited by its slow posted speed limits and termination as a minor approach to East Waiko Road. Wakiapu Gardens residents have complained that speeding is an issue along Waiale Road between Kuikahi Drive and East Waiko Road.

The Waikapu/South Wailuku area has experienced considerable growth in residential land use; this growth is anticipated to continue in tandem with commercial, industrial, park, and other ancillary land uses. Currently, Waikapu traffic within the study area and within the region bound by Honoapiilani Highway and Kuihelani Highway is afforded relatively limited access to Honoapiilani Highway, since the only major connections are at East Waiko Road and Kuikahi Drive.

Observations and Intersection Analysis

<u>Kuikahi Drive/Honoapiilani Highway</u>

This signalized intersection operates relatively smoothly during the AM and PM peak hours of traffic. However, a relatively heavy demand occurs in the westbound left-turn movement. It appears that vehicles making this movement originate either from East Wailuku (via Waiale Road) or Kahului (via Maui Lani Parkway/Wainu Road) as a means of bypassing the more congested areas of Honoapiilani Highway and High Street. However, the queues for this movement were observed to be between six (6) and eight (8) vehicles long, and cleared at the end of each cycle length.

This intersection operates at LOS E(E) or better and within capacity at all movements during the AM(PM) peak hours of traffic. See Figure 3 for intersection details.

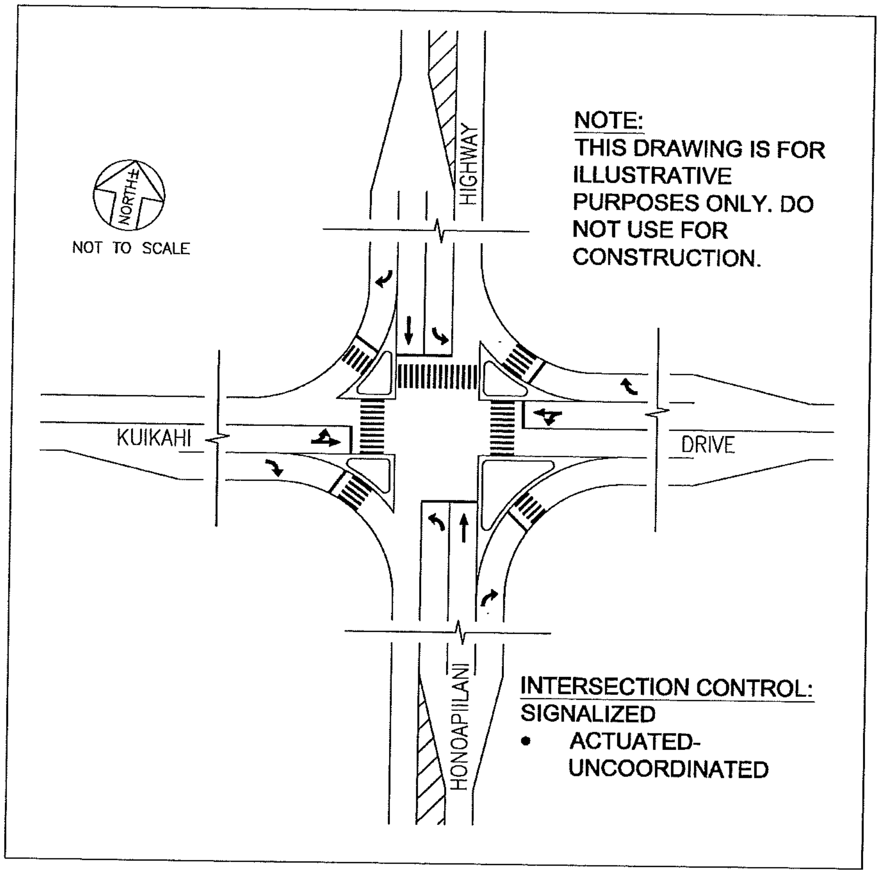


Figure 3: Existing Lane Configuration at Kuikahi Drive/Honoapiilani Highway

Pilikana Street/Honoapiilani Highway

This signalized "tee" intersection provides sole access to the Waiolani Mauka subdivision, and operates smoothly at an overall LOS A(A) during the AM(PM) peak hours of traffic. See Figure 4 for intersection details.

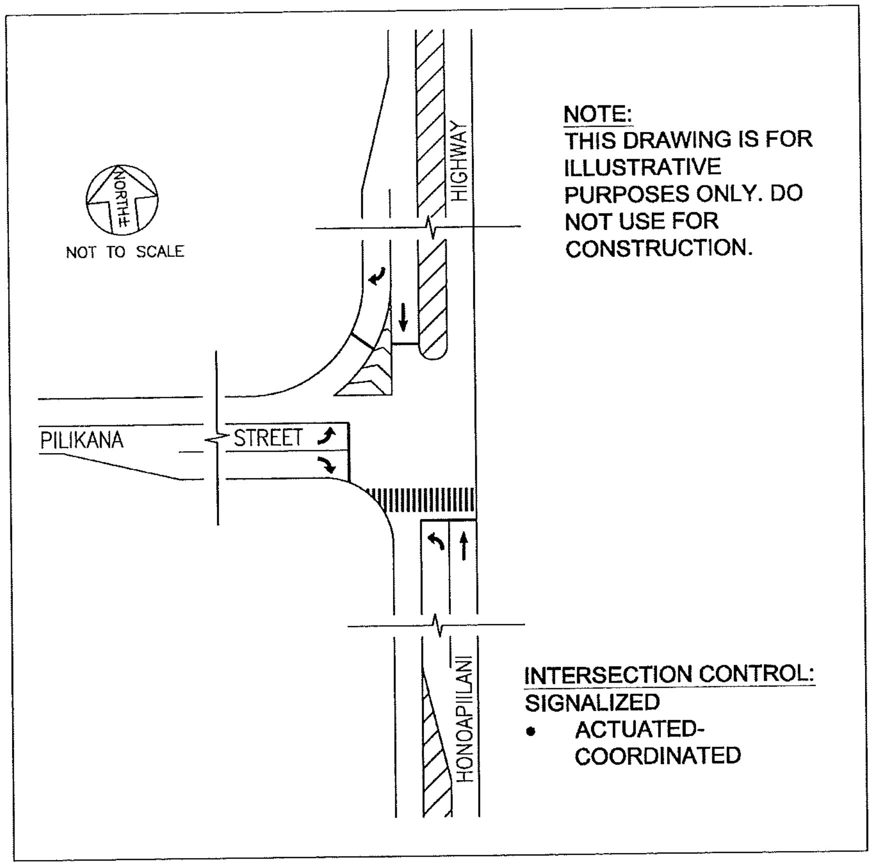


Figure 4: Existing Lane Configuration at Pilikana Street/Honoapiilani Highway

East Waiko Road/West Waiko Road/Honoapiilani Highway

This signalized intersection operates relatively smoothly at LOS B(B) during the AM(PM) peak hours of traffic. See Figure 5 for intersection details.

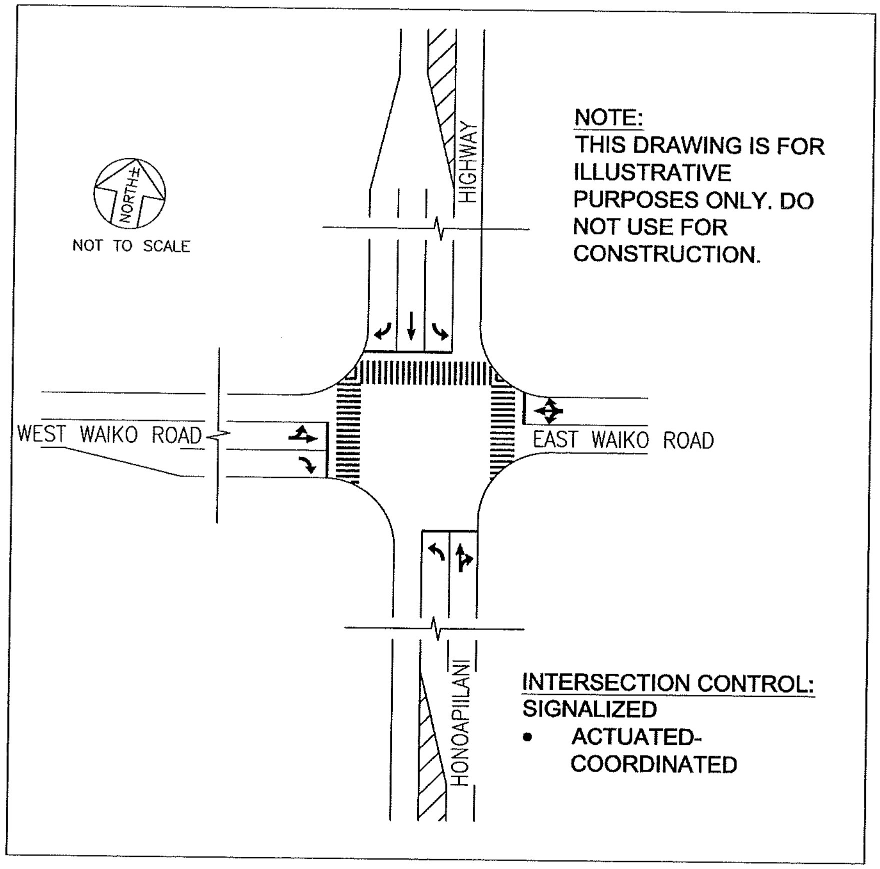


Figure 5: Existing Lane Configuration at Waiko Road/Honoapiilani Highway

MTP Access/Honoapiilani Highway

This two-way stop controlled intersection operates relatively smoothly during the AM(PM) peak hours of traffic as a result of the relatively low turning movement volume. The eastbound left-turn operates at LOS C(C) during the AM(PM) peak hours of traffic. See Figure 6 for intersection details.

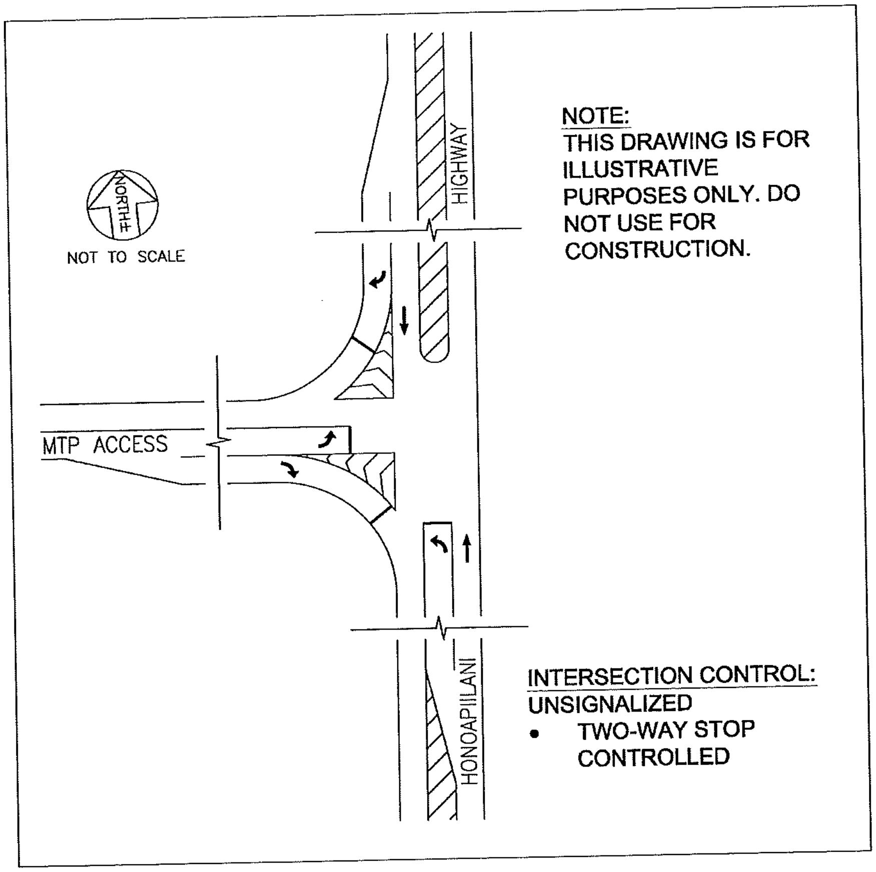


Figure 6: Existing Lane Configuration at MTP Access/Honoapiilani Highway

Kuikahi Drive/Waiale Road

Although the southbound and eastbound approaches were analyzed to operate at LOS E and F, respectively during the AM peak hour of traffic, this all-way stop-controlled (AWSC) intersection was observed to operate relatively smoothly (with minimal queuing and delay) during the AM(PM) peak hours of traffic. It should be noted that the headway (distance between vehicles) along the eastbound approach was observed to be relatively short. See Figure 7 for intersection details.

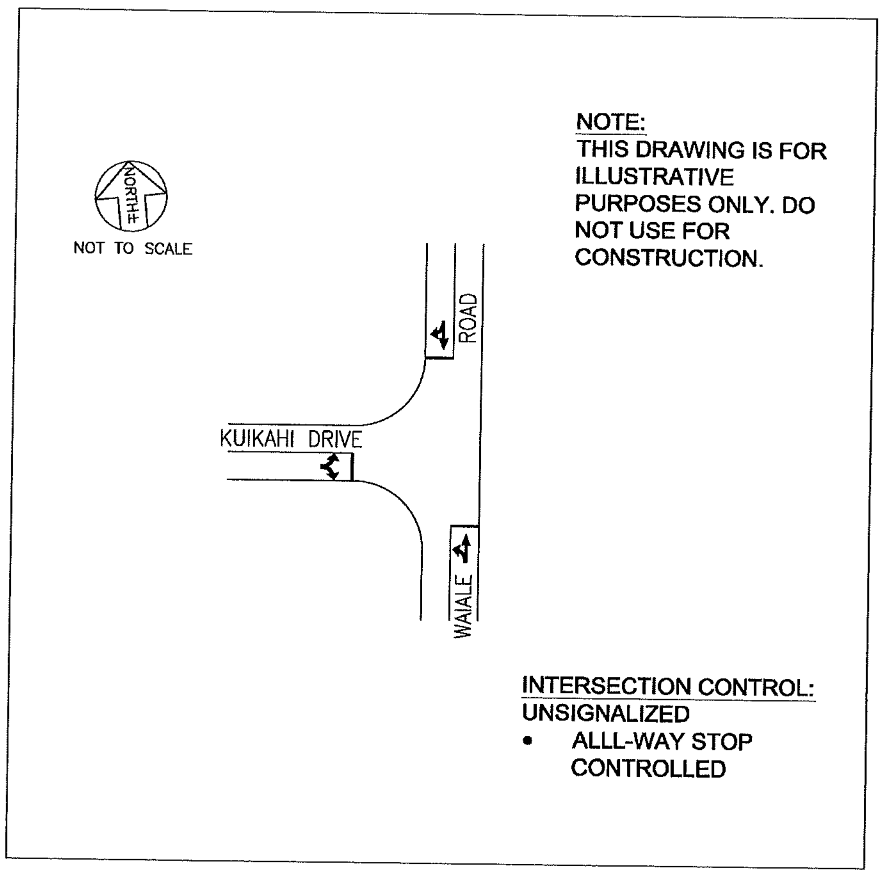


Figure 7: Existing Lane Configuration at Kuikahi Drive/Waiale Road

East Waiko Road/Waiale Road

The southbound approach to this two-way stop controlled intersection operates at LOS C(C) or better during the AM(PM) peak hours of traffic. See Figure 8 for intersection details.

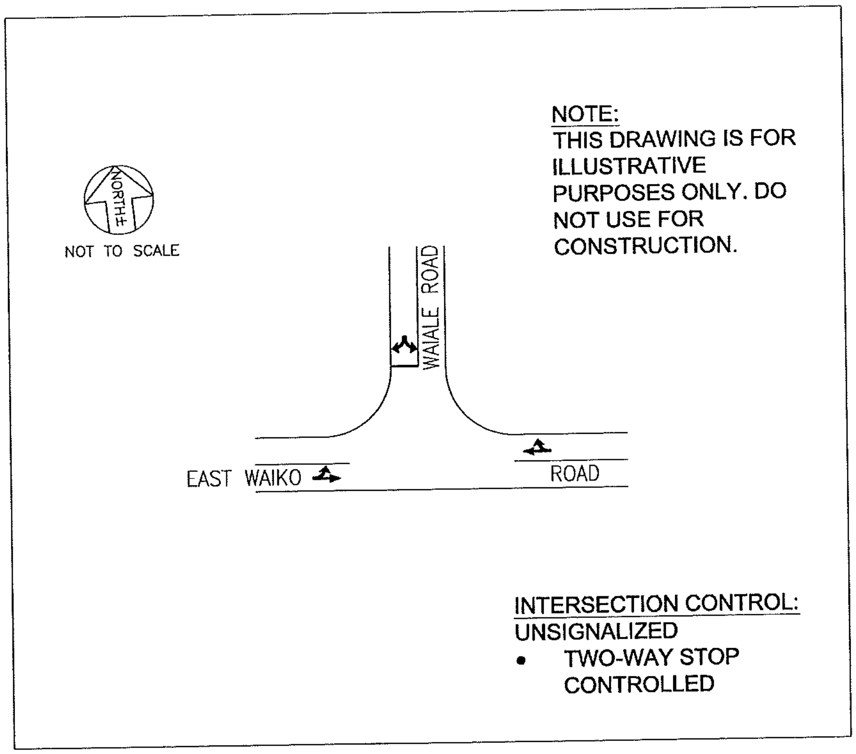


Figure 8: Existing Lane Configuration at Waiale Road/East Waiko Road

East Waiko Road/Kuihelani Highway

This signalized intersection generally operates smoothly at LOS B(A) during the during the AM(PM) peak hours of traffic. However, between 6:50 and 7:00 AM, an approximate 20-vehicle queue was observed to form in the eastbound left-turn movement. This queue had dispersed by 7:00 AM (prior to the AM peak hour).

See Figure 9 for intersection details.

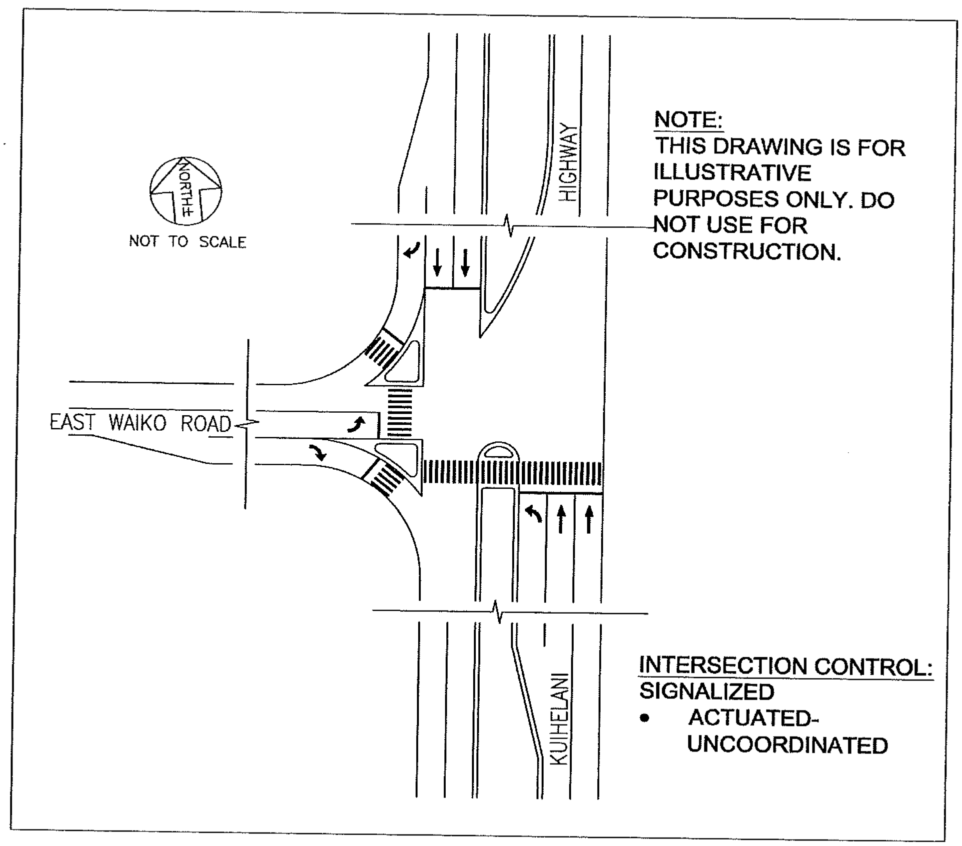
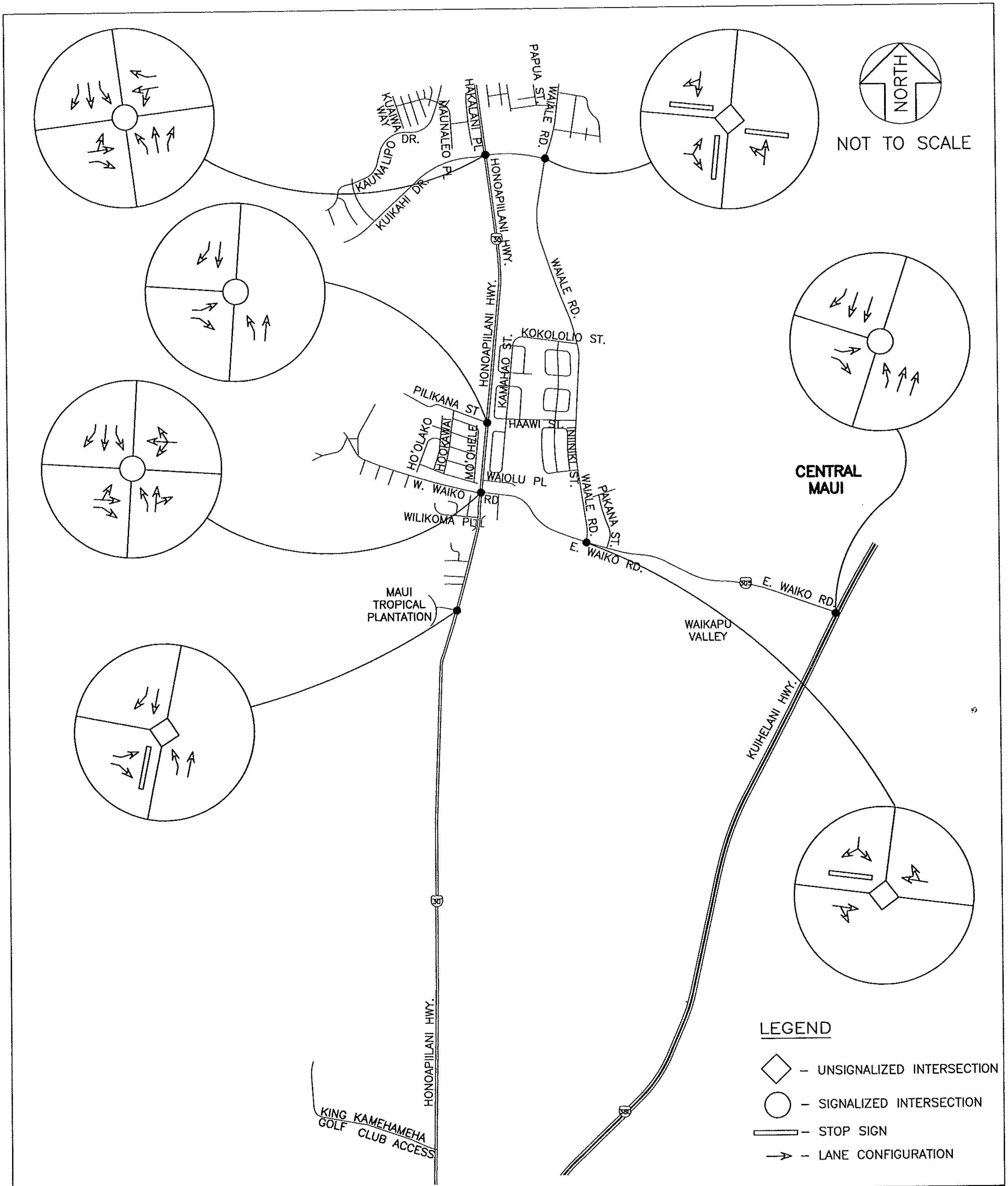


Figure 9: Existing Lane Configuration at East Waiko Road/Kuihelani Highway

See Figure 10 for Existing lane configurations. See Figure 11 for Existing Volumes and LOS. See Table 1 for Existing LOS and v/c ratios. See Appendix C for intersection analysis worksheets.



WAIALE ROAD EXTENSION

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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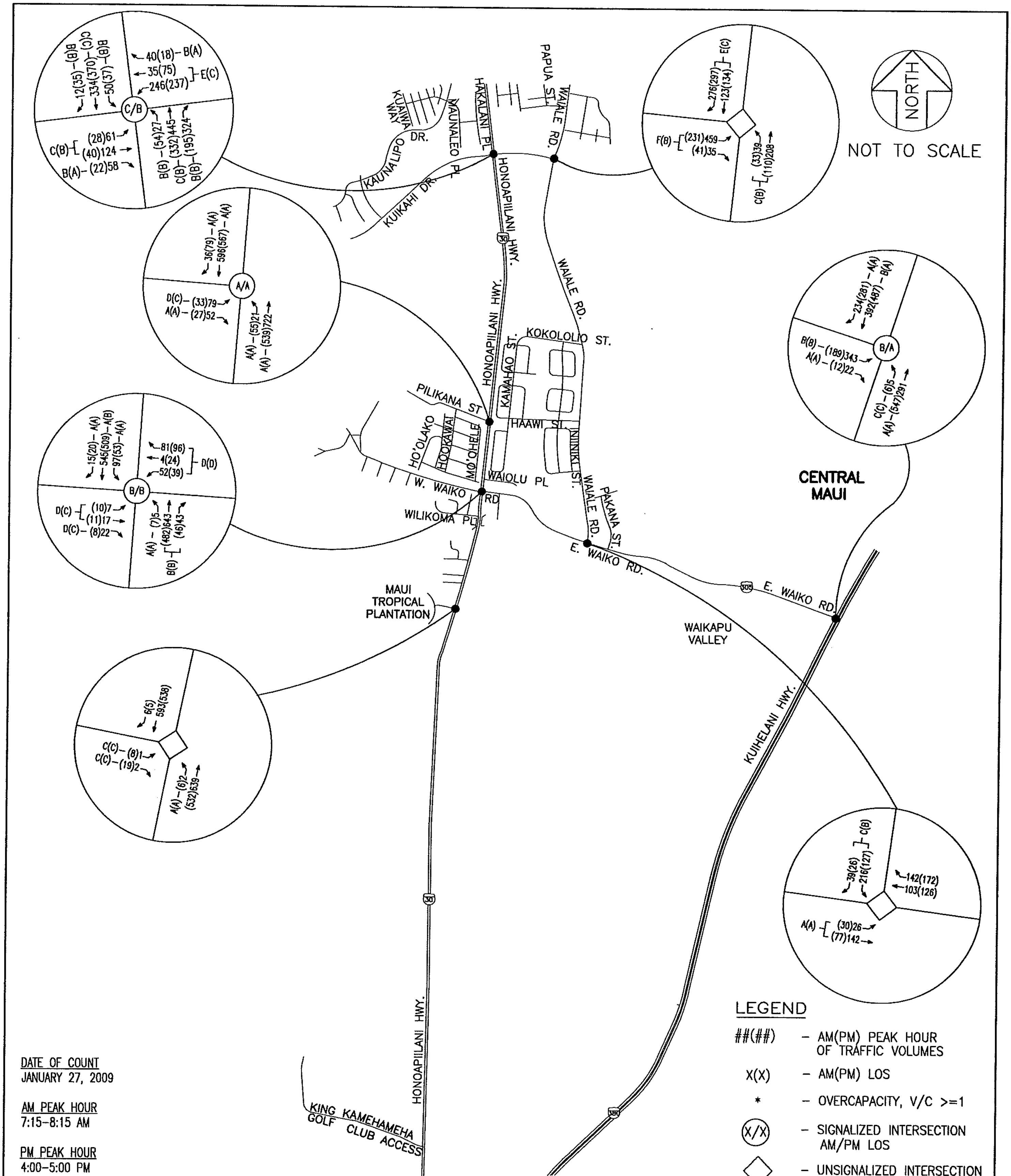
EXISTING LANE CONFIGURATION

FIGURE 10



DATE OF COUNT
JANUARY 27, 2009

AM PEAK HOUR
7:15-8:15 AM

PM PEAK HOUR
4:00-5:00 PM

WAIALE ROAD EXTENSION

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

FIGURE 11

EXISTING VOLUME AND LOS

TABLE 1

Level of Service Summary, Existing Conditions

	Exisitng 2008					
	AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Kuikahi Drive & Honoapiilani Highway						
EB LT/TH	20.7	0.55	C	16.6	0.19	B
EB RT	11.4	0.06	B	9.5	0.02	A
WB LT/TH	57.0	0.95	E	31.8	0.81	C
WB RT	11.2	0.03	B	9.4	0.02	A
NB LT	14.7	0.11	B	11.3	0.23	B
NB TH	27.3	0.76	C	16.7	0.50	B
NB RT	17.7	0.27	B	13.6	0.16	B
SB LT	16.7	0.32	B	10.7	0.14	B
SB TH	20.5	0.51	C	20.5	0.68	C
SB RT	15.5	0.02	B	12.7	0.03	B
Overall or Max v/c	26.7	0.83	C	19.4	0.70	B
Actuated Signal Cycle Length	84			66		
Pilikana Street & Honoapiilani Highway						
EB LT	51.0	0.59	D	32.8	0.24	C
EB RT	0.2	0.05	A	0.2	0.03	A
NB LT	3.2	0.04	A	5.5	0.13	A
NB TH	6.3	0.70	A	5.5	0.40	A
SB TH	7.3	0.49	A	8.7	0.53	A
SB RT	0.7	0.03	A	1.0	0.07	A
Overall or Max v/c	8.6	0.69	A	7.4	0.51	A
Actuated Signal Cycle Length	110			80		
East Waiko Road, West Waiko Road & Honoapiilani Highway						
EB LT/TH	51.2	0.59	D	29.5	0.17	C
EB RT	37.4	0.01	D	23.6	0.01	C
WB LT/TH/RT	54.8	0.68	D	37.5	0.67	D
NB LT	4.9	0.01	A	6.0	0.02	A
NB TH/RT	11.1	0.61	B	10.9	0.51	B
SB LT	6.1	0.33	A	7.7	0.16	A
SB TH	5.4	0.43	A	10.6	0.49	B
SB RT	3.6	0.02	A	9.9	0.02	A
Overall or Max v/c	14.8	0.60	B	14.9	0.57	B
Actuated Signal Cycle Length	110			80		

Note: * = Over-capacity Conditions.

** = v/c ratio not calculated.

TABLE 1 continued
Level of Service Summary, Exisitng Conditions

	Exisitng 2008					
	AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Maui Tropical Plantation & Honoapiilani Highway						
EB LT	20.0	0.02	C	16.3	0.08	C
EB RT	20.0	0.02	C	16.3	0.08	C
NB LT	8.8	0.00	A	8.8	0.01	A
Overall or Max v/c	0.1	**	A	0.8	**	A
Kuikahi Drive & Waiale Road						
EB LT/RT	114.8	**	F	15.0	**	B
NB LT/TH	22.1	**	C	10.8	**	B
SB TH/RT	40.4	**	E	17.4	**	C
Overall or Max v/c	67.5	**	D	15.5	**	B
East Waiko Road & Waiale Road						
EB LT/TH	1.8	0.04	A	2.3	0.03	A
SB LT/RT	22.6	0.63	C	13.7	0.30	B
Overall or Max v/c	9.0	**	A	4.1	**	A
East Waiko Road & Kuihelani Highway						
EB LT	19.3	0.74	B	17.4	0.59	B
EB RT	7.4	0.04	A	9.8	0.01	A
NB LT	24.7	0.18	C	23.0	0.14	C
NB TH	8.8	0.20	A	6.2	0.31	A
SB TH	14.1	0.38	B	9.6	0.36	A
SB RT	1.4	0.20	A	1.3	0.20	A
Overall or Max v/c	12.0	0.58	B	8.2	0.48	A
Actuated Signal Cycle Length	54			48		

Note: * = Over-capacity Conditions.
** = v/c ratio not calculated.

III. BASE YEAR 2030 SCENARIO *(See Section I.D. for Definition)*

By the year 2030[1], the Wailuku/Waikapu area will have experienced significant growth, both in its residential population and commercial/industrial/business land uses, primarily as a result of the following developments:

- Waikapu Country Town (WCT – planning phase)
- Maui Lani (partially constructed)
- Kehalani (partially constructed)
- Waiale (not started)
- Puunani Residences (not started)

These projects, along with other smaller ones combine to represent approximately 4,850 new dwelling units[2], as well as commercial, industrial, park, school, and other ancillary land uses.

The MTDFM[3] and Trip Generation Methodology (for the WCT only) were used to project (via growth ratios) and assign the traffic generated by these and other Maui developments onto the roadway network. The result was an approximate 140-percent increase in demand[4] along Honoapiilani Highway over existing conditions, which would cause congestion and require additional corridor capacity.

NEPA requires that TSM alternatives be investigated as an alternative to roadway construction for major projects proposed in urbanized areas with populations exceeding 200,000. As of 2008, Maui County's population of 143,691 did not reach this threshold. Nevertheless, the TSM and mass transit alternatives will also be discussed.

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[1] 20-year horizon required for federally funded projects.

[2] Maui County Department of Planning, Directed Growth Areas Listing and Units (2009).

[3] Socioeconomic/Land use data supplied by Maui County, October 2007.

[4] Based on through movements for the PM Peak Hour at the Honoapiilani Highway/Waiko Street intersection.

Projection Methodology

The MTDFM assigns land use and socioeconomic data to Traffic Analysis Zones (TAZ's). The attributes were obtained from Maui County in 2007 and used to generate and assign traffic across the roadway network.

Between 2001[5] and 2030, the MTDFM assumes an aggregate growth of 6,813[6] residential units and 3,320 employees for the TAZ's that overlap the Waikapu/South Maui Area.

Considering the fact that portions of the Kehalani and Maui Lani Subdivisions have been built during the intervening years between 2001 and 2008, the projections are considered to be either valid or conservative.

The Waikapu Country Town was noticeably absent in the MTDFM's projections; therefore, its traffic was projected using the Trip Generation methodology. See Table 2 for WCT Trip Generation Rates. See Table 3 below for the results of the WCT Trip Generation.

Table 2: WCT Trip Generation Rates

Land Use (ITE Code)	Independent Variable	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
		Trip Rate	% Entering	Trip Rate	% Entering
Single-Family Residential (210)	Dwelling Units	[a]	25%	[b]	63%
Shopping Center (820)	1,000 Sq. Ft. GFA	[c]	61%	[d]	49%

Source: Trip Generation, 8th Edition, Institute of Transportation Engineers.

[a] .7 * x + 9.74
[b] EXP (.9 * LN(x) + 0.51)
[c] EXP (0.59 * LN(x) + 2.32)
[d] EXP (0.67 * LN(x) + 3.37)
where "x" is the independent variable

[5] Base Year for MTDFM; this is the year during which the calibrated data was collected.

[6] Does not include the Waikapu Gardens Subdivision, as the project has already been completed.

Table 3: WCT Trip Generation

Land Use Designation	Independent Variable	AADT	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Enter (vph)	Exit (VPH)	Enter (vph)	Exit (VPH)
Single-Family Residential (210)	1,400 DU	11,787	247	742	712	418
Shopping Center	100,000 Sq. Ft. GFA	6,792	95	60	312	325
	Total	**18,579**	**342**	**802**	**1,024**	**743**

See Figure 12 for the MTDFM TAZ's with their respective household and employment growth, juxtaposed against known nearby developments. See Figure 13 for future employment areas within Waikapu and Wailuku. See Figure 14 for distribution of trips for new developments as based upon MTDFM analyses.

A. Core Assumptions for Maui Lani, Waiale, and Waikapu Country Town

It is likely that the Waiale, and Waikapu Country Town developments will require new collector roads with connectivity to Kahului, Honoapiilani Highway, and Kuihelani Highway to accommodate their respective traffic demands. However, these projects are at various stages of the entitlement process, and therefore the exact number and locations of these connections are as of yet unknown. The following assumptions were made:

Maui Lani

- Kuikahi Drive Extension and opened to the public; as of this writing, the road had already been constructed.
- Maui Lani Parkway extension to Kuikahi Drive opened to the public; as of this writing, the road had already been constructed.

Waiale

- Access provided at Waiale Road, north of East Waiko Road
- Second access provided at Kuihelani Highway, south of East Waiko Road

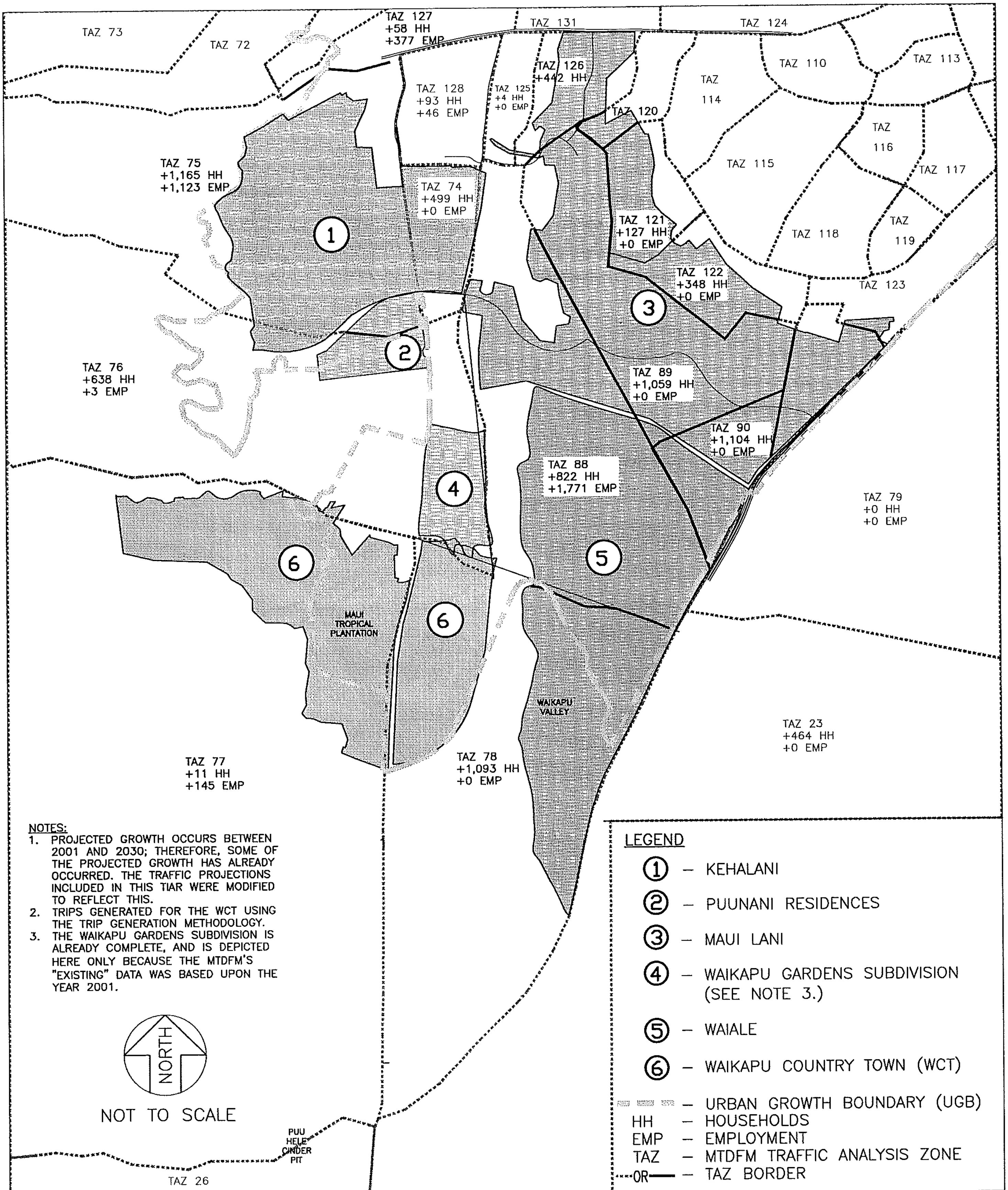
- Kamehameha Avenue extended southward beyond its current terminus near Pomaikai Elementary School to intersect with Waiko Road and continues southward to serve the Waiale Development.

<u>Waikapu Country Town</u>

Absent the WRE (Base Year 2030), it was assumed that access will only be provided via Honoapiilani Highway:

- Access for both mauka and makai sections provided at the Honoapiilani Highway/MTP Access intersection.
- Second access for the mauka section provided at the Honoapiilani Highway, south of the MTP Access.

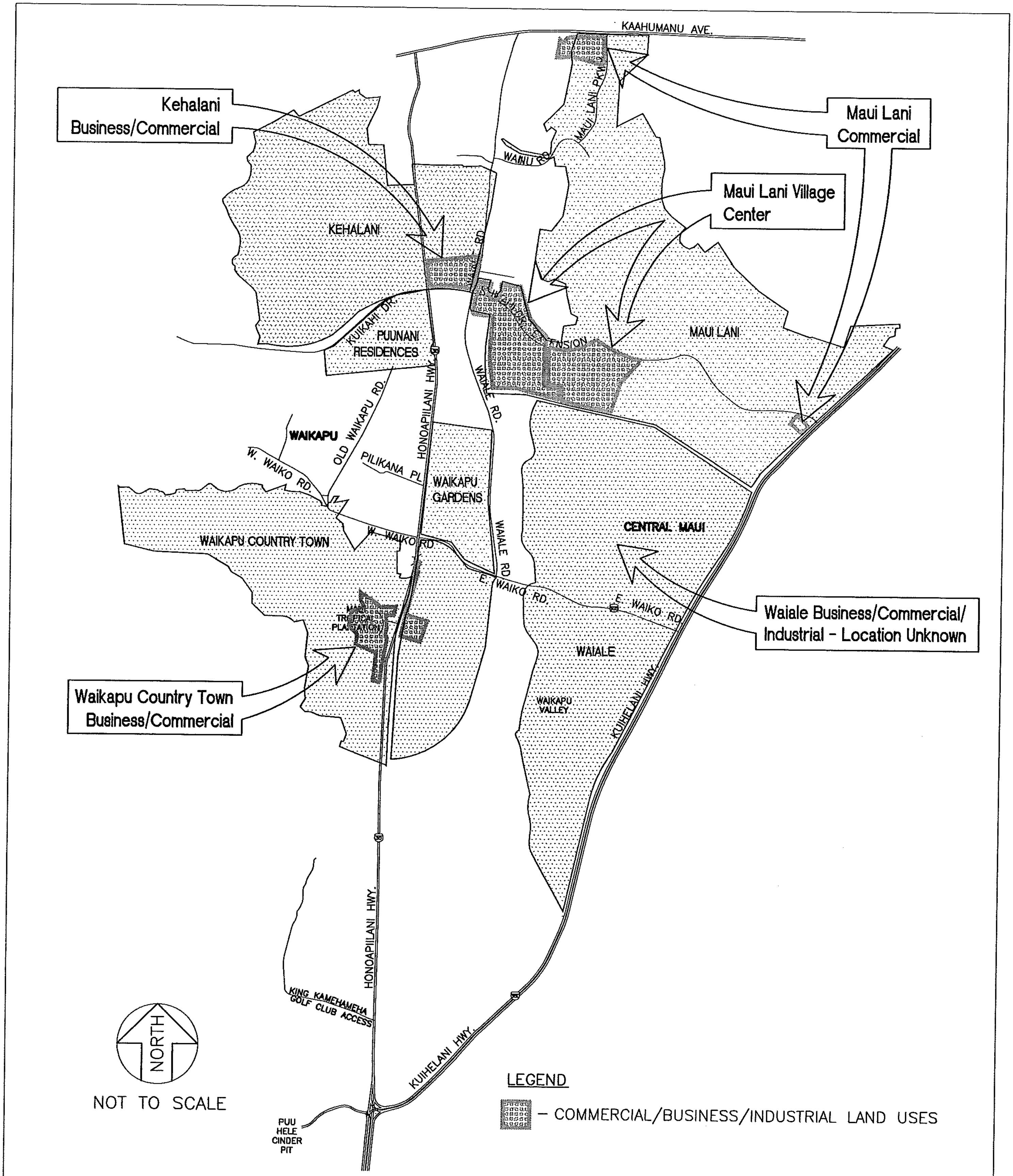
With the WRE, it was additionally assumed that access would also be provided via an additional intersection with the WRE. See Figure 15 for a depiction of the assumed connections.



NOTES:
1. PROJECTED GROWTH OCCURS BETWEEN 2001 AND 2030; THEREFORE, SOME OF THE PROJECTED GROWTH HAS ALREADY OCCURRED. THE TRAFFIC PROJECTIONS INCLUDED IN THIS TIAR WERE MODIFIED TO REFLECT THIS.
2. TRIPS GENERATED FOR THE WCT USING THE TRIP GENERATION METHODOLOGY.
3. THE WAIKAPU GARDENS SUBDIVISION IS ALREADY COMPLETE, AND IS DEPICTED HERE ONLY BECAUSE THE MTDFM'S "EXISTING" DATA WAS BASED UPON THE YEAR 2001.

LEGEND
- 1 – KEHALANI
- 2 – PUUNANI RESIDENCES
- 3 – MAUI LANI
- 4 – WAIKAPU GARDENS SUBDIVISION (SEE NOTE 3.)
- 5 – WAIALE
- 6 – WAIKAPU COUNTRY TOWN (WCT)
- – URBAN GROWTH BOUNDARY (UGB)
- HH – HOUSEHOLDS
- EMP – EMPLOYMENT
- TAZ – MTDFM TRAFFIC ANALYSIS ZONE
- ----OR—— – TAZ BORDER

WAIALE ROAD EXTENSION	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	MAJOR PROJECTS IN PROJECT VICINITY	12

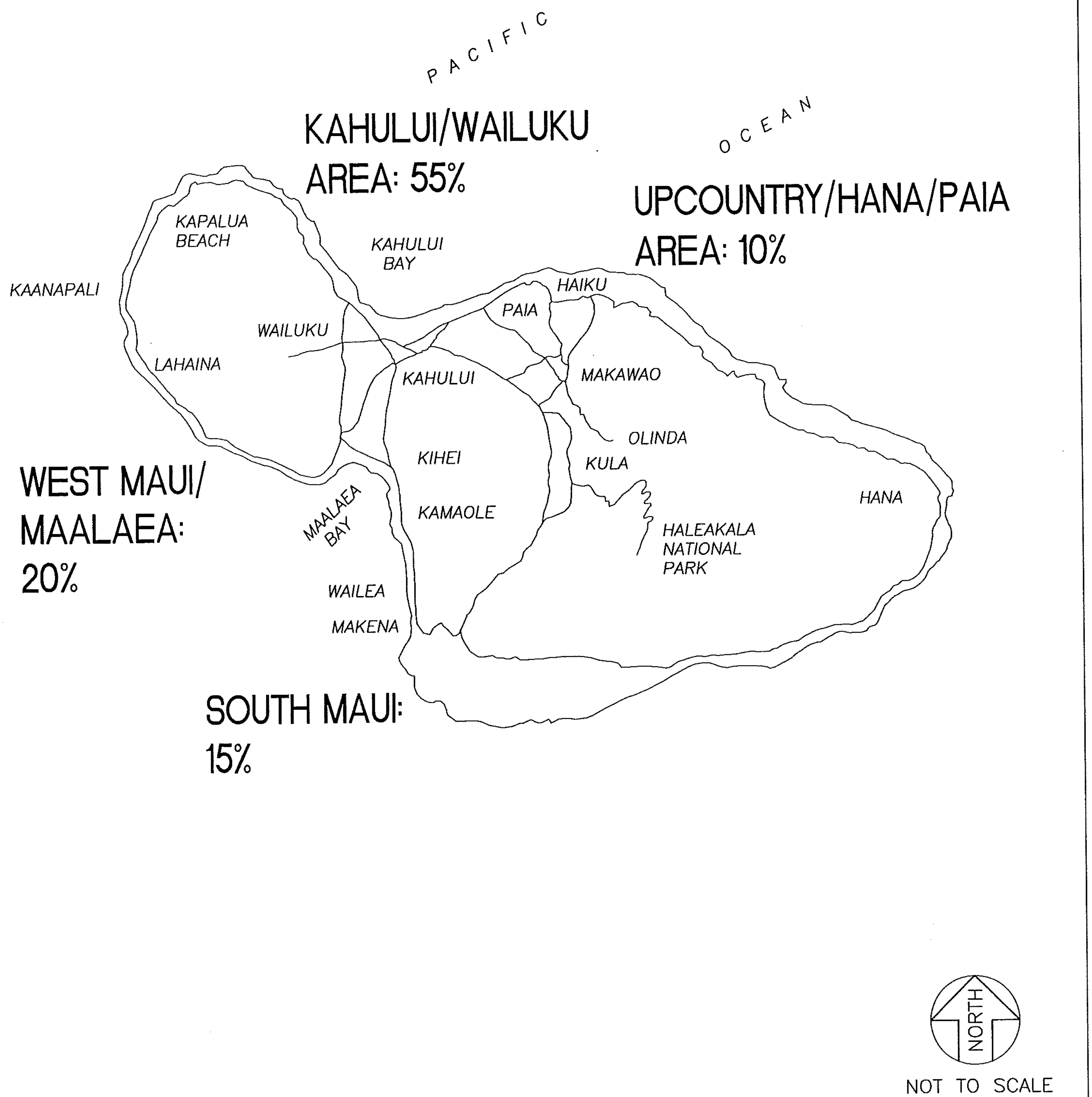


WAIALE ROAD EXTENSION

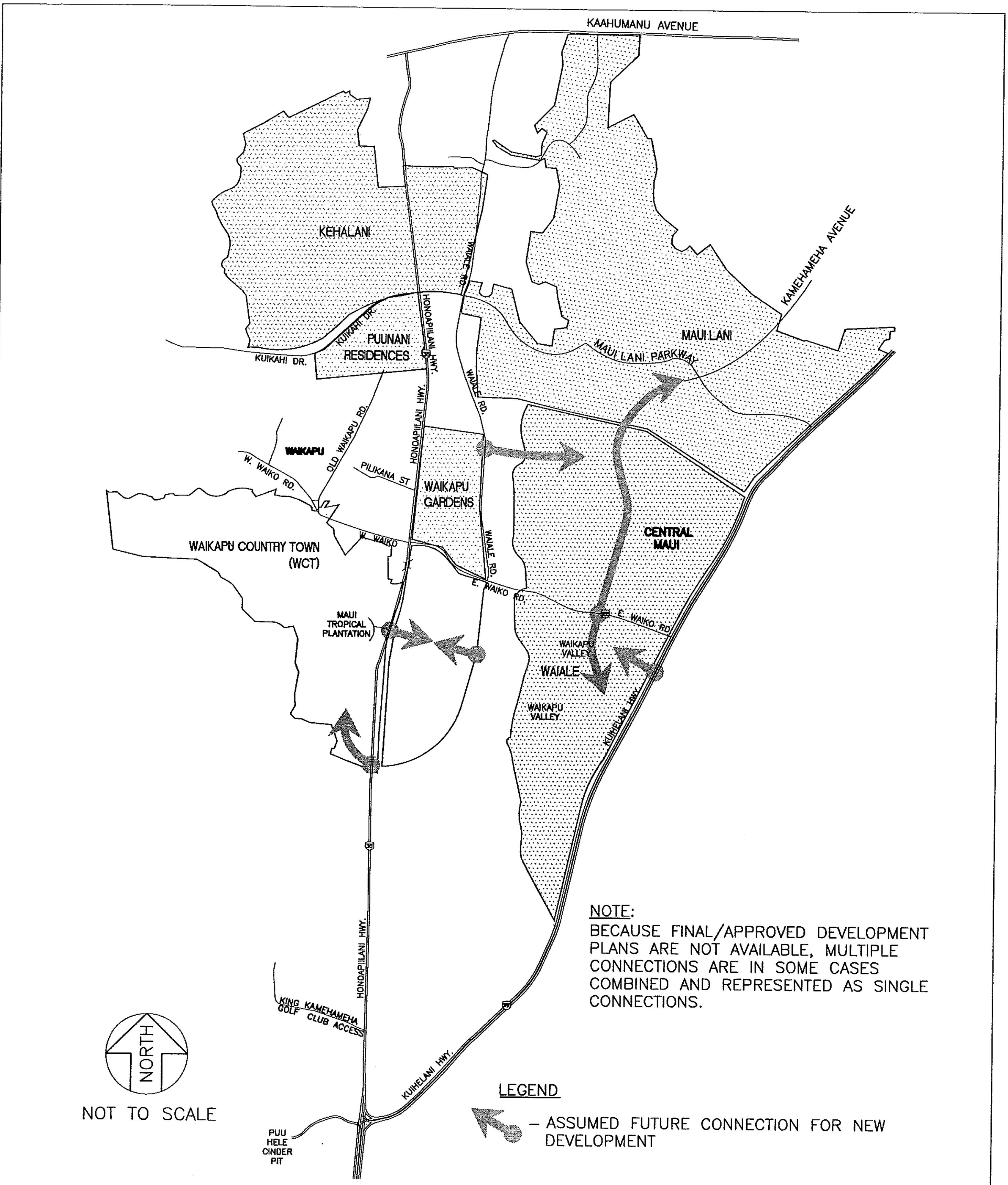
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, HAWAII

EMPLOYMENT IN PROJECT VICINITY

FIGURE 13



WAIALE ROAD EXTENSION	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	BASIS OF MTDFM DISTRIBUTION	14



WAIALE ROAD EXTENSION	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	ASSUMED CONNECTIONS	15

B. Planned Roadway Improvements

As part of the Maui Lani Master Plan, Kuikahi Drive has been extended beyond Waiale Road and will ultimately provide access to Kuihelani Highway via Maui Lani Parkway. This project will provide an alternate route between Honoapiilani Highway, Waikapu, and Kuihelani Highway; this is a function that Waiale Road and East Waiko Road currently serve. In addition, Maui Lani Parkway will ultimately link Kaahumanu Avenue and Kuihelani Highway. At the time of this writing, it was anticipated that the Kuikahi Drive Extension could open as early as March, 2010. See Figure 16 below.

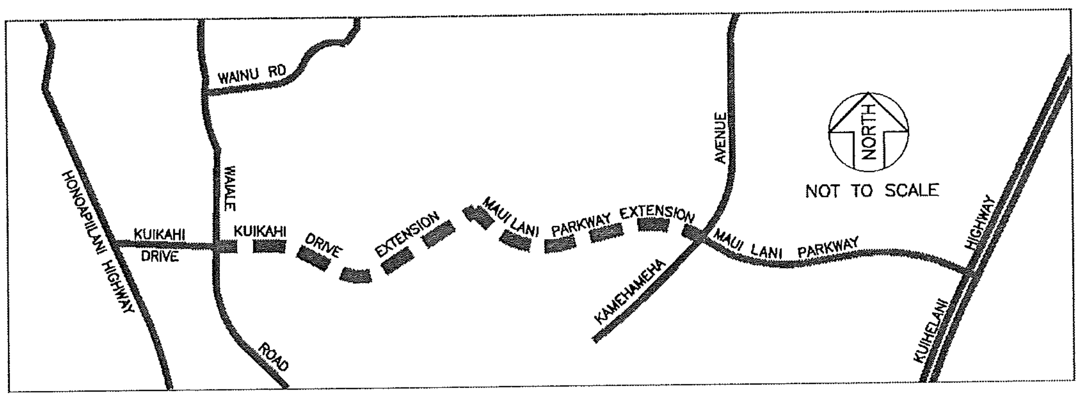


Figure 16: Kuikahi Drive and Maui Lani Parkway Extension

C. Transportation System Management (TSM) Alternative

TSM programs can include ridesharing, fringe parking, High-Occupancy Vehicle (HOV) lanes, and traffic signal timing optimization. In summary, the County already has plans to improve existing TSM programs. See below for the current state of such programs in Maui:

- <u>Ridesharing</u> – Vanpool Hawaii operates as a ridesharing service that is performed as part of a contract between the Hawaii Department of Transportation (HDOT) and VPSI, Inc. The program provides drivers with vans or SUV's, but requires participants to collectively pay a fee of $65 per month and for gasoline and parking fees. Participants can either form their own vanpools or be matched with suitable (by location) ride-sharers.

The company's website states that Vanpool Hawaii is "the first and largest vanpool company in the nation."[7]

- Fringe Parking (Park and Ride/Pool lots) – Currently, there is a Park and Ride lot situated at the southwest corner of the intersection of Puunene Avenue/Kuihelani Highway/Dairy Road. The Draft Maui Island Plan recommends the allocation of $8 Million towards the creation of new transit hub/park-n-ride facilities in Maalaea and in Central Maui.[8] The Central Maui Transit Hub will be constructed at the Queen Kaahumanu Center by the end of 2010.

- HOV lanes – Currently there are no HOV lanes within the County of Maui, owing to the fact that it has no freeways. HOV lanes would not be constructed on Honoapiilani Highway within the project area because it only offers a single lane in either direction. Kuihelani Highway would not be an ideal candidate for HOV lanes due to its provision of left-turn lanes.

D. Mass Transit

Maui County currently works with Roberts Hawaii to operate the Maui Bus, which serves the major areas of the island and offers a headway (time between successive busses) of either 60 or 90 minutes.

The bus fare is $1.00 per person, with monthly passes also available for $35.00 for general admission or $30.00 for students and senior citizens.

Maui County, as part of its Public Transit Program, plans to expand the number of routes, increase the fleet size, and reduce the headways of the vehicles in FY2010. As a result, they project that the number of fixed route boardings will increase from 1,765,516 in 2009 to 2,348,135 in 2010 – an increase of 33 percent. This would equate to approximately 16.5 annual per capita boardings. See Figure 17 for route map.

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[7] Website: http://www.vanpoolhawaii.com/vanpool/about_us.htm.

[8] Draft Maui Island Plan (2009). 9-14.

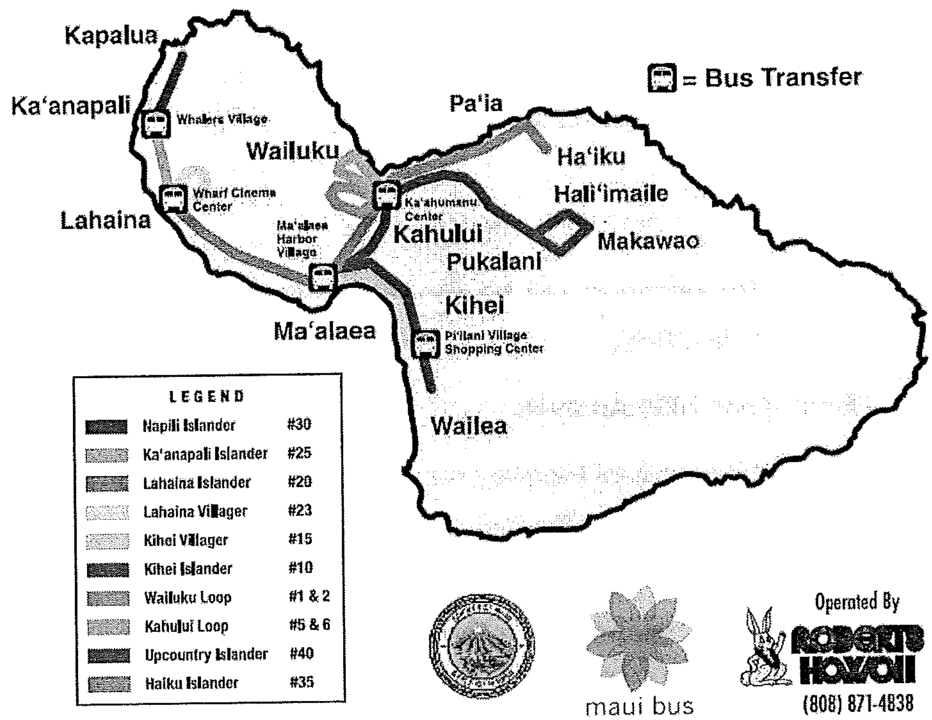

Figure 17: Maui Bus Service Map[9]

E. Consideration of Roundabouts

HDOT's December, 2008 "Modern Roundabouts Policy Guideline" requires that the feasibility of roundabouts be studied. However, it appears that the construction of roundabouts along Honoapiilani Highway or Kuihelani Highway would be infeasible because:

- The traffic volumes are much higher along Honoapiilani Highway and Kuihelani Highway than on their intersecting side streets; therefore, the flow will not be balanced.
- At this time, the roundabout policy only allows the consideration of modern single-lane roundabouts. RODEL analysis indicates that

[9] Website: http://www.vanpoolhawaii.com/vanpool/about_us.htm.

double-lane roundabouts would be required at the major intersections along Honoapiilani Highway and Kuihelani Highway.

- "Roundabouts: an Informational Guide" (2000) states that where major arterials intersect minor arterials or local roads, "roundabouts delay and deflect all traffic entering the intersection and could introduce excessive delay or speed inconsistencies to flow on the major arterial."

Roundabouts will be considered as an alternative for the intersections along Waiale Road.

F. Base Year 2030 Analysis

Honoapiilani Highway will become overburdened with all of the additional traffic generated by the new projects. The turning movement volume at its intersections with Kuikahi Drive and East/West Waiko Road will exceed capacity. Widening the highway to four (4) lanes was not deemed to be a viable mitigation for the following reasons:

1. Honoapiilani Highway's right-of-way is approximately 70 feet wide based upon HDOT's straight-line diagram.
2. Widening the highway to four (4) lanes would require:
   a. 48 feet for through lanes
   b. 12 feet for median/left-turn lanes
   c. 24 feet for right-turn lanes
   d. Additional width for swales, shoulders, sidewalks (if applicable), and property setbacks – minimum 16 feet
   e. Required ROW: 100 feet or more.
3. While it is possible that ROW could be acquired from the Kehalani and WCT developments, it appears that eminent domain would be required in the vicinity of East/West Waiko Road.

See below for a discussion of the individual intersections and mitigative measures.

Kuikahi Drive/Honoapiilani Highway

This intersection is anticipated to experience significant traffic growth due to the future development within the Waikapu/Wailuku area (see Figure 12). As a consequence, at the intersection will operate at an overall LOS F and overcapacity conditions during the AM and PM peak hours of traffic.

Mitigative Measures

ROW currently exists to widen Kuikahi Drive to accommodate dedicated left-turn lanes for both the eastbound and westbound approaches. These improvements will allow for the initiation of left-turn phasing, and significantly reduce the overall delay. Despite these improvements, however, the intersection will continue to operate at LOS F(F) and overcapacity conditions during the AM(PM) peak hours of traffic. See Figure 18 for a diagram of the proposed mitigation.

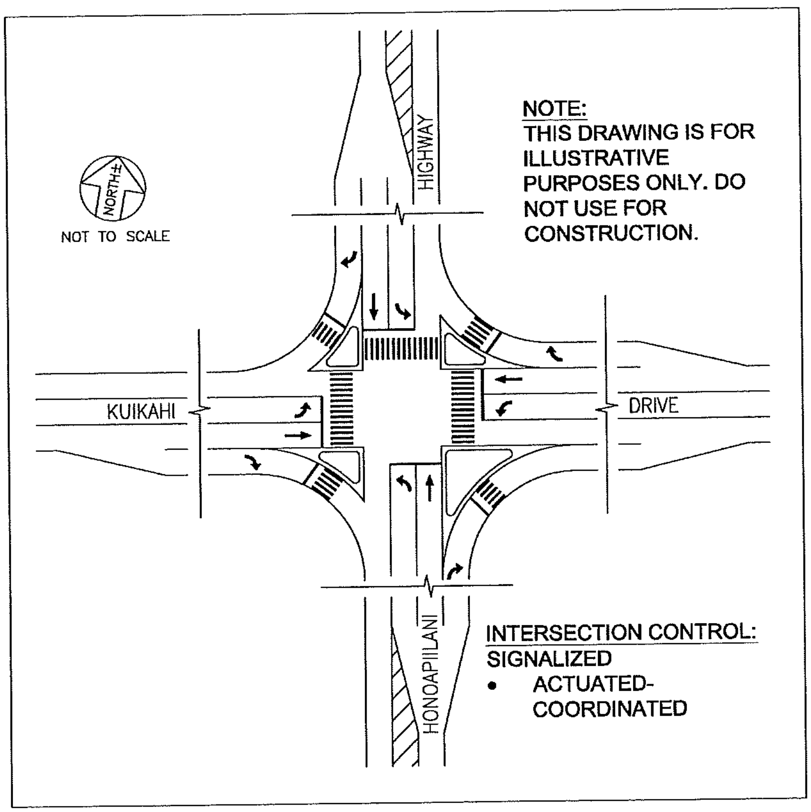

Figure 18: Base Year 2030 Lane Configuration at Kuikahi Drive/Honoapiilani Highway with Mitigative Measures

Pilikana Street/Honoapiilani Highway

Although this intersection will operate at LOS F(F) and over-capacity during the AM(PM) peak hours of traffic, no mitigation outside of the WRE as a diversionary route (see Section IV) is recommended, since the relatively low turning movement volumes entering and exiting Pilikana Street would not warrant the construction of additional turning lanes.

East Waiko Road/West Waiko Road/Honoapiilani Highway

Although this intersection will operate at LOS F(F) and over-capacity during the AM(PM) peak hours of traffic, no mitigation outside of the WRE as a diversionary route (see Section IV) is recommended, since the intersection is bound by a relatively limited ROW, and is bordered by residential properties.

MTP Access/Honoapiilani Highway

As discussed earlier, it was conservatively assumed that this intersection would provide sole access to the Waikapu Country Town's Makai Section. However, it is likely that additional accessibility could be provided via the WRE and/or another access along Honoapiilani Highway. As a baseline:

- Exclusive left-turn, through, and right-turn lanes were assumed on the eastbound and westbound approaches
- Exclusive right-turn deceleration lanes were assumed for the northbound and southbound approaches
- The intersection was assumed to be signalized, as it will most likely be warranted. See Appendix D for signal warrant analysis.

Given this lane configuration, the intersection would operate at an overall LOS D(F) during the AM(PM) peak hours of traffic and overcapacity conditions during the (PM) peak hour of traffic.

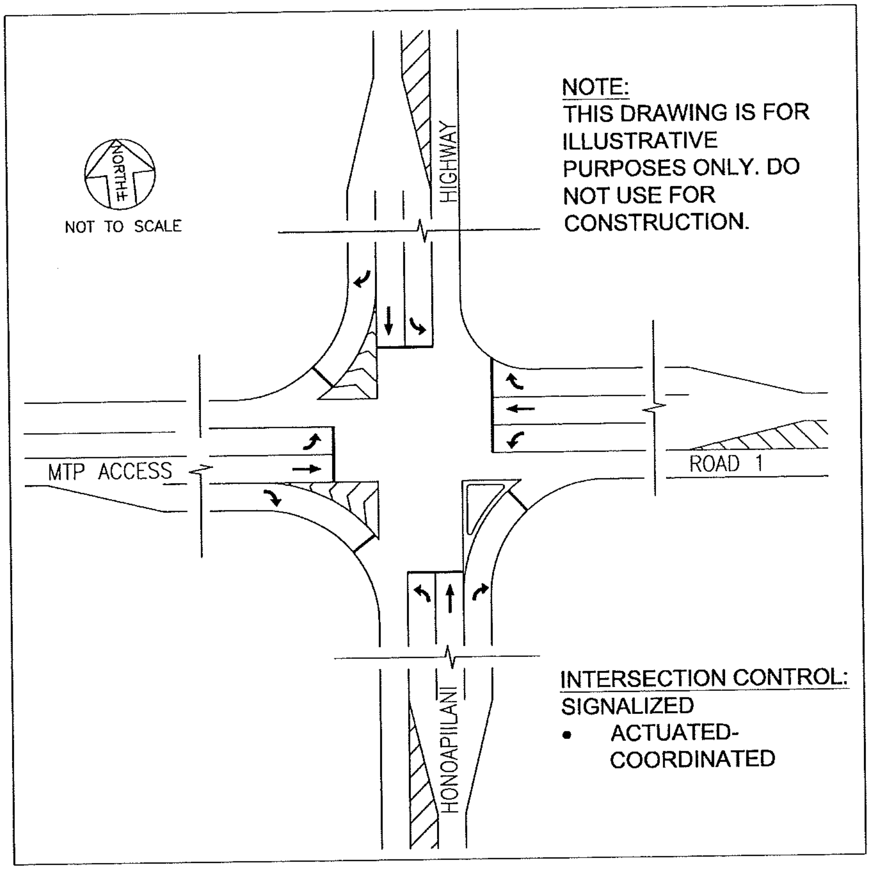

Figure 19: Base Year 2030 Lane Configuration at MTP Access/Road 1/Honoapiilani Highway

Mitigative Measures

It is recommended that two (2) left-turn lanes be provided for the southbound approach to accommodate the traffic entering the WCT.

Even with these improvements, this intersection will continue operating at LOS D(F) during the AM(PM) peak hours of traffic, and overcapacity during the PM peak hour of traffic.

See Figure 20 below for the assumed lane configuration.

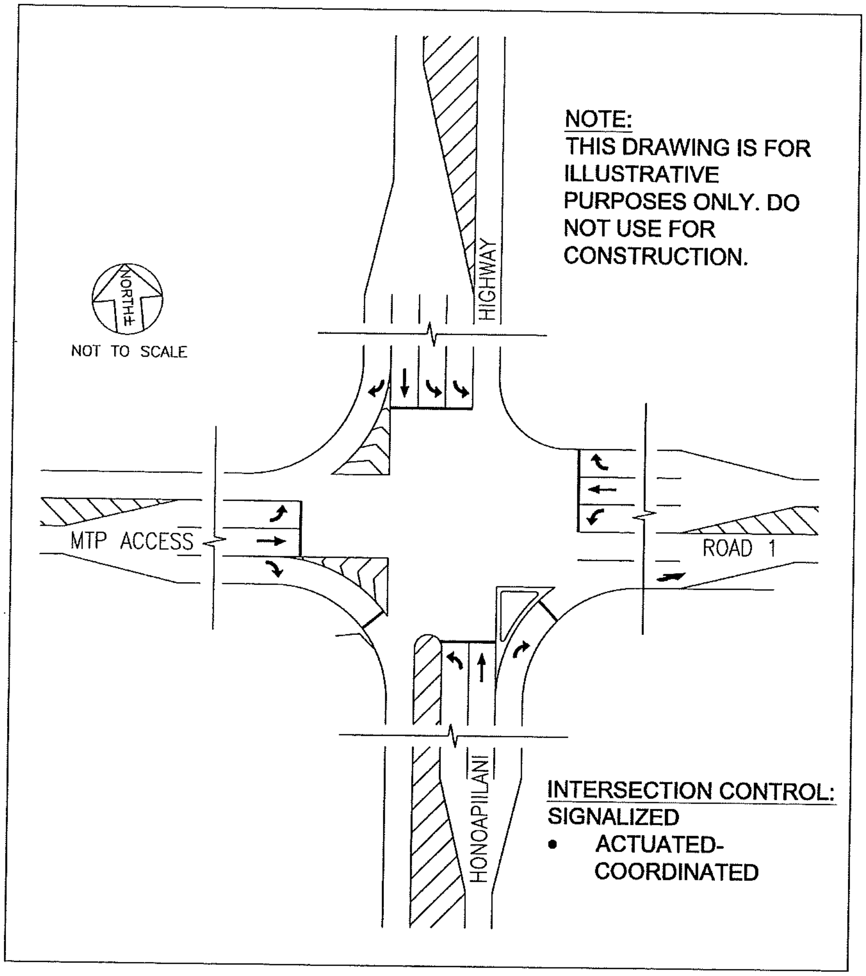

Figure 20: Base Year 2030 Lane Configuration at MTP Access/Road 1/Honoapiilani Highway with Mitigative Measures

Kuikahi Drive/Waiale Road

This intersection will experience more delay than during existing conditions as a result of:

1. Increased traffic due to nearby developments, especially the Kehalani Commercial/Business and Maui Lani Village Center. Refer to Figure 13.

2. Construction of the Kuikahi Drive Extension in conjunction with the Maui Lani Parkway Extension – where the intersection is planned to be signalized and upgraded; this will improve connectivity to the

Maui Lani Development, Kuihelani Highway, and Kaahumanu Avenue.

The assumed geometric layout for this intersection was based upon current plans for the Kuikahi Drive Extension and Kuikahi Drive/Waiale Road signalization. The plan includes new exclusive left-turn lanes along existing approaches, and exclusive left-turn and right-turn lanes along the Kuikahi Drive Extension (westbound) approach.

Even with these planned improvements, the intersection will operate at LOS F(F) and overcapacity conditions the AM(PM) peak hours of traffic. This can be attributed to the heavy projected turning movements. See Figure 21 for assumed lane configuration.

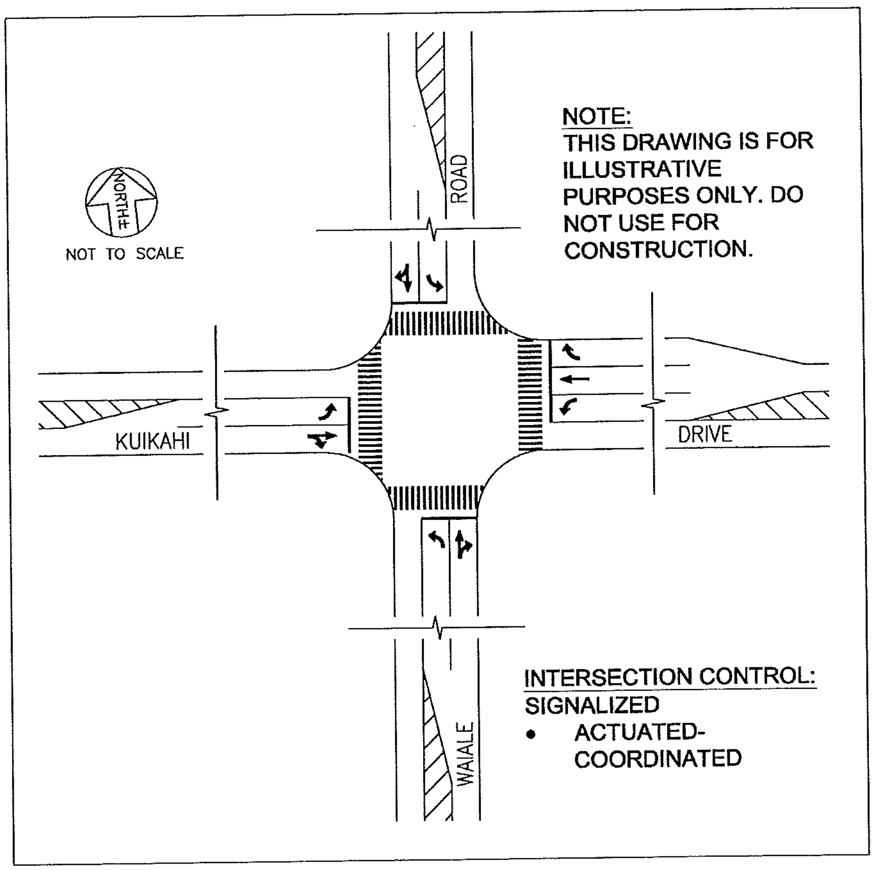

Figure 21: Base Year 2030 Lane Configuration at Kuikahi Drive/Waiale Road

Mitigative Measures

It is recommended that all approaches to this intersection incorporate dedicated left-turn and right-turn lanes.

All of these improvements would improve intersection operations to LOS E or better at all approaches, and within capacity.

It should be noted that preliminary analysis indicates that if a single-lane roundabout were to be constructed at this intersection, it would operate at LOS F(F) during the AM(PM) peak hours of traffic. This would also be true for Alternative 1 during the AM Peak hour of traffic. Therefore, this option was not considered for any of the future scenarios.

See Figure 22 for proposed mitigative measures.

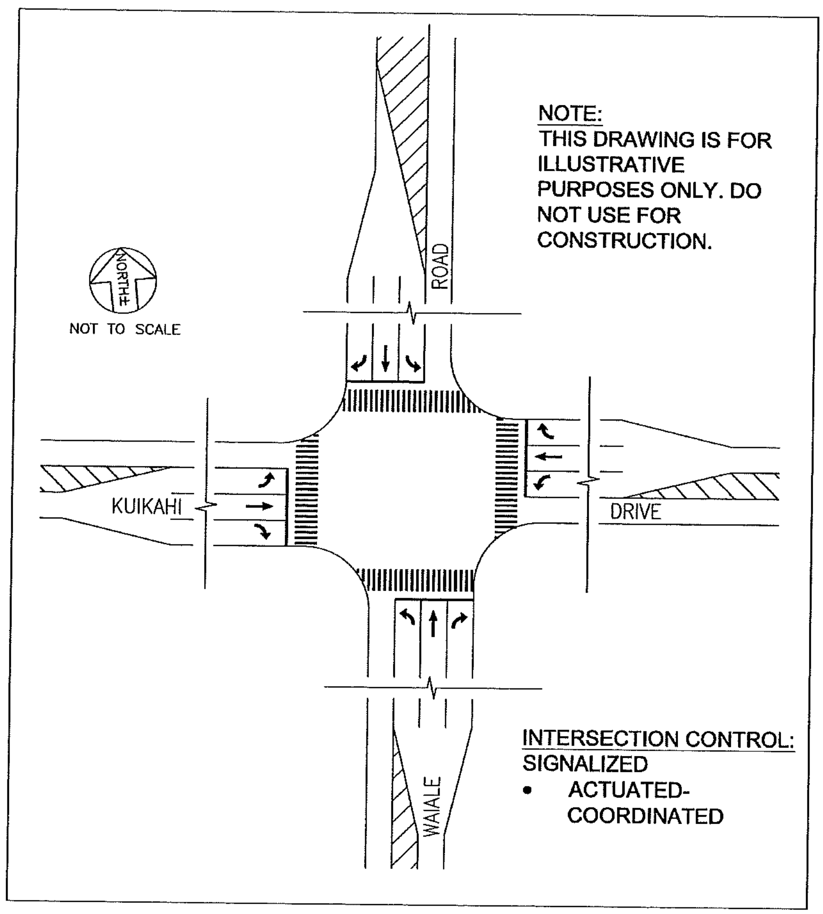

Figure 22: Base Year 2030 Lane Configuration at Kuikahi Drive/Waiale Road with Mitigative Measures

Waiale Road/East Waiko Road

This intersection will continue to share the burden of future growth within the Waikapu and Lower Wailuku Areas. The southbound approach will operate at LOS F(F) during the AM(PM) peak hours of traffic. The same would be true for Two-Way Stop Control (TWSC – existing method of control) even if the intersection were widened to provide eastbound and westbound turning lanes; AWSC would likely not be warranted.

Mitigative Measures

Operations at this intersection could be improved through one of the following measures:

1. Construct a single-lane roundabout. The roundabout would operate at LOS C(C) with a delay of 18.3(17.1) seconds during the AM(PM) peak hours of traffic. The roundabout would likely require significant ROW acquisition and re-alignment of existing roadways. See Figure 23 for proposed roundabout mitigation.

2. Signalize the intersection and widen all of its approaches to incorporate dedicated left-turn and right-turn lanes where applicable. The signal would most likely be warranted. This improvement would require ROW acquisition to widen the approaches. With these improvements, all movements would operate at LOS C(C) or better and within capacity during the AM(PM) peak hours of traffic. See Figure 24 for proposed signalized mitigation. See Appendix D for signal warrant analysis.

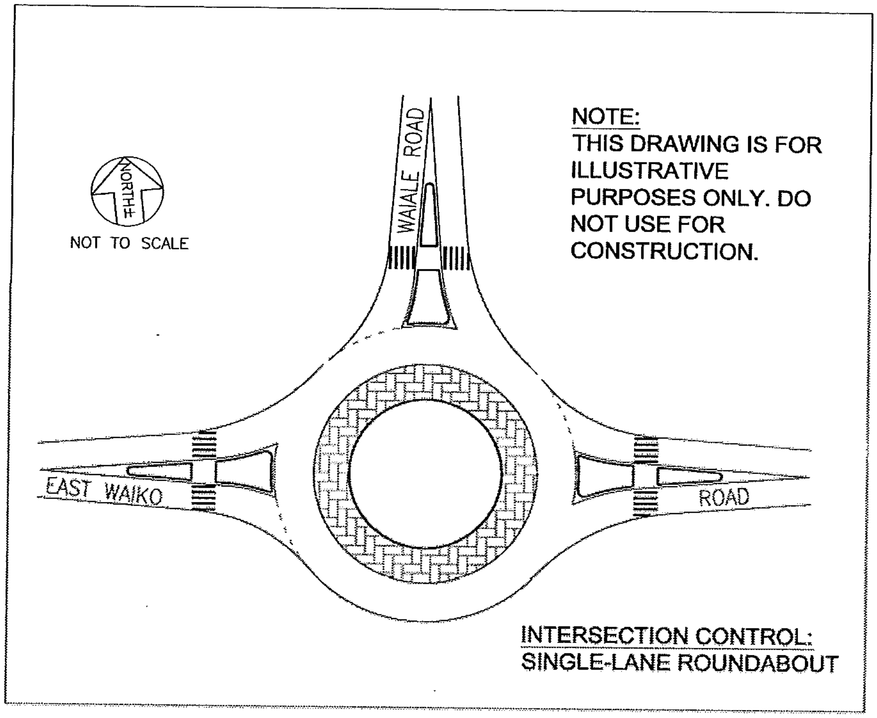

Figure 23: Base Year 2030 Lane Configuration at Waiale Road/East Waiko Road – with Roundabout

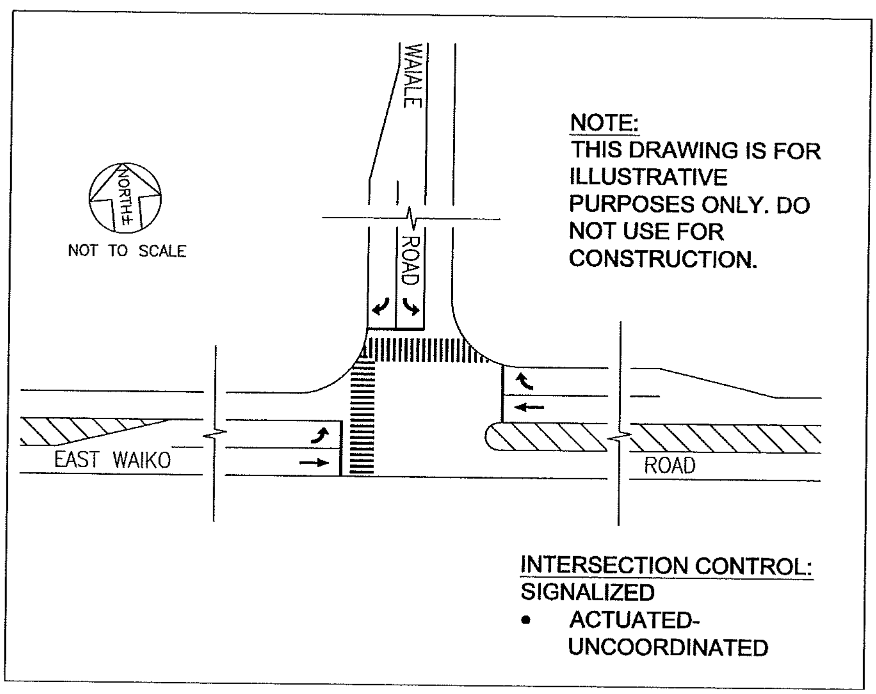

Figure 24: Base Year 2030 Lane Configuration at Waiale Road/East Waiko Road – with Traffic Signal

East Waiko Road/Kuihelani Highway

The eastbound left-turn movement will operate at LOS F and over-capacity conditions during the AM peak hour of traffic due to the 565 (65% increase over existing conditions) projected westbound left-turns[10].

Mitigative Measures

It is recommended that an eastbound double left-turn be constructed at this intersection. With this improvement, all movements would operate at LOS D(D) or better and within capacity for all movements during the AM(PM) peak hours of traffic. See Figure 25 for a diagram of the proposed mitigation.

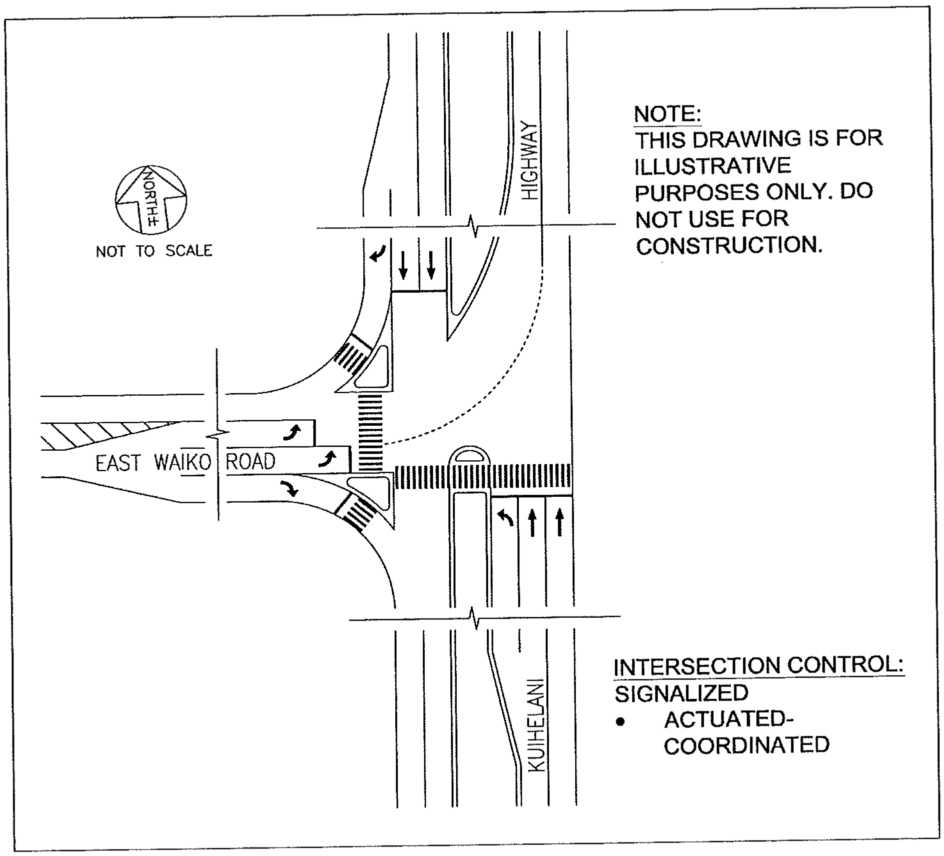

Figure 25: Base Year 2030 Lane Configuration at East Waiko Road/Kuihelani Highway with Mitigative Measures

[10] Coordinated signal timing assumed due to the possibility of future nearby traffic signals along Kuihelani Highway. The signal currently uses uncoordinated signal timing.

Waiale Road/Waikapu Gardens Access Roads

Residents of the Waikapu Gardens community have voiced concerns regarding speeding and the potential for increased traffic along Waiale Road near their development. It is anticipated that Base Year growth, in concert with the opening of the Kuikahi Drive Extension, will increase traffic along Waiale Road by 43 percent over existing conditions by the year 2030.

The following improvements were considered as possible mitigation for one or more of the three intersections between Waiale Road and Waikapu Gardens' accesses:

1. Construct deceleration and median acceleration lanes along Waiale Road – this would facilitate access to and from Waikapu Gardens; This could be achieved within existing ROW. **Recommended**.

2. Signalize one of the intersections – based upon the projections contained within the TIAR for the Waikapu Affordable Housing Project (2004), **it is unlikely that a signal would be warranted at any of the project accesses**. However, this issue should be re-evaluated as traffic increases along Waiale Road. **Not Recommended at this time**.

3. Construct a mini-roundabout – although preferable, a standard roundabout would likely be too large to fit within the existing ROW and physical constraints. A mini-roundabout could fulfill the same purpose, but would offer a comparatively lower operating capacity and require fully mountable islands. The following issues should be considered:

   a. Mini-roundabouts generally have a planning-level recommended handling capacity of 15,000 Average Annual Daily Traffic (AADT)[11]; the projections for 2030 would exceed this threshold.

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[11] FHWA, Mini-Roundabouts (2010).

b. The capacity of a Mini-roundabout decreases as the percentage of heavy trucks increases. Waiale road terminates in an industrial area.

c. For these reasons, a mini-roundabout is **Not Recommended.**

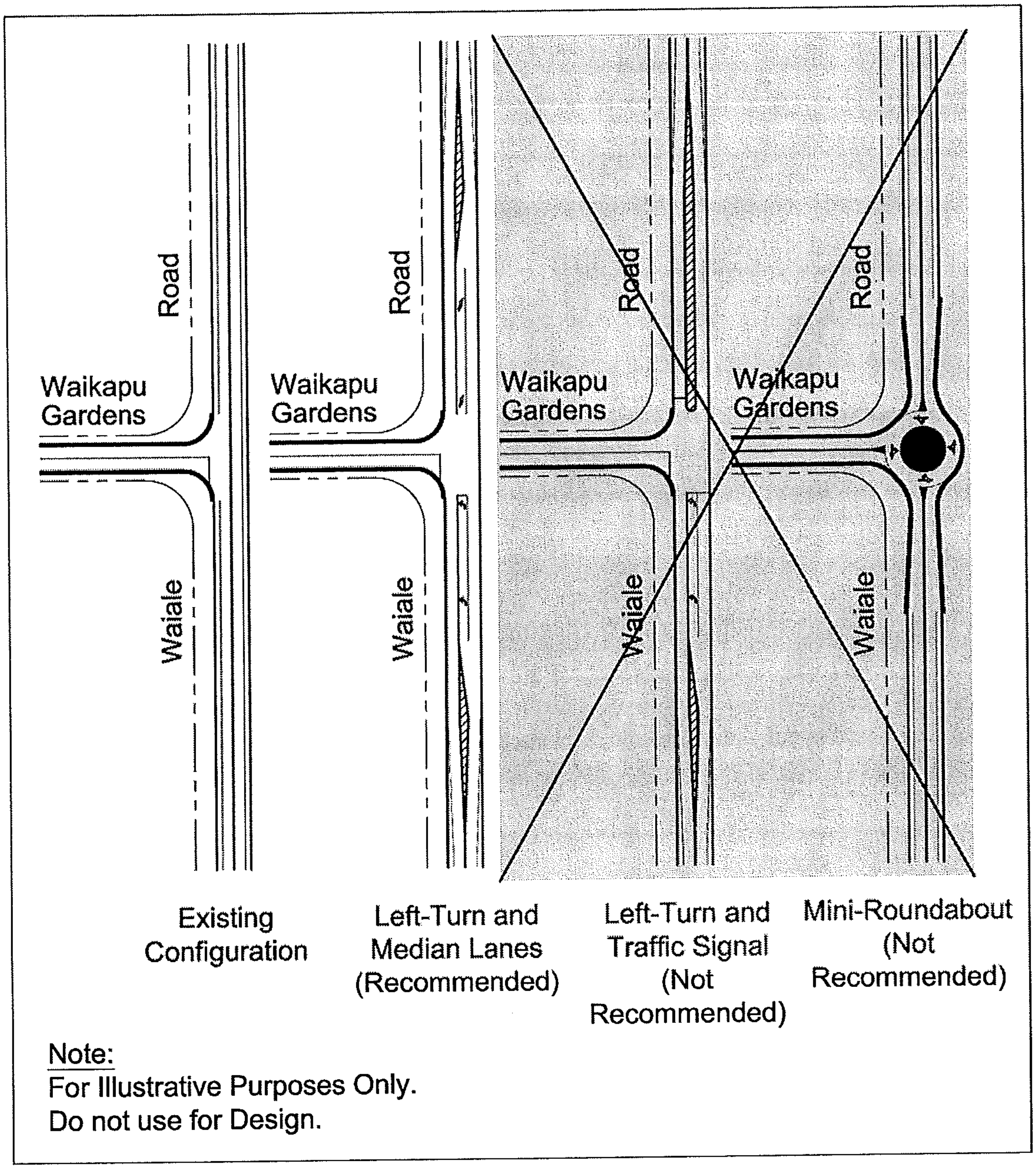
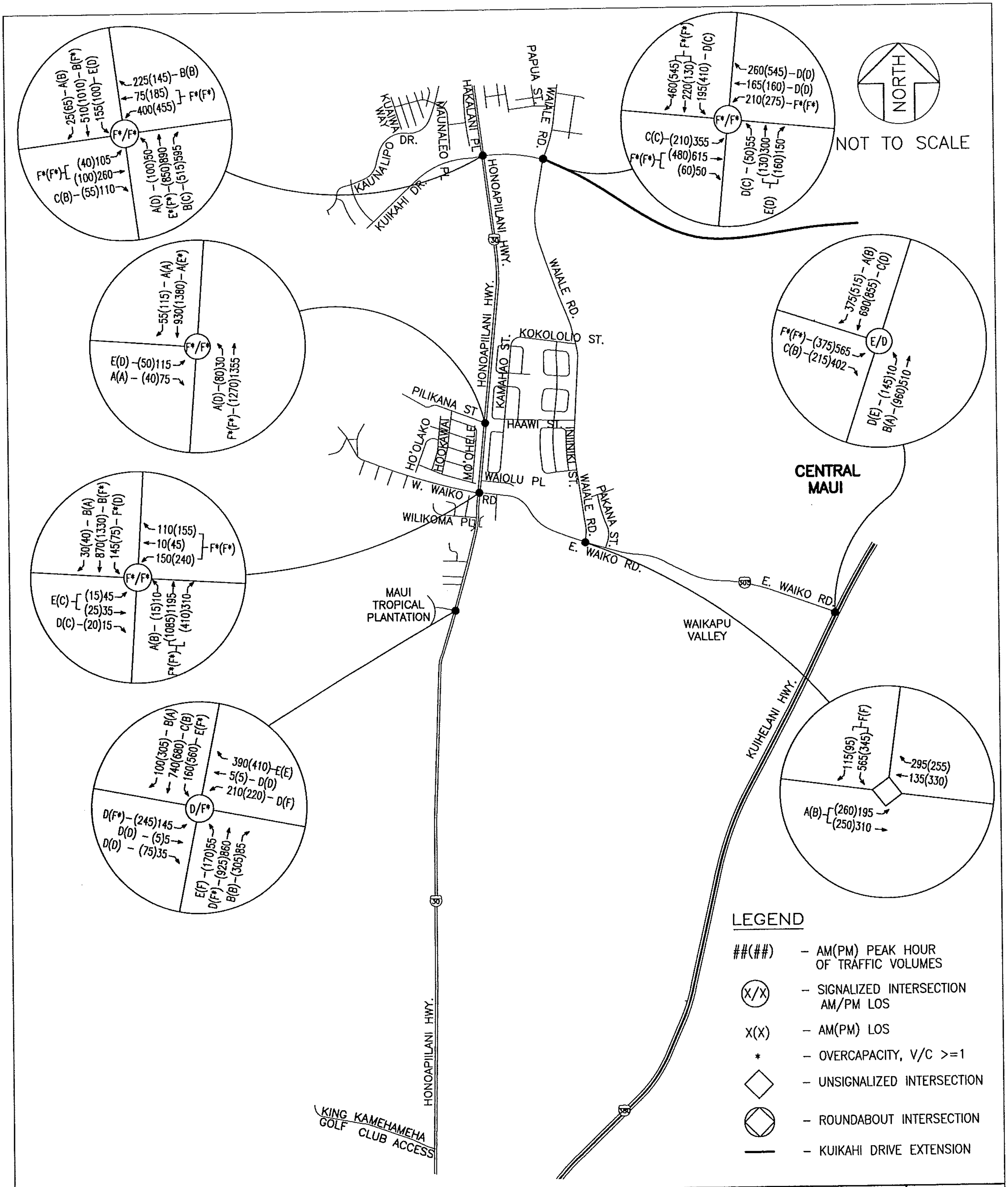


Figure 26: Base Year 2030 Alternative Configurations for Waikapu Gardens Intersections.

See Figure 27 for Base Year 2030 Volume and LOS. See Figure 28 for Base Year 2030 with Mitigative Measures Lane Configurations. See Figure 29 for Base Year 2030 with Mitigative Measures Volume and LOS. See Table 4 for a comparative analysis between existing and Base Year 2030 conditions. See Appendix C for intersection analysis worksheets.



WAIALE ROAD EXTENSION

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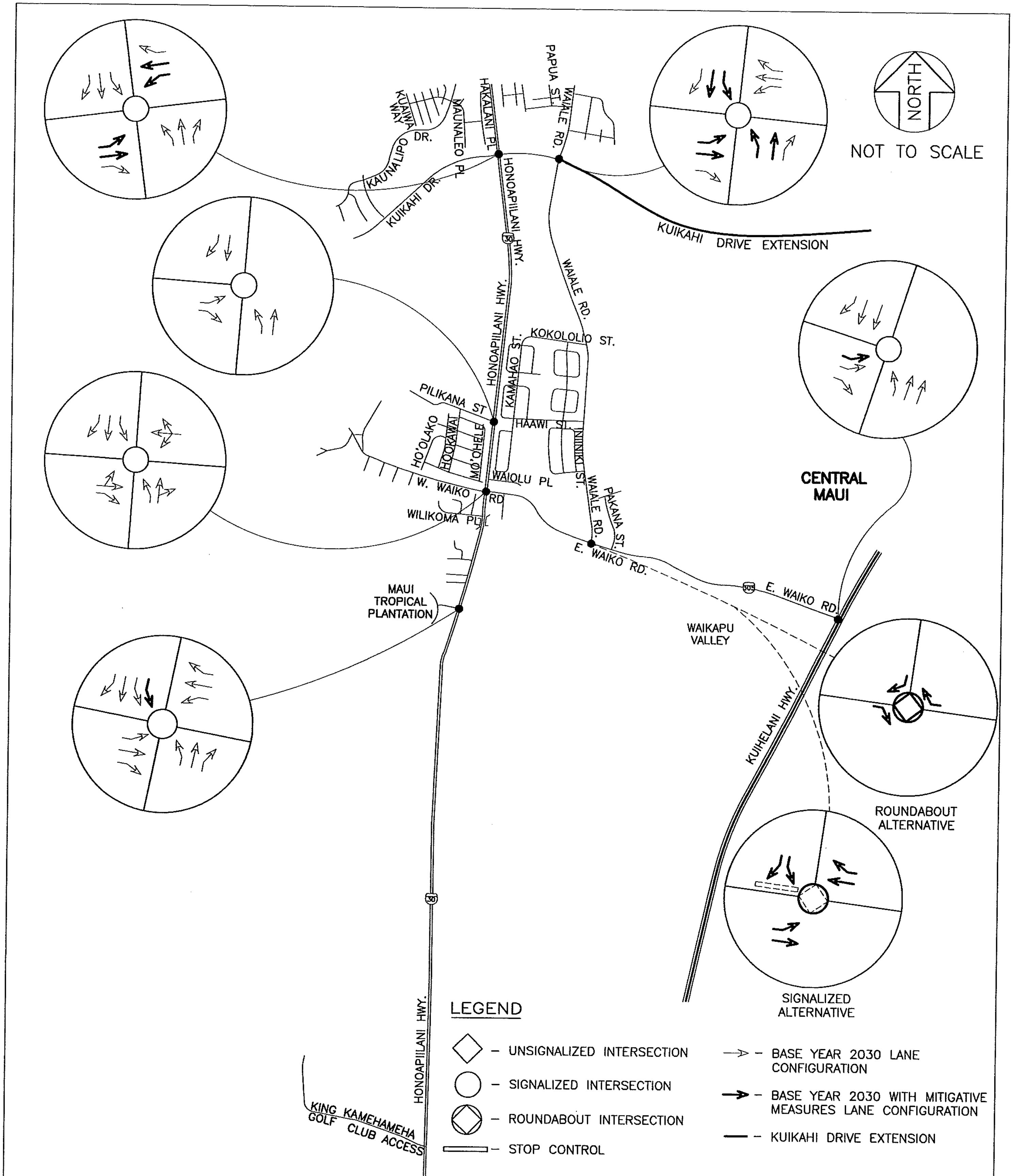
BASE YEAR 2030 VOLUME AND LOS

FIGURE 27



WAIALE ROAD EXTENSION

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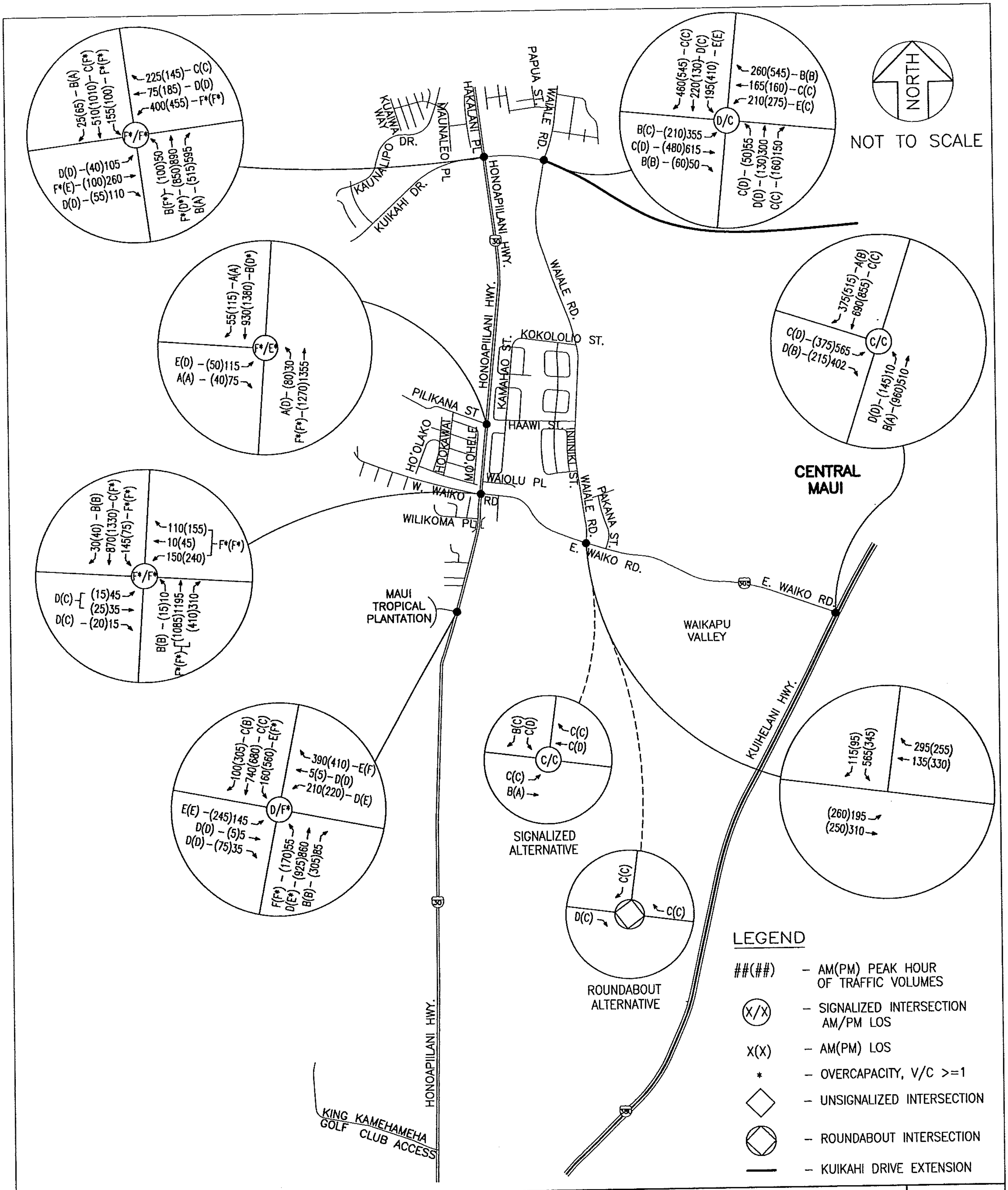
BASE YEAR 2030 ALTERNATIVE LANE CONFIGURATIONS

FIGURE 28



WAIALE ROAD EXTENSION

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BASE YEAR 2030 WITH MITIGATIVE MEASURES VOLUME AND LOS

FIGURE 29

TABLE 4

Level of Service Summary, Existing, Base Year 2030 and Base Year 2030 with Mitigative Measures

	Existing 2008						Base year 2030						Base Year 2030 With Mitigative Measures					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Kuikahi Drive & Honoapiilani Highway																		
													EB & WB: Exclusive LT,TH,RT lanes					
EB LT													44.4	0.46	D	43.8	0.3	D
EB TH													155.5	1.16	F*	59.5	0.7	E
EB LT/TH	20.7	0.55	C	16.6	0.19	B	5712.0	13.49	F*	776.2	2.57	F*						
EB RT	11.4	0.06	B	9.5	0.02	A	24.7	0.2	C	18.6	0.07	B	41.0	0.15	D	41.1	0.1	D
WB LT													252.7	1.44	F*	310.5	1.58	F*
WB TH													39.3	0.23	D	50.2	0.75	D
WB LT/TH	57.0	0.95	E	31.8	0.81	C	4540.6	10.98	F*	712.4	2.49	F*						
WB RT	11.2	0.03	B	9.4	0.02	A	10.6	0.34	B	19.5	0.18	B	31.5	0.33	C	31.9	0.17	C
NB LT	14.7	0.11	B	11.3	0.23	B	6.5	0.17	A	48.8	0.82	D	12.6	0.24	B	221.3	1.39	F*
NB TH	27.3	0.76	C	16.7	0.50	B	74.5	1.12	E*	112.5	1.16	F*	150.1	1.27	F*	42.2	1.03	D*
NB RT	17.7	0.27	B	13.6	0.16	B	15.1	0.84	B	24.3	0.62	C	15.5	0.72	B	2.9	0.52	A
SB LT	16.7	0.32	B	10.7	0.14	B	68.7	0.89	E	52.6	0.84	D	295.3	1.49	F*	215.5	1.29	F*
SB TH	20.5	0.51	C	20.5	0.68	C	14.9	0.51	B	156.2	1.26	F*	30.1	0.63	C	86.6	1.10	F*
SB RT	15.5	0.02	B	12.7	0.03	B	9.5	0.04	A	16.3	0.15	B	11.9	0.04	B	7.8	0.12	A
Overall or Max v/c	26.7	0.83	C	19.4	0.70	B	1392.9	4.5	F*	241.5	1.71	F*	108.2	1.44	F*	90.7	1.4	F*
Actuated Signal Cycle Length		84			66			120			110			140			120	
Pilikana Street & Honoapiilani Highway																		
EB LT	51.0	0.59	D	32.8	0.24	C	57.5	0.69	E	54.3	0.49	D	69.9	0.73	E	54.3	0.49	D
EB RT	0.2	0.05	A	0.2	0.03	A	0.2	0.08	A	0.2	0.04	A	0.1	0.07	A	0.2	0.04	A
NB LT	3.2	0.04	A	5.5	0.13	A	7.8	0.13	A	44.2	0.81	D	7.1	0.12	A	42.6	0.81	D
NB TH	6.3	0.70	A	5.5	0.40	A	159.1	1.34	F*	106.2	1.19	F*	147.0	1.31	F*	95.7	1.19	F*
SB TH	7.3	0.49	A	8.7	0.53	A	5.6	0.78	A	64.2	1.09	E*	10.9	0.75	B	50.8	1.09	D*
SB RT	0.7	0.03	A	1.0	0.07	A	0.0	0.04	A	0.7	0.09	A	2.6	0.04	A	2.2	0.09	A
Overall or Max v/c	8.6	0.69	A	7.4	0.51	A	96.7	1.25	F*	80.8	1.13	F*	92.0	1.24	F*	70.1	1.13	E*
Actuated Signal Cycle Length		110			80			120			120			140			120	
East Waiko Road, West Waiko Road & Honoapiilani Highway																		
EB LT/TH	51.2	0.59	D	29.5	0.17	C	55.4	0.7	E	30.8	0.15	C	46.2	0.5	D	34.6	0.17	C
EB RT	37.4	0.01	D	23.6	0.01	C	35.6	0.02	D	24.7	0.02	C	35.4	0.02	D	27.9	0.02	C
WB LT/TH/RT	54.8	0.68	D	37.5	0.67	D	343.9	1.61	F*	186.6	1.3	F*	140.4	1.12	F*	285.7	1.51	F*
NB LT	4.9	0.01	A	6.0	0.02	A	6.7	0.06	A	13.1	0.25	B	16.3	0.08	B	12.3	0.24	B
NB TH/RT	11.1	0.61	B	10.9	0.51	B	288.3	1.59	F*	424.4	1.89	F*	312.1	1.64	F*	331.7	1.69	F*
SB LT	6.1	0.33	A	7.7	0.16	A	99.9	1.05	F*	37.1	0.75	D	327.3	1.55	F*	97.1	1.08	F*
SB TH	5.4	0.43	A	10.6	0.49	B	19.2	0.73	B	188.0	1.38	F*	23.1	0.79	C	148.1	1.29	F*
SB RT	3.6	0.02	A	9.9	0.02	A	10.4	0.04	B	3.6	0.08	A	13.7	0.05	B	11.3	0.07	B
Overall or Max v/c	14.8	0.60	B	14.9	0.57	B	193.1	1.54	F*	278.0	1.69	F*	200.1	1.49	F*	239.8	1.62	F*
Actuated Signal Cycle Length		110			80			120			120			140			120	

Note: * = Over-capacity contidiotns.
v/c n [illegible] ulatec

TABLE 4 continued

Level of Service Summary, Existing, Base Year 2030 and Base Year 2030 with Mitigative Measures

	Existing 2008						Base year 2030						Base Year 2030 With Mitigative Measures					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Maui Tropical Plantation & Honoapiilani Highway																		
							Signalized Coordinated EB,WB,NB & SB: LT, TH and RT lanes						Signalized Coordinated SB: Double LT EB,WB & NB: LT, TH and RT lanes					
EB LT	20.0	0.02	C	16.3	0.08	C	54.7	0.67	D	193.4	1.24	F*	63.7	0.69	E	68.4	0.87	E
EB TH							48.3	0.03	D	47.7	0.02	D	54.6	0.02	D	43.1	0.02	D
EB RT	20.0	0.02	C	16.3	0.08	C	48.3	0.02	D	47.9	0.05	D	54.6	0.02	D	43.7	0.09	D
WB LT							47.4	0.71	D	97.8	0.97	F	49.7	0.65	D	57	0.78	E
WB TH							43.1	0.02	D	45.7	0.02	D	46.5	0.01	D	43.1	0.02	D
WB RT							69.1	0.83	E	63.1	0.73	E	73.4	0.84	E	83.2	0.91	F
NB LT	8.8	0.00	A	8.8	0.01	A	63.6	0.68	E	84.9	0.96	F	84.0	0.76	F	98.1	1.00	F*
NB TH	0	0.42	0	0	0.33	0	51.8	0.98	D	91.9	1.1	F*	35.7	0.89	D	78.7	1.07	E*
NB RT			*			*	13.9	0.06	B	17.6	0.25	B	12.9	0.09	B	18	0.35	B
SB LT							71.9	0.91	E	493.9	1.96	F*	77.3	0.89	E	296.0	1.52	F*
SB TH	0	0.37	0	0	0.36	0	24.6	0.77	C	19.9	0.81	B	28.8	0.75	C	24.5	0.87	C
SB RT	0	0	0	0	0.01	0	12.4	0.11	B	8.9	0.35	A	23.6	0.11	C	10.9	0.38	B
Overall or Max v/c	0.1	**	A	0.8	**	A	45.8	0.9	D	123.8	1.33	F*	44.6	0.88	D	87.6	1.04	F*
Actuated Signal Cycle Length														140			120	
Kuikahi Drive & Waiale Road																		
							Signalized Coordinated WB: LT,TH and RT lanes EB, NB & SB: LT and shared TH/RT						Signalized Coordinated WB, EB, NB & SB: LT,TH and RT lanes					
EB LT							30.2	0.87	C	26.8	0.63	C	19.3	0.71	B	20.1	0.44	C
EB LT/RT	114.8	**	F	15.0	**	B												
EB TH													32.8	0.85	C	39.1	0.78	D
EB TH/RT							191.7	1.33	F*	247.9	1.46	F*						
EB RT													11.7	0.07	B	15.9	0.08	B
WB LT							126.8	1.09	F*	131.9	1.15	F*	62.6	0.90	E	32.4	0.80	C
WB TH							48.8	0.51	D	38.5	0.40	D	26.6	0.23	C	24.4	0.23	C
WB RT							42.3	0.18	D	38.7	0.38	D	16.9	0.19	B	11.9	0.48	B
NB LT							38.5	0.62	D	31.1	0.37	C	32.6	0.22	C	39.5	0.22	D
NB TH													54.8	0.79	D	52.9	0.65	D
NB LT/TH	22.1	**	C	10.8	**	B												
NB TH/RT							62.8	0.99	E	44.2	0.75	D						
NB RT													26.9	0.19	C	27.6	0.16	C
SB LT							41.2	0.76	D	30.0	0.83	C	68.1	0.89	E	74.0	0.99	E
SB TH													42.6	0.55	D	34.9	0.34	C
SB TH/RT	40.4	**	E	17.4	**	C	129.2	1.18	F*	86.9	1.07	F*						
SB RT													29.1	0.44	C	26.2	0.52	C
Overall or Max v/c	67.5	**	D	15.5	**	B	101.0	1.22	F*	90.3	1.19	F*	35.6	0.90	D	33.4	0.83	C
Actuated Signal Cycle Length								120			110			140			120	

Note: * = Over-capacity contidiotns.

** = v/c not calculated

TABLE 4 continued

Level of Service Summary, Existing, Base Year 2030 and Base Year 2030 with Mitigative Measures

	Existing 2008						Base year 2030						Base Year 2030 With Mitigative Measures					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
East Waiko Road & Waiale Road																		
													Roundabout Single-Lane Analysis performed using RODEL					
EB LT/TH	1.8	0.04	A	2.3	0.03	A	7.2	0.33	A	12.1	0.53	B						
EB LT/TH/RT													27.6	0.62	D	21.0	0.54	C
WB LT/TH/RT													16.8	0.42	C	22.2	0.59	C
SB LT/RT	22.6	0.63	C	13.7	0.30	B	Err	8.42	F	Err	12.11	F						
SB LT/TH/RT													22.8	0.64	C	18.6	0.46	C
Overall or Max v/c	9.0	**	A	4.1	**	A	4046.1	0	G	2705.6	0.00	F	18.3	**	C	17.1	**	C
East Waiko Road & Waiale Road - Alternate intersection control																		
													Signalized Uncoordinated WB: TH and RT lanes EB: TH and LT lanes SB: LT and RT lanes					
EB LT													23.0	0.73	C	28.0	0.76	C
EB TH													17.0	0.50	B	9.0	0.28	A
WB TH													32.5	0.64	C	41.7	0.82	D
WB RT													26.5	0.21	C	29.0	0.45	C
SB LT													32.9	0.91	C	47.5	0.86	D
SB RT													12.1	0.14	B	26.5	0.16	C
Overall or Max v/c													26.2	0.81	C	32.4	0.79	C
Actuated Signal Cycle Length													80			102		
East Waiko Road & Kuihelani Highway																		
													EB: Double LT					
EB LT	19.3	0.74	B	17.4	0.59	B	176.3	1.28	F*	187.2	1.29	F*	34.6	0.66	C	50.3	0.76	D
EB RT	7.4	0.04	A	9.8	0.01	A	29.5	0.86	C	12.2	0.48	B	47.5	0.95	D	18.2	0.50	B
NB LT	24.7	0.18	C	23.0	0.14	C	42.2	0.11	D	60.4	0.91	E	46.0	0.14	D	54.3	0.88	D
NB TH	8.8	0.20	A	6.2	0.31	A	13.2	0.28	B	8.7	0.43	A	13.2	0.28	B	7.2	0.41	A
SB TH	14.1	0.38	B	9.6	0.36	A	32.3	0.59	C	37.0	0.75	D	28.4	0.54	C	34.4	0.71	C
SB RT	1.4	0.20	A	1.3	0.20	A	4.6	0.34	A	18.0	0.67	B	3.3	0.32	A	14.2	0.62	B
Overall or Max v/c	12.0	0.58	B	8.2	0.48	A	56.8	0.90	E	45.3	0.94	D	28.3	0.77	C	26.6	0.78	C
Actuated Signal Cycle Length	54			48			120			120			120			120		

Note: * = Over-capacity contidiotns.
** = v/c r[illegible] [illegible]ulated

IV. YEAR 2030 WITH PROJECT

This section will consider the effect of Alternatives 1 and 2 of the WRE on the roadway network. The impact of the EWRI on traffic operations at the study intersections will only be significant in that the pavement will be widened from its existing 20 feet to 36 feet. This, in combination with improved roadway conditions, will improve capacity along the roadway; hence, the effect of the EWRI will be implicitly included as a component of upstream roadway capacity in the discussion of Alternatives 1 and 2.

The primary purposes of the WRE will be to:

1. Increase the viability of Waiale Road as an alternate route to Honoapiilani Highway and Kuihelani Highway through the Waikapu area,
2. Improve access to Honoapiilani Highway and Kuihelani Highway for existing and new developments within the Waikapu/South Wailuku areas, and
3. Reduce turning movements to/from Honoapiilani Highway onto/off of Kuikahi Drive and East Waiko Road, which would otherwise serve as the only means of accessing Honoapiilani Highway from within the region within the study area and bound by Honoapiilani Highway and Kuihelani Highway. This reduction will be most noticeable in the northbound right-turn and westbound left-turn movements due to the fact that they might provide more direct links to the drivers' ultimate destinations. As such, Figure 30 shows the shift in the balance of volume for these movements across the different alternatives.

	BASE YEAR 2030	ALTERNATIVE 1	ALTERNATIVE 2

KUIKAHI DRIVE/HONOAPIILANI HIGHWAY

	BASE YEAR 2030	ALTERNATIVE 1	ALTERNATIVE 2
AM:	57%	34%	34%
PM:	45%	29%	29%

(PERCENTAGE OF NBRT AND WBLT TRAFFIC ACROSS THESE 4 INTERSECTIONS)

WAIKO ROAD/HONOAPIILANI HIGHWAY

	BASE YEAR 2030	ALTERNATIVE 1	ALTERNATIVE 2
AM:	26%	10%	10%
PM:	30%	8%	8%

(PERCENTAGE OF NBRT AND WBLT TRAFFIC ACROSS THESE 4 INTERSECTIONS)

MTP/HONOAPIILANI HIGHWAY/ROAD 1

	BASE YEAR 2030	ALTERNATIVE 1	ALTERNATIVE 2
AM:	17%*	12%	56%
PM:	24%*	17%	63%

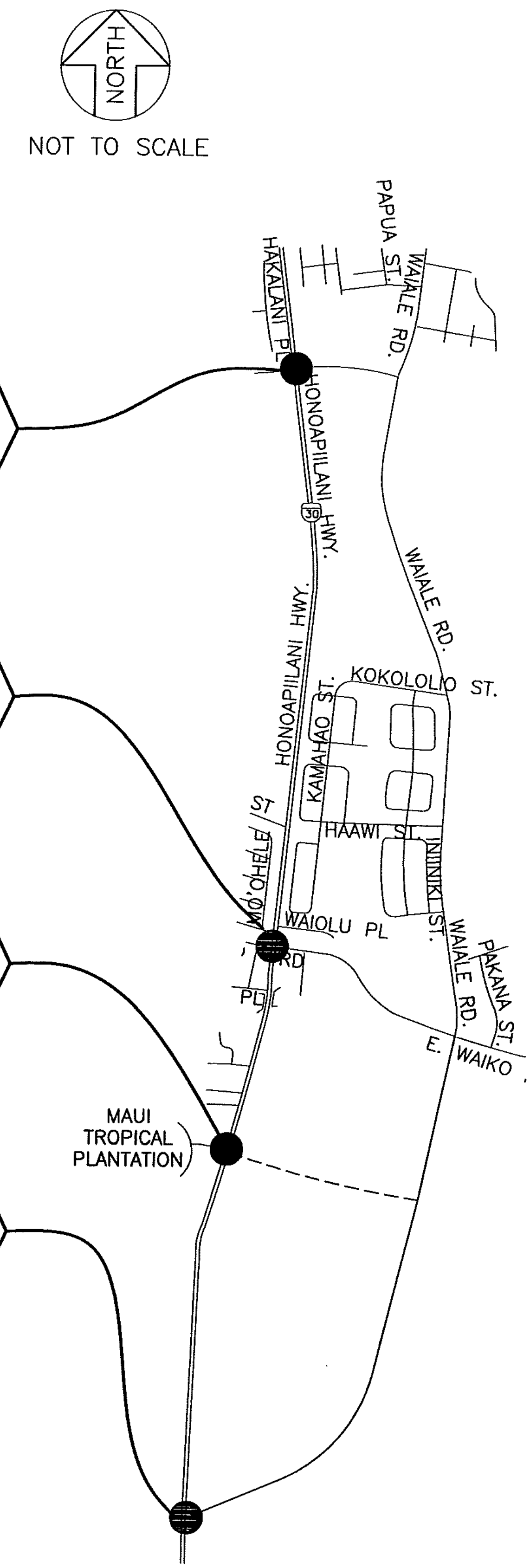
(PERCENTAGE OF NBRT AND WBLT TRAFFIC ACROSS THESE 4 INTERSECTIONS)

WRE/HONOAPIILANI HIGHWAY

	BASE YEAR 2030	ALTERNATIVE 1	ALTERNATIVE 2
AM:	--	44%	--
PM:	--	46%	--

(PERCENTAGE OF NBRT AND WBLT TRAFFIC ACROSS THESE 4 INTERSECTIONS)

*VOLUME DUE TO ASSUMED WCT ACCESS



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WRE ALTERNATIVE 1 AND 2 DISTRIBUTION VOLUME AND LOS

FIGURE 30

A. Alternative 1

As mentioned earlier, Alternative 1 represents the southward extension of Waiale Road with a connection to Honoapiilani Highway 4,700 feet south of the MTP Access.

It is expected that many of the trips that currently access Honoapiilani Highway via East Waiko Road and Kuikahi Drive will be diverted to the new intersection, thereby improving conditions at the Honoapiilani Highway/Kuikahi Drive and Honoapiilani Highway/East Waiko Road intersections.

The following intersections experience significant changes in volume and differ from Base Year 2030 with Mitigative Measures:

<u>Kuikahi Drive/Honoapiilani Highway</u>

Operations at this intersection will improve over Base Year 2030 with mitigative measures:

- Base Year 2030:
  - Overall LOS F(F) and overcapacity conditions during AM(PM) peak hours of traffic
- Alternative 1:
  - Although some minor movements experience LOS F, the intersection operates near capacity and at LOS D(D) during the AM(PM) peak hours of traffic.

The improvement will be a result of the diversion of westbound left-turn and northbound right-turn movements from this intersection to the WRE.

<u>East Waiko Road/West Waiko Road/Honoapiilani Highway</u>

Similar to the Kuikahi Drive/Honoapiilani Highway intersection, operations at this intersection are expected to improve as a result of the diversion of westbound left-turns and northbound right-turn movements from this intersection to the WRE:

- Base Year 2030:
  - Overall LOS F(F) and overcapacity conditions during AM(PM) peak hours of traffic
- Alternative 1:
  - Although some minor movements experience LOS F and overcapacity conditions, the intersection operates near capacity and at LOS D(D) during the AM(PM) peak hours of traffic.

<u>Pilikana Street/Honoapiilani Highway</u>

Operations at this intersection will significantly improve over Base Year 2030, with the overall LOS improving to B(A), and all movements operating at LOS E(E) or better during the AM(PM) peak hours of traffic.

<u>MTP Access/Honoapiilani Highway</u>

Operations at this intersection will improve significantly over Base Year 2030 due to:

1. The provision of an alternate access route for WCT traffic, and
2. Reduction of traffic along Honoapiilani Highway.

Similar to Base Year 2030, a traffic signal will most likely be warranted. However, a southbound double left-turn lane would not be recommended, as the volume will have decreased significantly. See Appendix D for signal warrant analysis.

With this lane configuration, the intersection will improve to operate at LOS E or better for all approaches during the PM peak hour of traffic, and LOS D or better for all approaches during the AM peak hour of traffic. See Figure 31.

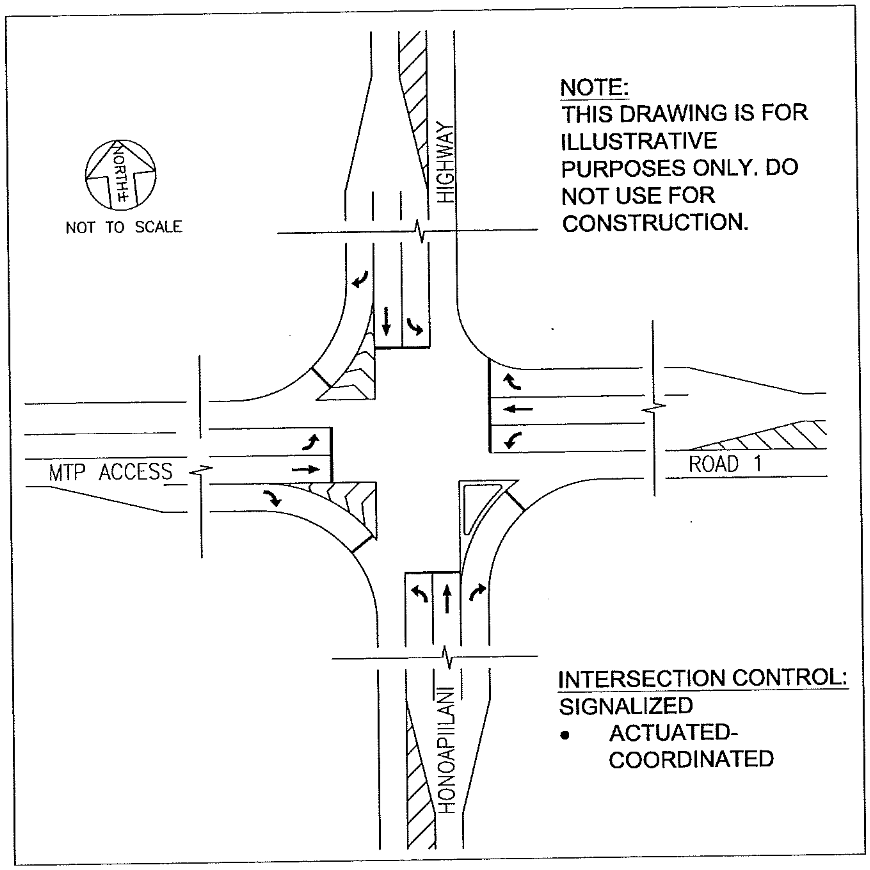


Figure 31: Year 2030 with Alternative 1 Lane Configuration at MTP Access/Road 1/Honoapiilani Highway

WRE/Honoapiilani Highway

It is likely that this intersection will warrant a traffic signal. It is recommended that this intersection provide deceleration lanes for its northbound and southbound right-turn and left-turn movements. For the westbound approach, a dedicated left-turn lane and shared though/right-turn lane are recommended.

With these improvements, the intersection would operate at LOS E(E) or better and within capacity for all movements during the AM(PM) peak hours of traffic. See Appendix D for signal warrant analysis.

See Figure 32 for recommended lane configuration.

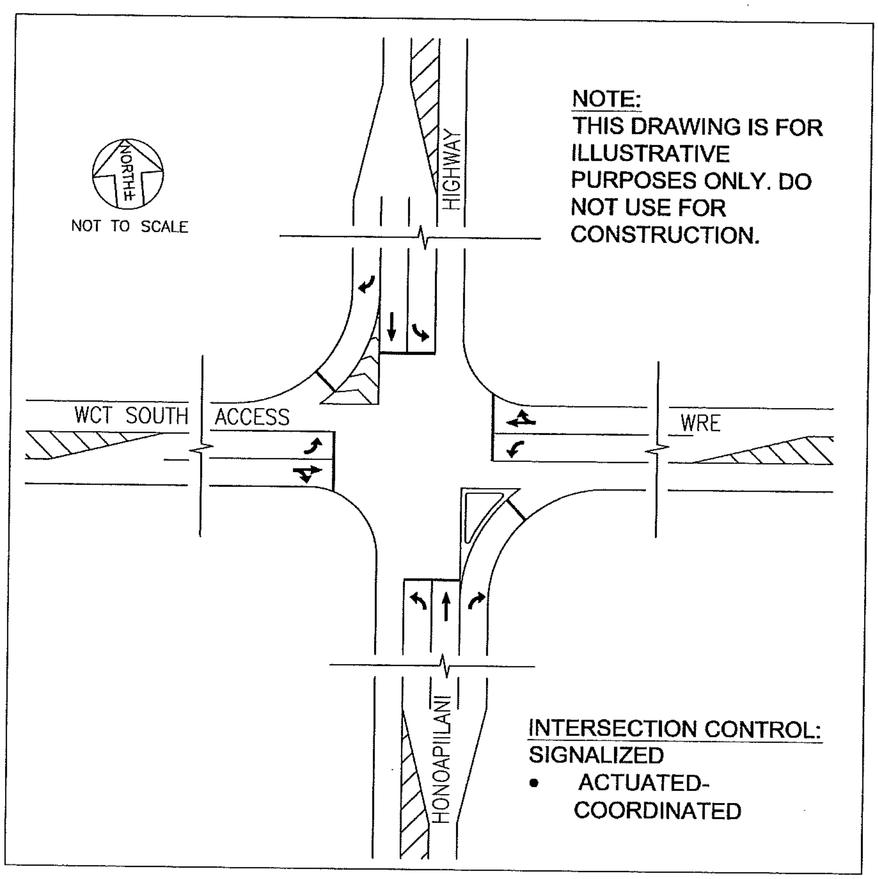


Figure 32: Year 2030 with Alternative 1 Lane Configuration WRE/WCT South Access/Honoapiilani Highway

Waiale Road/East Waiko Road

This intersection will differ from that of Base Year 2030 with Mitigative Measures in that a fourth leg will be added as a connection to the WRE. As such, the volume will increase.

RODEL analysis would indicate that a roundabout would operate at LOS F on its northbound and southbound approaches during the AM peak hour of traffic and on its westbound and southbound approaches during the (PMP peak hour of traffic. As with Base Year 2030, a roundabout would require significant ROW acquisition to accommodate the approaches' realignments. See Figure 33 for roundabout configuration.

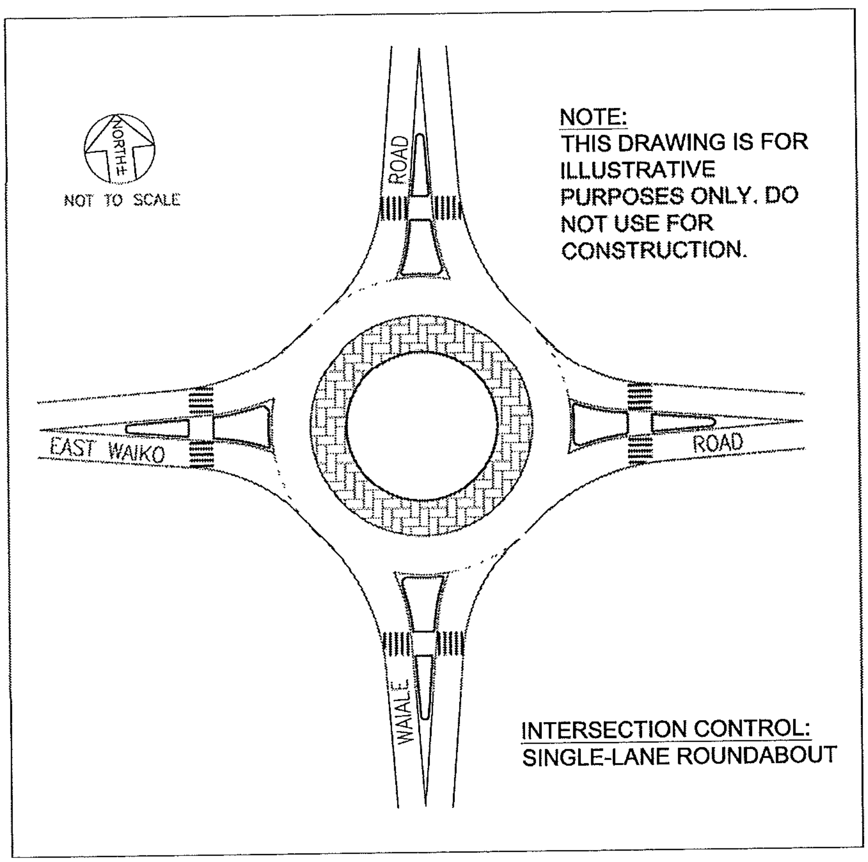


Figure 33: Year 2030 with Alternative 1 Lane Configuration Waiale Road/East Waiko Road Intersection – Roundabout

A traffic signal would most likely be warranted. If the intersection is signalized, it is recommended that dedicated left-turn lanes be provided on all approaches, and that an exclusive right-turn lane be provided for the westbound and northbound approaches. Although ROW may need to be acquired near the intersection, the impact will likely be smaller than with a roundabout. With the traffic signal, all movements would operate at LOS D(D) or better during the AM(PM) peak hours of traffic. Therefore, the traffic signal is recommended.

See Figure 34 for signalized lane configuration. See Appendix D for signal warrant analysis.

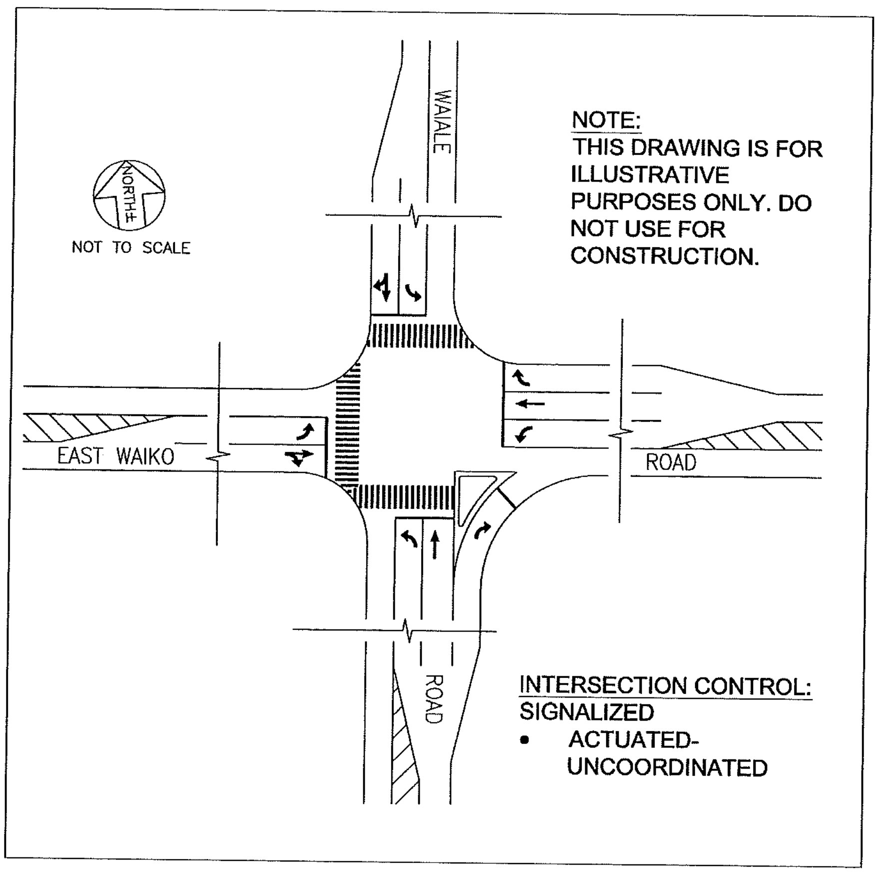
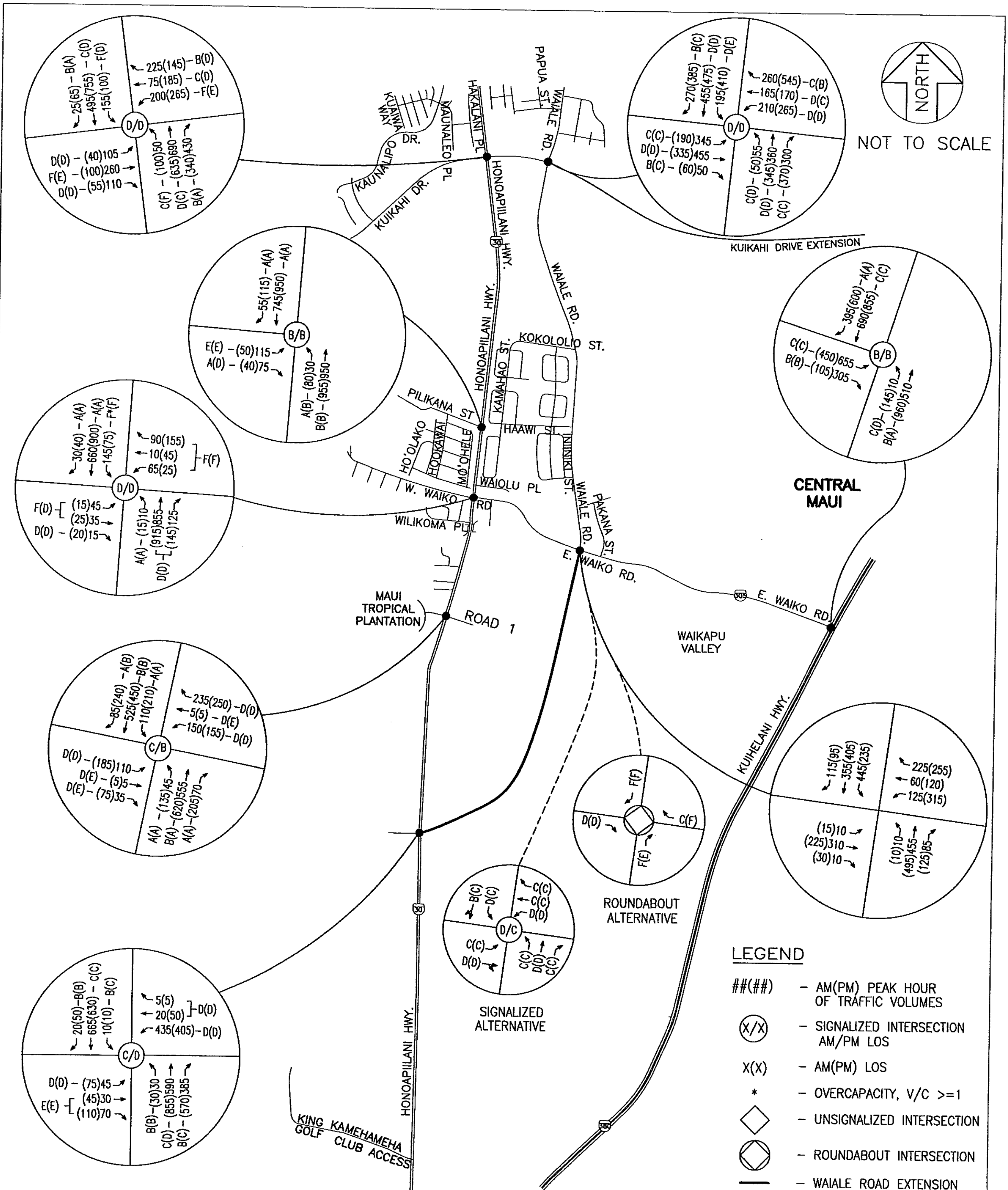


Figure 34: Year 2030 with Alternative 1 Lane Configuration
Waiale Road/East Waiko Road Intersection – Traffic Signal

Waiale Road/Waikapu Gardens Access Roads

It is estimated that the WRE would increase traffic along Waiale Road near Waikapu Gardens by an additional 32 percent over Base Year 2030. However, no additional improvements are recommended given the fact that a traffic signal would likely not be warranted, and a mini-roundabout would continue to experience volumes in excess of the planning-level recommended ADT of 15,000 vehicles per day. See Figure 35 for Year 2030 with Alternative 1 volume and LOS.



WAIALE ROAD EXTENSION

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ALTERNATIVE 1 VOLUME AND LOS

FIGURE 35

B. Alternative 2

In Alternative 2, the WCT is bifurcated by the WRE. This will result in:

1. Higher turning movement volumes at the WRE/MTP Access/Honoapiilani Highway intersection
2. Longer roadway crossings for pedestrians (including school children) across higher volumes attributed to the WCT.
3. Potential for queue spillback onto Honoapiilani Highway from WCT's internal intersections.

Outside of the immediate vicinity of the MTP Access/Road 1/Honoapiilani Highway intersection, it was assumed that traffic patterns and volumes will be similar to that of Alternative 1.

<u>MTP Access/WRE/Honoapiilani Highway</u>

As with Base Year 2030 and Alternative 1, this intersection will most likely warrant a traffic signal. The geometric configuration differs from Alternative 1 in that an additional westbound left-turn (dual) lane has been added to accommodate the compound demand from both the WRE and the WCT. As a result, an additional receiving lane would be necessary in the southbound direction along Honoapiilani Highway.

Furthermore, the heavy northbound right-turn volume would create the need for a "free" northbound right-turn.

Even with these improvements, the intersection will operate at LOS F(F) and overcapacity on some of its movements during the AM(PM) peak hours of traffic.

See Figure 36 for recommended lane configuration. See Appendix D for signal warrant analysis.

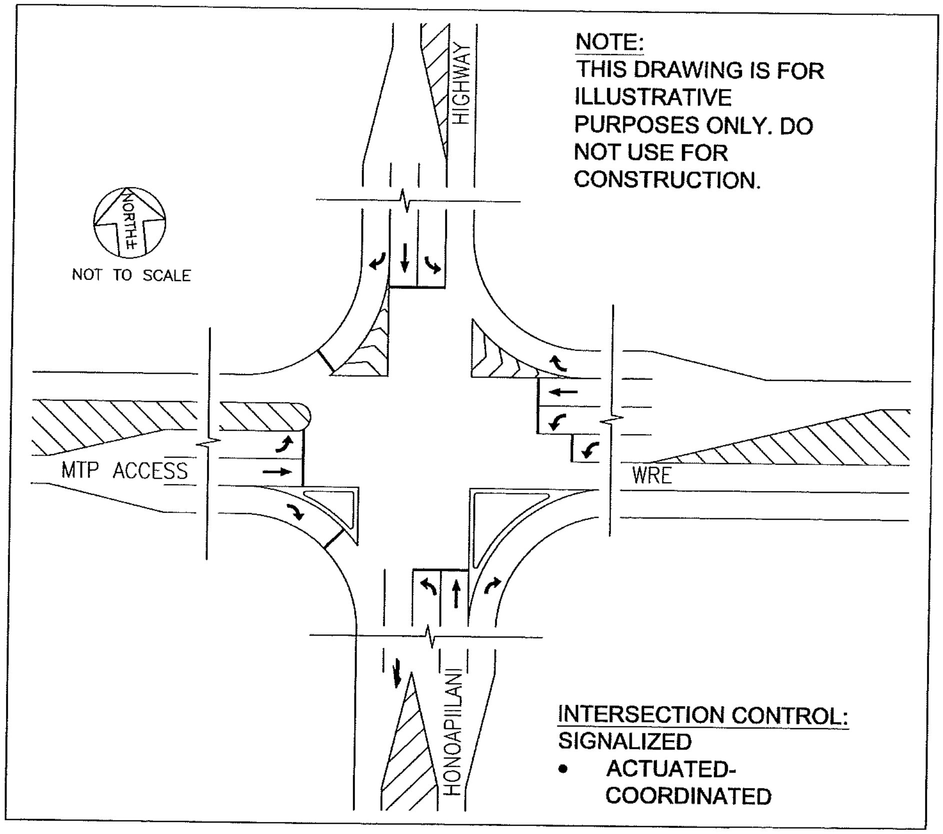


Figure 36: Year 2030 with Alternative 2 Lane Configuration Waiale Road/Honoapiilani Highway

C. Discussion

Based upon intersection and highway operations and safety, Alternative 1 should be considered the preferred alternative.

Highway Operations

Alternative 1 would allow "bypass" traffic to access the WRE without passing thorough the local intersections of the WCT. Having a dedicated access from the WRE to Honoapiilani Highway would improve the efficiency of the connection.

See Tables 5 and 6 below for a comparison of overall intersection delay across the different scenarios.

Table 5: Alternative Comparison – AM Delay

Overall AM Intersection Delay			
Overall Intersection AM Delay	**Base Year 2030 with Mitigative Measures**	**Alternative 1**	**Alternative 2**
Kuikahi Drive/Honoapiilani Highway	108.2	47.1	45.8
East Waiko Road/West Waiko Road/Honoapiilani Highway	200.1	51.9	48.0
MTP Access/Road 1/Honoapiilani Highway	44.6	22.9	43.4
WRE/Honoapiilani Highway	--	31.7	--
Average	**117.6**	**38.4**	**45.7**

Table 6: Alternative Comparison – PM Delay

Overall PM Intersection Delay			
Overall Intersection PM Delay	**Base Year 2030 with Mitigative Measures**	**Alternative 1**	**Alternative 2**
Kuikahi Drive/Honoapiilani Highway	90.7	42.0	43.2
East Waiko Road/West Waiko Road/Honoapiilani Highway	239.8	38.3	37.0
MTP Access/Road 1/Honoapiilani Highway	87.6	19.2	50.0
WRE/Honoapiilani Highway	--	38.4	--
Average	**139.4**	**34.5**	**43.4**

Safety

Alternative 2 would require the WRE to bifurcate the WCT, which plans to develop residential, commercial, and potentially school land uses – all of which would generate internal pedestrian traffic that would have to cross the WRE.

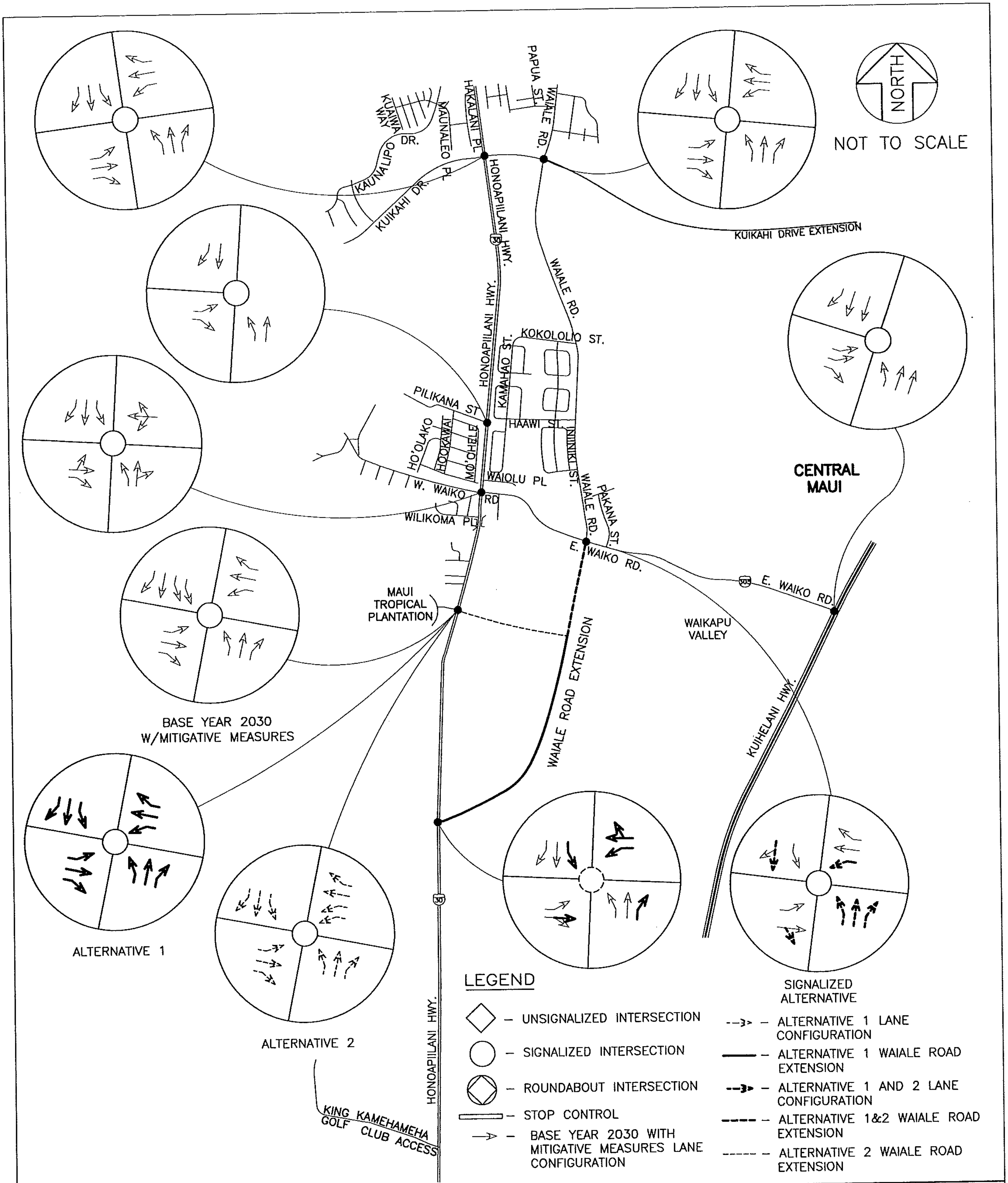
In contrast, Alternative 1 would allow the WCT access to better serve its local demand, allowing lower volumes and potentially narrower pavement widths.

Other Recommendations

Our discussion and assessment of these alternatives and their effects on the distribution and operations of traffic have been limited to projects contained within the Urban Growth Boundary (UGB). However, it is possible that the underlying assumptions could change, and that the UGB could be expanded in the future beyond 2030. Therefore, it is recommended that ROW be preemptively acquired along Honoapiilani from south of East/West Waiko Road to the Honoapiilani Highway/Kuihelani Highway (currently undeveloped) intersection to eventually widen the highway to four (4) lanes.

It should also be remembered that the recommendations made for Waiale and the WCT's accesses are based upon preliminary information and assumptions. Therefore, in some cases, the assumptions made in this TIAR have been conservative.

The lane configurations for all intersections are shown in Figure 37. The results of intersection analysis are shown in Table 7 and Figure 38. See Appendix C for intersection analysis worksheets.



WAIALE ROAD EXTENSION

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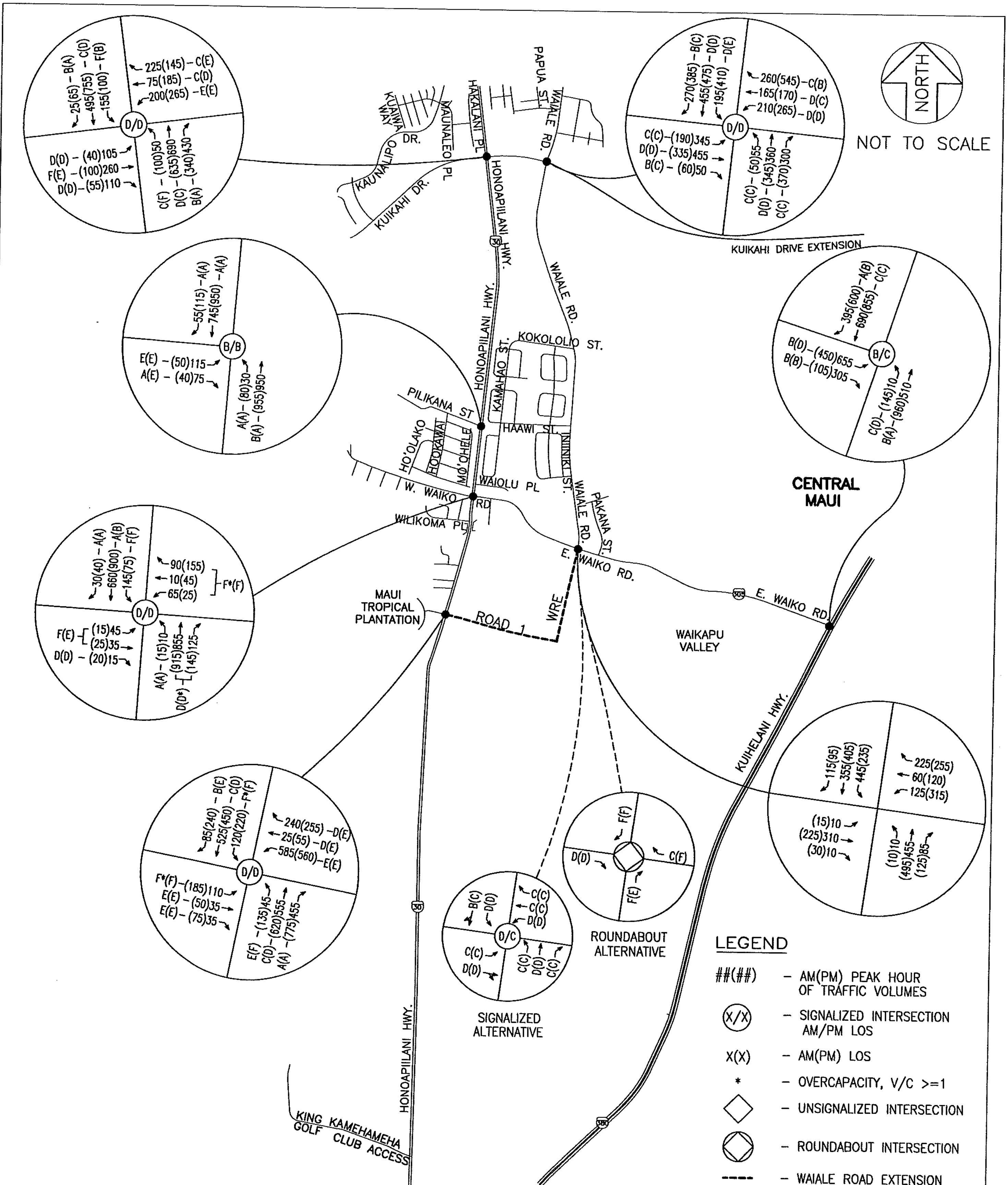
ALTERNATIVE 1 AND 2 LANE CONFIGURATIONS

FIGURE 37



WAIALE ROAD EXTENSION

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FIGURE 38

ALTERNATIVE 2 VOLUME AND LOS

TABLE 7

Level of Service Summary, Base Year 2030 with Mitigative Measures, Alternative 1 and Alternative 2

	Base Year 2030 With Mitigative Measures						Alternative 1						Alternative 2					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Kuikahi Drive & Honoapiilani Highway																		
	EB & WB: Added Excluisve LT and TH lanes						EB & WB: Added Excluisve LT and TH lanes						EB & WB: Added Excluisve LT and TH lanes					
EB LT	44.4	0.46	D	43.8	0.30	D	38.9	0.33	D	49.9	0.22	D	39.6	0.33	D	50.0	0.22	D
EB TH	155.5	1.16	F*	59.5	0.70	E	95.4	0.99	F	69.5	0.73	E	95.4	0.99	F	69.5	0.73	E
EB RT	41.0	0.15	D	41.1	0.10	D	36.3	0.12	D	45.0	0.04	D	36.3	0.12	D	45.0	0.04	D
WB LT	252.7	1.44	F*	310.5	1.58	F*	89.7	0.98	F	56.1	0.85	E	71.4	0.93	E	55.2	0.83	E
WB TH	39.3	0.23	D	50.2	0.75	D	34.2	0.19	C	48.1	0.57	D	33.8	0.18	C	48.4	0.56	D
WB RT	31.5	0.33	C	31.9	0.17	C	18.7	0.32	B	51.6	0.12	D	25.8	0.32	C	63.3	0.12	E
NB LT	12.6	0.24	B	221.3	1.39	F*	25.0	0.25	C	93.5	0.99	F	23.4	0.26	C	114.1	0.99	F
NB TH	150.1	1.27	F*	42.2	1.03	D*	48.5	0.92	D	30.6	0.83	C	47.4	0.94	D	30.7	0.72	C
NB RT	15.5	0.72	B	2.9	0.52	A	18.4	0.58	B	9.4	0.31	A	15.1	0.56	B	7.8	0.30	A
SB LT	295.3	1.49	F*	215.5	1.29	F*	95.4	0.98	F	44.0	0.81	D	97.0	0.98	F	18.2	0.47	B
SB TH	30.1	0.63	C	86.6	1.10	F*	29.3	0.68	C	49.4	0.96	D	30.2	0.69	C	51.3	0.97	D
SB RT	11.9	0.04	B	7.8	0.12	A	10.3	0.02	B	8.8	0.06	A	11.0	0.02	B	9.1	0.06	A
Overall or Max v/c	108.2	1.44	F*	90.7	1.40	F*	47.1	0.94	D	42.0	0.90	D	46.1	0.92	D	43.2	0.91	D
Actuated Signal Cycle Length		140			120			140			140			140			140	
Pilikana Street & Honoapiilani Highway																		
EB LT	69.9	0.73	E	54.3	0.49	D	69.9	0.73	E	65.1	0.53	E	69.9	0.73	E	76.5	0.57	E
EB RT	0.1	0.07	A	0.2	0.04	A	0.1	0.07	A	52.1	0.04	D	0.1	0.07	A	61.0	0.04	E
NB LT	7.1	0.12	A	42.6	0.81	D	4.9	0.08	A	11.6	0.26	B	4.1	0.08	A	6.4	0.25	A
NB TH	147.0	1.31	F*	95.7	1.19	F*	11.4	0.92	B	10.1	0.87	B	11.9	0.92	B	6.1	0.86	A
SB TH	10.9	0.75	B	50.8	1.09	D*	3.5	0.60	A	6.0	0.74	A	3.7	0.60	A	10.0	0.72	A
SB RT	2.6	0.04	A	2.2	0.09	A	0.0	0.04	A	0.5	0.08	A	0.0	0.04	A	0.7	0.08	A
Overall or Max v/c	92.0	1.24	F*	70.1	1.13	E*	11.4	0.89	B	6.8	0.56	A	11.7	0.89	B	10.2	0.84	B
Actuated Signal Cycle Length		140			120			140			140			140			160	
East Waiko Road, West Waiko Road, & Honoapiilani Highway																		
EB LT/TH	46.2	0.50	D	34.6	0.17	C	87.3	0.85	F	53.4	0.5	D	106.7	0.92	F	56.5	0.37	E
EB RT	35.4	0.02	D	27.9	0.02	C	42.1	0.03	D	41.2	0.02	D	43.0	0.02	D	46.4	0.02	D
WB LT/TH/RT	140.4	1.12	F*	285.7	1.51	F*	113.3	0.98	F	107.5	0.99	F	124.9	1.01	F*	92.3	0.92	F
NB LT	16.3	0.08	B	12.3	0.24	B	9.8	0.04	A	8.4	0.06	A	8.2	0.04	A	6.5	0.10	A
NB TH/RT	312.1	1.64	F*	331.7	1.69	F*	51.5	0.99	D	42.1	0.96	D	41.0	0.99	D	36.3	1.02	D*
SB LT	327.3	1.55	F*	97.1	1.08	F*	115.9	1.01	F*	88.5	0.8	F	91.1	0.96	F	85.0	0.81	F
SB TH	23.1	0.79	C	148.1	1.29	F*	9.4	0.54	A	6.8	0.76	A	9.9	0.54	A	14.4	0.75	B
SB RT	13.7	0.05	B	11.3	0.07	B	5.1	0.04	A	3.0	0.05	A	6.5	0.04	A	8.1	0.06	A
Overall or Max v/c	200.1	1.49	F*	239.8	1.62	F*	51.9	0.98	D	38.3	0.99	D	47.5	0.99	D	37.0	0.98	D
Actuated Signal Cycle Length		140			120			140			140			140			160	

Note: * = Over-capacity conditions.
** = v/c not calculated.

TABLE 7 continnued

Level of Service Summary, Base Year 2030 with Mitigative Measures, Alternative 1 and Alternative 2

	Base Year 2030 With Mitigative Measures						Alternative 1						Alternative 2					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Maui Tropical Plantation & Honoapiilani Highway & Road 1																		
	Signalized Coordinated SB: Double LT EB,WB & NB: LT,TH and RT lanes						Signalized Coordinated EB,WB,NB & SB: LT, TH and RT lanes						Signalized Coordinated EB: LT, TH and RT lanes WB: Double LT, TH, RT lanes					
EB LT	63.7	0.69	E	68.4	0.87	E	50.6	0.54	D	49.8	0.6	D	164.6	1.05	F*	96.9	0.87	F
EB TH	54.6	0.02	D	43.1	0.02	D	53.8	0.05	D	58.4	0.03	E	67	0.4	E	75.4	0.47	E
EB RT	54.6	0.02	D	43.7	0.09	D	53.7	0.02	D	58.6	0.05	E	63.2	0.02	E	70.8	0.05	E
WB LT	49.7	0.65	D	57	0.78	E	46.1	0.59	D	52.3	0.58	D	66.3	0.89	E	69	0.84	E
WB TH	46.5	0.01	D	43.1	0.02	D	50.4	0.03	D	58	0.04	E	46	0.07	D	61	0.22	E
WB RT	73.4	0.84	E	83.2	0.91	F	51.4	0.16	D	49.1	0.17	D	47.0	0.16	D	60.5	0.17	E
NB LT	84.0	0.76	F	98.1	1.00	F*	7.7	0.10	A	2.6	0.26	A	67.4	0.48	E	82.8	0.74	F
NB TH	35.7	0.89	D	78.7	1.07	E*	14.1	0.52	B	4.4	0.57	A	25.4	0.61	C	48.5	0.82	D
NB RT	12.9	0.09	B	18.0	0.35	B	8.9	0.06	A	1.2	0.21	A	0.5	0.31	A	1.3	0.53	A
SB LT	77.3	0.89	E	296.0	1.52	F*	8.2	0.25	A	6.9	0.49	A	139.5	1.03	F*	83.7	0.94	F
SB TH	28.8	0.75	C	24.5	0.87	C	12.8	0.47	B	12.4	0.44	B	23.7	0.56	C	47.6	0.56	D
SB RT	23.6	0.11	C	10.9	0.38	B	8.4	0.06	A	12.3	0.21	B	19.5	0.08	B	59.9	0.24	E
Overall or Max v/c	44.6	0.88	D	87.6	1.04	F*	22.9	0.53	C	19.2	0.58	B	43.4	0.68	D	50.0	0.82	D
Actuated Signal Cycle Length	140			120			120			140			140			160		
WRE & Honoapiilani Highway																		
							Alternative 1 Only Signalized Coordinated EB & WB: LT, shared TH/RT lanes											
EB LT							48.4	0.17	D	45.2	0.24	D						
EB TH/RT							64.9	0.4	E	67.3	0.62	E						
WB LT							51.6	0.87	D	51.5	0.87	D						
WB TH/RT							42.1	0.06	D	41.9	0.13	D						
NB LT							17.2	0.16	B	17.8	0.15	B						
NB TH							24.7	0.63	C	46.1	0.93	D						
NB RT							18.5	0.33	B	24.6	0.58	C						
SB LT							14.9	0.04	B	28.7	0.21	C						
SB TH							27.4	0.71	C	26.5	0.69	C						
SB RT							14.5	0.02	B	18.9	0.05	B						
Overall or Max v/c							31.7	0.76	C	38.4	0.89	D						
Actuated Signal Cycle Length							140			140								

Note: * = Over-capacity conditions.
** = v/c not calculated.

TABLE 7 continnued

Level of Service Summary, Base Year 2030 with Mitigative Measures, Alternative 1 and Alternative 2

	Base Year 2030 With Mitigative Measures						Alternative 1						Alternative 2					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
Kuikahi Drive & Waiale Road																		
	Signalized Coordinated WB, EB, NB& SB: LT,TH and RT lanes						Signalized Coordinated WB, EB, NB& SB: LT,TH and RT lanes						Signalized Coordinated WB, EB, NB& SB: LT,TH and RT lanes					
EB LT	19.3	0.71	B	20.1	0.44	C	26.9	0.82	C	30.7	0.57	C	26.6	0.82	C	30.2	0.50	C
EB TH	32.8	0.85	C	39.1	0.78	D	41.6	0.81	D	45.1	0.73	D	42.2	0.82	D	49.7	0.74	D
EB RT	11.7	0.07	B	15.9	0.08	B	18.0	0.07	B	21.4	0.10	C	16.0	0.07	B	22.1	0.08	C
WB LT	62.6	0.90	E	32.4	0.80	C	54.2	0.83	D	42.1	0.80	D	47.2	0.79	D	39.2	0.77	D
WB TH	26.6	0.23	C	24.4	0.23	C	46.9	0.39	D	33.5	0.28	C	43.2	0.36	D	33.7	0.28	C
WB RT	16.9	0.19	B	11.9	0.48	B	30.0	0.30	C	18.1	0.54	B	27.6	0.31	C	18.1	0.54	B
NB LT	32.6	0.22	C	39.5	0.22	D	32.7	0.38	C	35.6	0.31	D	33.4	0.39	C	34.3	0.19	C
NB TH	54.8	0.79	D	52.9	0.65	D	49.3	0.80	D	54.5	0.77	D	51.4	0.81	D	54.9	0.77	D
NB RT	26.9	0.19	C	27.6	0.16	C	23.7	0.33	C	28.8	0.51	C	23.2	0.32	C	28.7	0.51	C
SB LT	68.1	0.89	E	74.0	0.99	E	35.2	0.71	D	71.5	0.98	E	36.7	0.72	D	69.1	0.97	E
SB TH	42.6	0.55	D	34.9	0.34	C	51.6	0.87	D	44.8	0.84	D	53.7	0.89	D	36.4	0.68	D
SB RT	29.1	0.44	C	26.2	0.52	C	13.4	0.29	B	22.9	0.43	C	14.6	0.23	B	20.9	0.31	C
Overall or Max v/c	35.6	0.90	D	33.4	0.83	C	37.6	0.80	D	38.9	0.87	D	37.6	0.81	D	37.4	0.85	D
Actuated Signal Cycle Length	140			120			140			140			140			140		
East Waiko Road & Waiale Road																		
	Roundabout Single-Lane Analysis performed using RODEL						Roundabout Single-Lane Analysis performed using RODEL						Roundabout Single-Lane Analysis performed using RODEL					
EB LT/TH/RT	27.6	0.62	D	21.0	0.54	C	29.4	0.54	D	26.4	0.45	D	29.4	0.54	D	26.4	0.45	D
WB LT/TH/RT	16.8	0.42	C	22.2	0.59	C	19.8	0.47	C	64.8	0.82	F	19.8	0.47	C	64.8	0.82	F
NB LT/TH/RT							63.6	0.78	F	36.0	0.73	E	63.6	0.78	F	36.0	0.73	E
SB LT/TH/RT	22.8	0.64	C	18.6	0.46	C	90.0	0.89	F	63.6	0.83	F	90.0	0.89	F	63.6	0.83	F
Overall or Max v/c	18.3	**	C	17.1	**	C	36.4	**	E	32.6	**	D	36.4	**	E	32.6	**	D

Note: * = Over-capacity conditions.
** = v/c not calculated.

TABLE 7 continnued

Level of Service Summary, Base Year 2030 with Mitigative Measures, Alternative 1 and Alternative 2

	Base Year 2030 With Mitigative Measures						Alternative 1						Alternative 2					
	AM			PM			AM			PM			AM			PM		
	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS	HCM Delay (sec)	v/c Ratio	LOS
East Waiko Road & Waiale Road - Alternate intersection control																		
	Signalized Uncoordinated WB: TH and RT lanes EB: LT and TH lanes SB: LT and RT lanes						Signalized Uncoordinated NB & WB: LT, TH and RT lanes EB & SB: LT and shared TH/RT lanes						Signalized Uncoordinated NB & WB: LT, TH and RT lanes EB & SB: LT and shared TH/RT lanes					
EB LT	23.0	0.73	C	28.0	0.76	C	34.1	0.03	C	30.1	0.06	C	34.1	0.03	C	29.9	0.06	C
EB TH	17.0	0.50	B	9.0	0.28	A												
EB TH/RT							52.1	0.80	D	41.0	0.68	D	52.1	0.80	D	42.5	0.72	D
WB LT							45.1	0.72	D	39.6	0.86	D	45.1	0.72	D	42.3	0.87	D
WB TH	32.5	0.64	C	41.7	0.82	D	31.6	0.12	C	23.1	0.21	C	31.6	0.12	C	23.0	0.20	C
WB RT	26.5	0.21	C	29.0	0.45	C	32.2	0.18	C	22.9	0.17	C	32.2	0.18	C	22.7	0.18	C
NB LT							28.1	0.04	C	20.9	0.04	C	28.1	0.04	C	21.4	0.05	C
NB TH							51.8	0.87	D	39.1	0.84	D	51.8	0.87	D	40.3	0.85	D
NB RT							29.9	0.16	C	22.6	0.20	C	29.9	0.16	C	23.1	0.20	C
SB LT	32.9	0.91	C	47.5	0.86	D	53.6	0.92	D	34.3	0.82	C	53.6	0.92	D	37.6	0.84	D
SB TH/RT							16.7	0.50	B	22.2	0.65	C	16.7	0.50	B	22.8	0.65	C
SB RT	12.1	0.14	B	26.5	0.16	C												
Overall or Max v/c	26.2	0.81	C	32.4	0.79	C	40.6	0.86	D	31.6	0.80	C	40.6	0.86	D	32.9	0.81	C
Actuated Signal Cycle Length	80			102			118			97			118			98		
East Waiko Road & Kuihelani Highway																		
	EB: Double LT						EB: Double LT						EB: Double LT					
EB LT	34.6	0.66	C	50.3	0.76	D	20.2	0.69	C	31.6	0.74	C	19.5	0.68	B	40.0	0.79	D
EB RT	47.5	0.95	D	18.2	0.50	B	17.6	0.74	B	13.4	0.22	B	16.7	0.73	B	10.8	0.23	B
NB LT	46.0	0.14	D	54.3	0.88	D	32.7	0.26	C	36.1	0.66	D	32.2	0.26	C	53.8	0.92	D
NB TH	13.2	0.28	B	7.2	0.41	A	12.1	0.33	B	8.1	0.47	A	12.3	0.33	B	7.7	0.45	A
SB TH	28.4	0.54	C	34.4	0.71	C	21.4	0.61	C	20.2	0.65	C	22.1	0.63	C	33.5	0.81	C
SB RT	3.3	0.32	A	14.2	0.62	B	1.7	0.34	A	5.1	0.49	A	1.7	0.34	A	16.8	0.76	B
Overall or Max v/c	28.3	0.77	C	26.6	0.78	C	15.9	0.69	B	16.3	0.68	B	15.8	0.69	B	25.8	0.83	C
Actuated Signal Cycle Length	120			120			73			81			73			95		

Note: * = Over-capacity conditions.
** = v/c not calculated.

V. CONCLUSIONS

Existing Conditions

Currently, traffic within the study area runs relatively smoothly along Honoapiilani Highway and Kuihelani Highway. However, during the AM peak hour of traffic, congestion occurs in the northbound direction headed towards Wailuku; the queue was observed to extend to Kehalani Mauka Parkway.

The all-way stop controlled (AWSC) Kuikahi Drive/Waiale Road intersection was the only intersection with movements analyzed as having LOS F; this occurred for the eastbound shared left-turn/right-turn. However, during our field investigation, its queues and delays were observed to be minimal despite a steady flow of traffic from the eastbound approach.

At the East Waiko Road/Kuihelani Highway intersection, a 20-vehicle queue was observed to form in the eastbound left-turn movement due to its high-volume, single-lane operation. This queue began to form at 6:50 AM, and had dispersed by 7:00 AM. The queue did not appear to have any regional implications; the congestion was localized and based on demand fluctuation.

Base Year 2030

Traffic demand will increase significantly, primarily as a result of the new and/or continuing development of:

- Waikapu Country Town (planning phase)
- Maui Lani (partially constructed)
- Kehalani (partially constructed)
- Waiale (not started)
- Puunani Residences (not started)

Development will also occur in Kahului and other parts of the island. It is assumed that the new developments will need to provide new roadways with access to Kuihelani Highway, Honoapiilani Highway, and Kaahumanu Avenue (via Kamehameha Avenue).

Heavy congestion will likely occur along Honoapiilani Highway due to the increased north-south demand, and heavy concentration of turning movements at the

East Waiko Road/West Waiko Road/Honoapiiani Highway and Kuikahi Drive/Honoapiilani Highway intersections, particularly from their east sides.

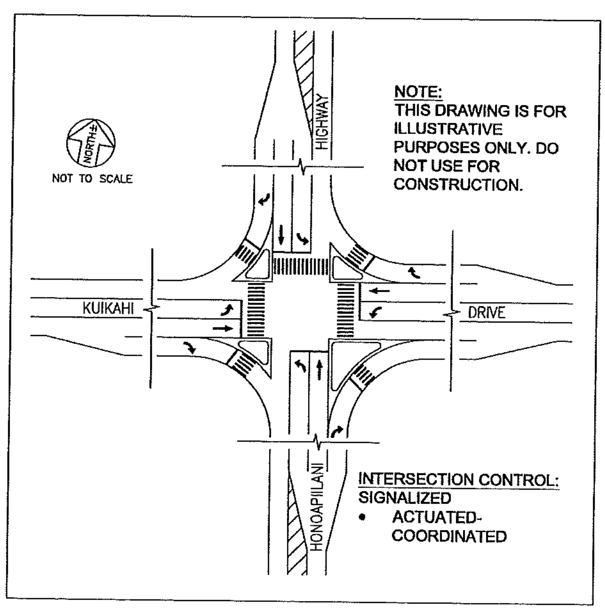
Mitigation would require widening Honoapiilani Highway beyond its existing ROW, in some cases through established communities.

Year 2030 with Project

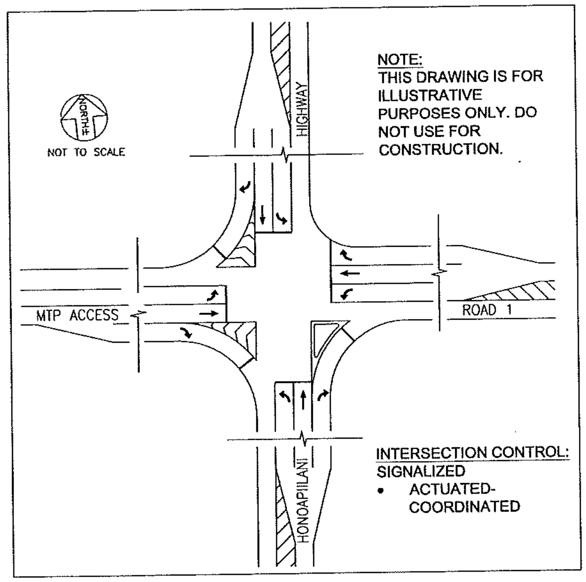
Alternative 1 is considered the "preferred alternative" based upon safety, highway and intersection operations, and accommodation of future growth (beyond the existing UGB and the year 2030). The TSM and Mass Transit alternatives were also considered; further discussion is provided in Section III.A.

VI. RECOMMENDATIONS

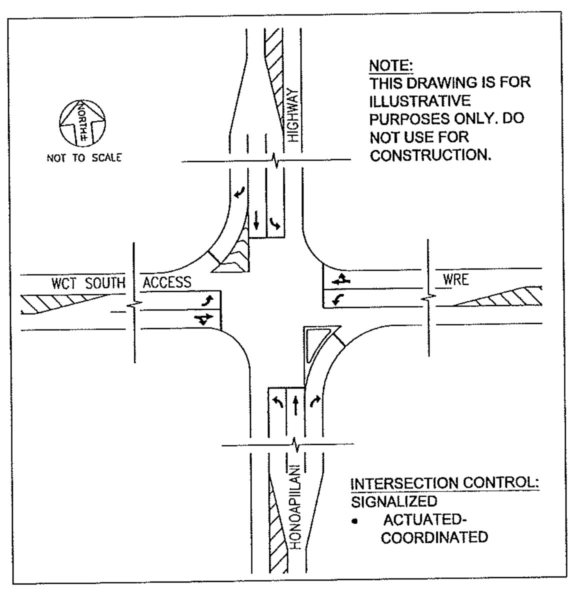
1. Implement Alternative 1 of the WRE in concert with the EWRI.
2. Acquire ROW along Honoapiilani Highway from south of East/West Waiko Road (beyond existing housing) to the Honoapiilani Highway/Kuihelani Highway intersection to eventually widen Honoapiilani Highway to four (4) lanes when it becomes necessary.
3. Modify the Honoapiilani Highway/Kuikahi Drive intersection to provide the following lane configuration:



4. Signalize the MTP Access/Road 1/Honoapiilani Highway intersection when warranted. Based upon current information[12], provide the following lane configuration:

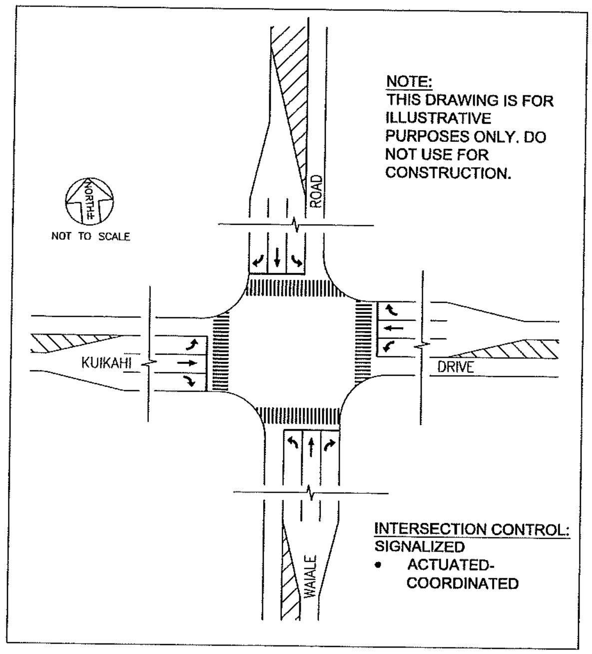


5. Signalize the WRE/Honoapiilani Highway intersection when warranted. Provide the following lane configuration:

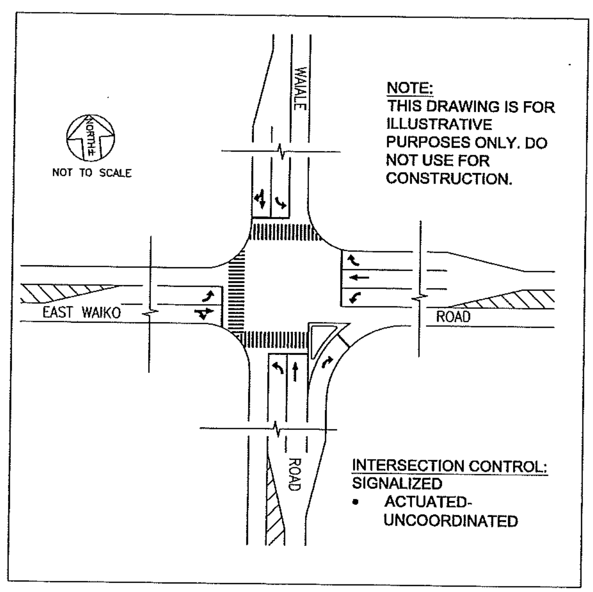


[12] The WCT has not yet gone through the entitlement process; therefore, its final site plan, unit counts, and number and locations of the roadway connections are currently not known.

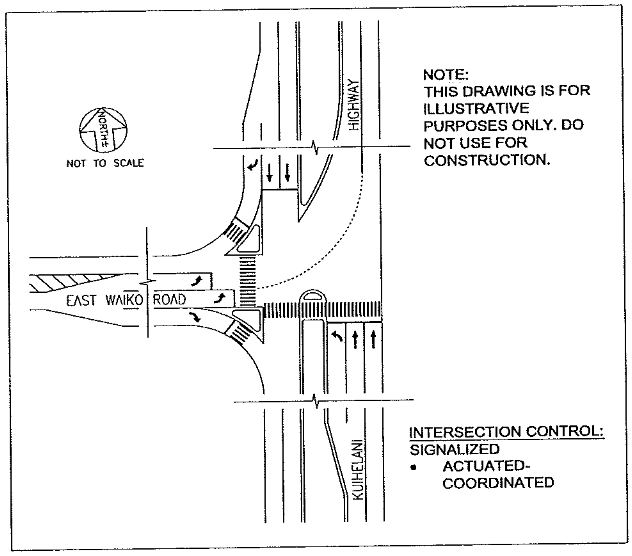
6. Modify the Kuikahi Drive/Waiale Road intersection to provide the following lane configuration:



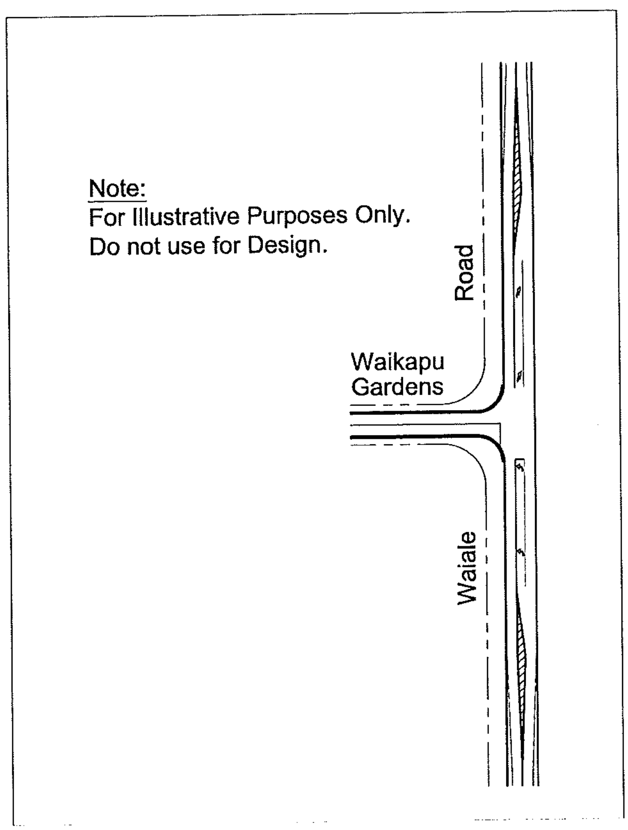
7. Signalize the Waiale Road/East Waiko Road intersection when warranted. Provide the following lane configuration:



8. Modify the East Waiko Road/Kuihelani Highway intersection to provide the following lane configuration:



9. Construct median acceleration and deceleration lanes along Waiale Road at its intersections with Kokololio Street, Haawi Street, and Nokekula Street.



VII. REFERENCES

1. Directed Growth Areas Listing and Units, Maui County Department of Planning, October 1, 2009.

2. Draft Maui Island Plan, 2009.

3. Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Including Revision 1, 2004.

4. Federal Highway Administration, Mini-Roundabouts, 2010.

5. Institute of Transportation Engineers, Trip Generation, 8th Edition, 1997.

6. Parsons Brinckerhoff Quade & Douglas, Inc., Maui Lani 100 VMX/Affordable Housing Development, 2004.

7. Parsons Brinckerhoff Quade & Douglas, Inc., Maui Lani Development Master Plan, 2002.

8. Phillip Rowell and Associates, Waikapu Affordable Housing Project, 2004.

9. Transportation Research Board, Highway Capacity Manual, 2000.

10. Website: http://www.vanpoolhawaii.com/vanpool/about_us.htm.

APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

Austin, Tsutsumi and Associates
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817
ph: 533-3646 Fax: 526-1267

File Name : Honoapiilani - Kuikahi AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Kuikahi From East				Honoapiilani From South				Kuikahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	2	82	4	0	4	3	39	0	68	38	1	0	13	10	6	0	270
06:45	5	92	8	0	8	6	31	0	50	55	7	0	22	27	7	0	318
Total	7	174	12	0	12	9	70	0	118	93	8	0	35	37	13	0	588
07:00	5	79	6	0	6	8	49	0	46	59	4	0	12	24	10	0	308
07:15	1	85	17	0	11	6	45	0	76	110	3	0	13	47	21	0	435
07:30	4	76	16	0	10	4	76	0	105	140	6	0	20	38	22	0	517
07:45	7	94	7	0	11	14	76	0	88	101	10	0	13	16	7	0	444
Total	17	334	46	0	38	32	246	0	315	410	23	0	58	125	60	0	1704
08:00	0	79	10	0	8	11	49	0	55	94	8	0	15	23	8	0	360
08:15	3	61	1	0	3	7	40	0	53	84	8	0	13	13	6	0	292
Grand Total	27	648	69	0	61	59	405	0	541	681	47	0	121	198	87	0	2944
Apprch %	3.6	87.1	9.3	0	11.6	11.2	77.1	0	42.6	53.7	3.7	0	29.8	48.8	21.4	0	
Total %	0.9	22	2.3	0	2.1	2	13.8	0	18.4	23.1	1.6	0	4.1	6.7	3	0	
Unshifted	27	648	69	0	61	59	405	0	541	681	47	0	121	198	87	0	2944
% Unshifted	100	100	100	0	100	100	100	0	100	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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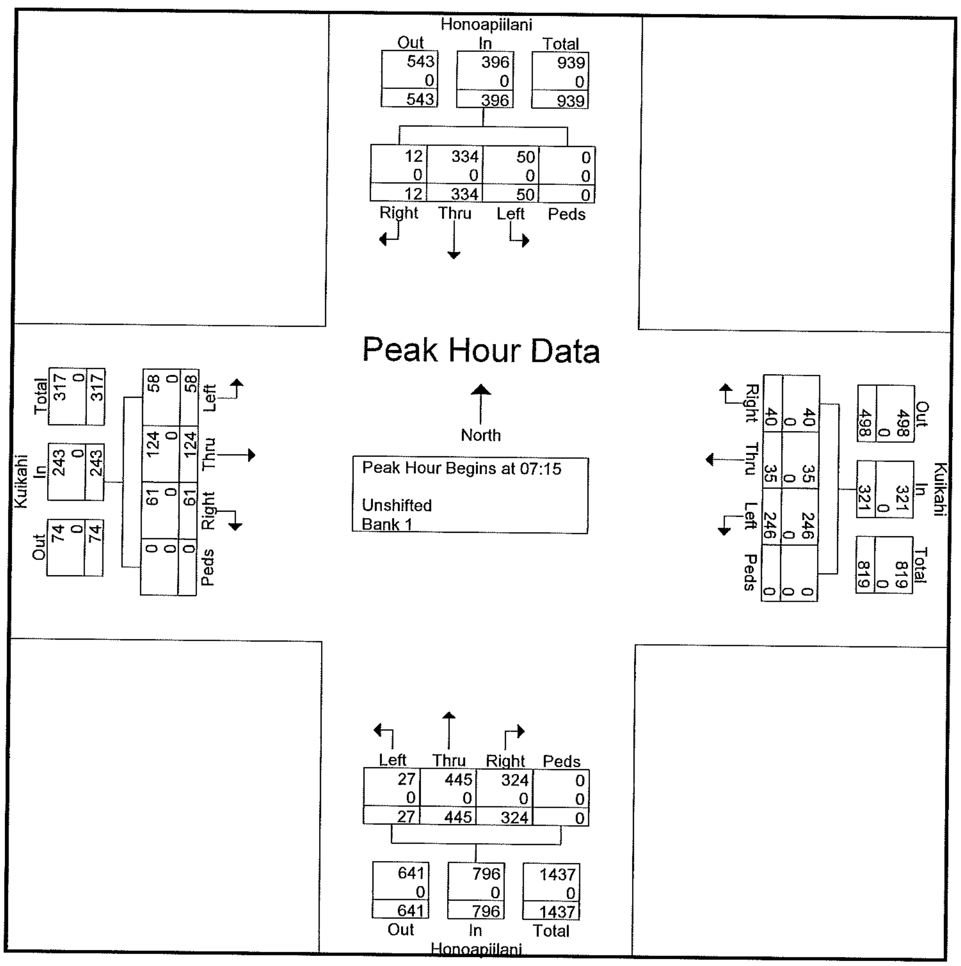
File Name : Honoapiilani - Kuikahi AM
Site Code : 00000000
Start Date : 1/28/2009

	Honoapiilani From North					Kuikahi From East					Honoapiilani From South					Kuikahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	1	85	**17**	0	103	**11**	6	45	0	62	76	110	3	0	189	13	**47**	21	0	**81**	435
07:30	4	76	16	0	96	10	4	**76**	0	90	**105**	**140**	6	0	**251**	**20**	38	**22**	0	80	**517**
07:45	**7**	**94**	7	0	**108**	11	**14**	76	0	**101**	88	101	**10**	0	199	13	16	7	0	36	444
08:00	0	79	10	0	89	8	11	49	0	68	55	94	8	0	157	15	23	8	0	46	360
Total Volume	12	334	50	0	396	40	35	246	0	321	324	445	27	0	796	61	124	58	0	243	1756
% App. Total	3	84.3	12.6	0		12.5	10.9	76.6	0		40.7	55.9	3.4	0		25.1	51	23.9	0		
PHF	.429	.888	.735	.000	.917	.909	.625	.809	.000	.795	.771	.795	.675	.000	.793	.763	.660	.659	.000	.750	.849
Unshifted	12	334	50	0	396	40	35	246	0	321	324	445	27	0	796	61	124	58	0	243	1756
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Pilikana AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Pilikana From East				Honoapiilani From South				Pilikana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	1	121	0	0	0	0	0	0	0	83	5	0	12	0	25	0	247
06:45	2	147	0	0	0	0	0	0	0	93	6	0	12	0	18	0	278
Total	3	268	0	0	0	0	0	0	0	176	11	0	24	0	43	0	525
07:00	6	135	0	0	0	0	0	0	0	91	6	0	12	0	17	0	267
07:15	2	146	0	0	0	0	0	0	0	178	6	0	20	0	26	0	378
07:30	9	155	0	0	0	0	0	0	0	210	4	0	18	0	25	0	421
07:45	13	161	0	0	0	0	0	0	0	179	6	0	8	0	16	0	383
Total	30	597	0	0	0	0	0	0	0	658	22	0	58	0	84	0	1449
08:00	12	134	0	0	0	0	0	0	0	155	5	0	6	0	12	0	324
08:15	3	112	0	0	0	0	0	0	0	123	9	0	9	0	11	0	267
Grand Total	48	1111	0	0	0	0	0	0	0	1112	47	0	97	0	150	0	2565
Apprch %	4.1	95.9	0	0	0	0	0	0	0	95.9	4.1	0	39.3	0	60.7	0	
Total %	1.9	43.3	0	0	0	0	0	0	0	43.4	1.8	0	3.8	0	5.8	0	
Unshifted	48	1111	0	0	0	0	0	0	0	1112	47	0	97	0	150	0	2565
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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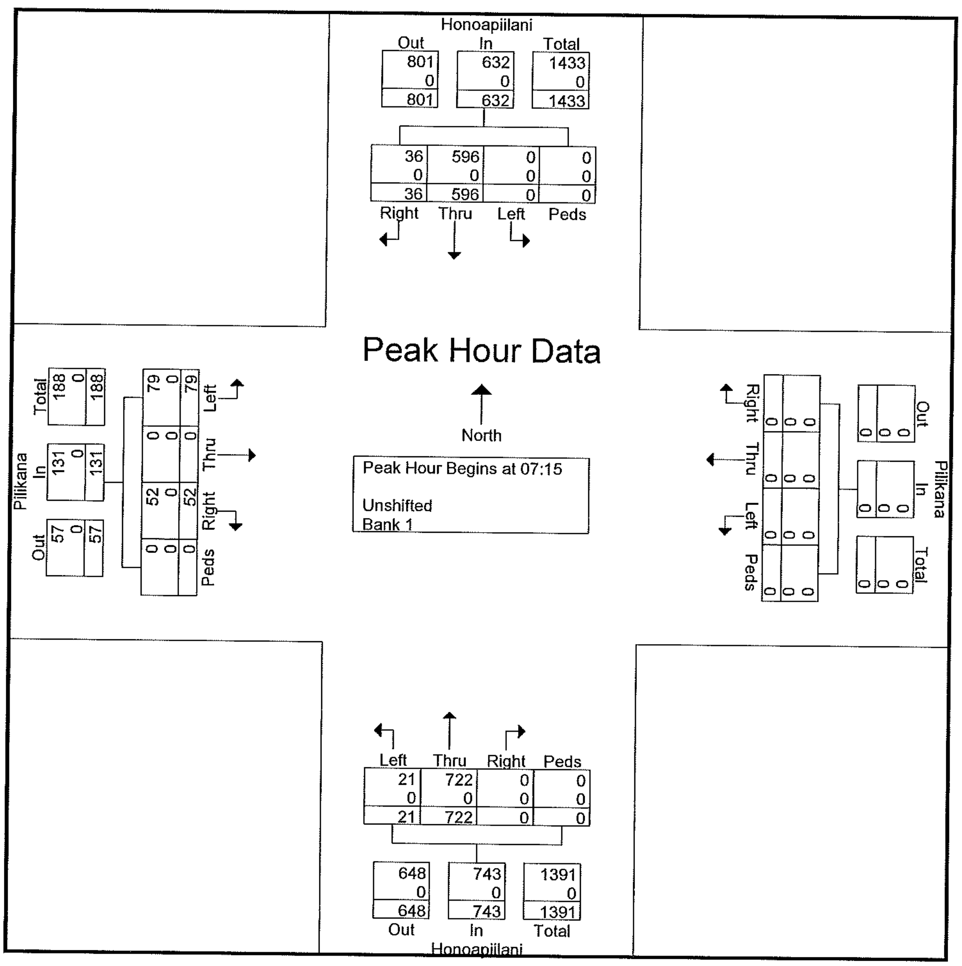
File Name : Honoapiilani - Pilikana AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 2

	Honoapiilani From North					Pilikana From East					Honoapiilani From South					Pilikana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	2	146	0	0	148	0	0	0	0	0	0	178	**6**	0	184	**20**	0	**26**	0	**46**	378
07:30	9	155	0	0	164	0	0	0	0	0	0	**210**	4	0	**214**	18	0	25	0	43	**421**
07:45	**13**	**161**	0	0	**174**	0	0	0	0	0	0	179	6	0	185	8	0	16	0	24	383
08:00	12	134	0	0	146	0	0	0	0	0	0	155	5	0	160	6	0	12	0	18	324
Total Volume	36	596	0	0	632	0	0	0	0	0	0	722	21	0	743	52	0	79	0	131	1506
% App. Total	5.7	94.3	0	0		0	0	0	0		0	97.2	2.8	0		39.7	0	60.3	0		
PHF	.692	.925	.000	.000	.908	.000	.000	.000	.000	.000	.000	.860	.875	.000	.868	.650	.000	.760	.000	.712	.894
Unshifted	36	596	0	0	632	0	0	0	0	0	0	722	21	0	743	52	0	79	0	131	1506
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Waiko From East				Honoapiilani From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	1	116	13	0	8	1	11	0	4	79	0	0	2	3	2	0	240
06:45	0	136	27	0	12	1	15	0	12	83	0	0	2	2	4	1	295
Total	1	252	40	0	20	2	26	0	16	162	0	0	4	5	6	1	535
07:00	4	114	23	0	12	4	22	0	12	81	0	0	2	3	4	0	281
07:15	2	133	27	0	13	1	15	0	11	168	0	0	3	5	12	0	390
07:30	3	141	37	0	25	2	14	0	15	178	2	0	2	4	1	1	425
07:45	3	146	21	0	28	1	14	0	7	158	1	0	0	3	5	0	387
Total	12	534	108	0	78	8	65	0	45	585	3	0	7	15	22	1	1483
08:00	7	125	12	0	15	0	9	0	10	139	2	0	2	5	4	0	330
08:15	1	106	9	0	13	1	13	1	6	115	0	0	1	2	6	0	274
Grand Total	21	1017	169	0	126	11	113	1	77	1001	5	0	14	27	38	2	2622
Apprch %	1.7	84.3	14	0	50.2	4.4	45	0.4	7.1	92.4	0.5	0	17.3	33.3	46.9	2.5	
Total %	0.8	38.8	6.4	0	4.8	0.4	4.3	0	2.9	38.2	0.2	0	0.5	1	1.4	0.1	
Unshifted	21	1017	169	0	126	11	113	1	77	1001	5	0	14	27	38	2	2622
% Unshifted	100	100	100	0	100	100	100	100	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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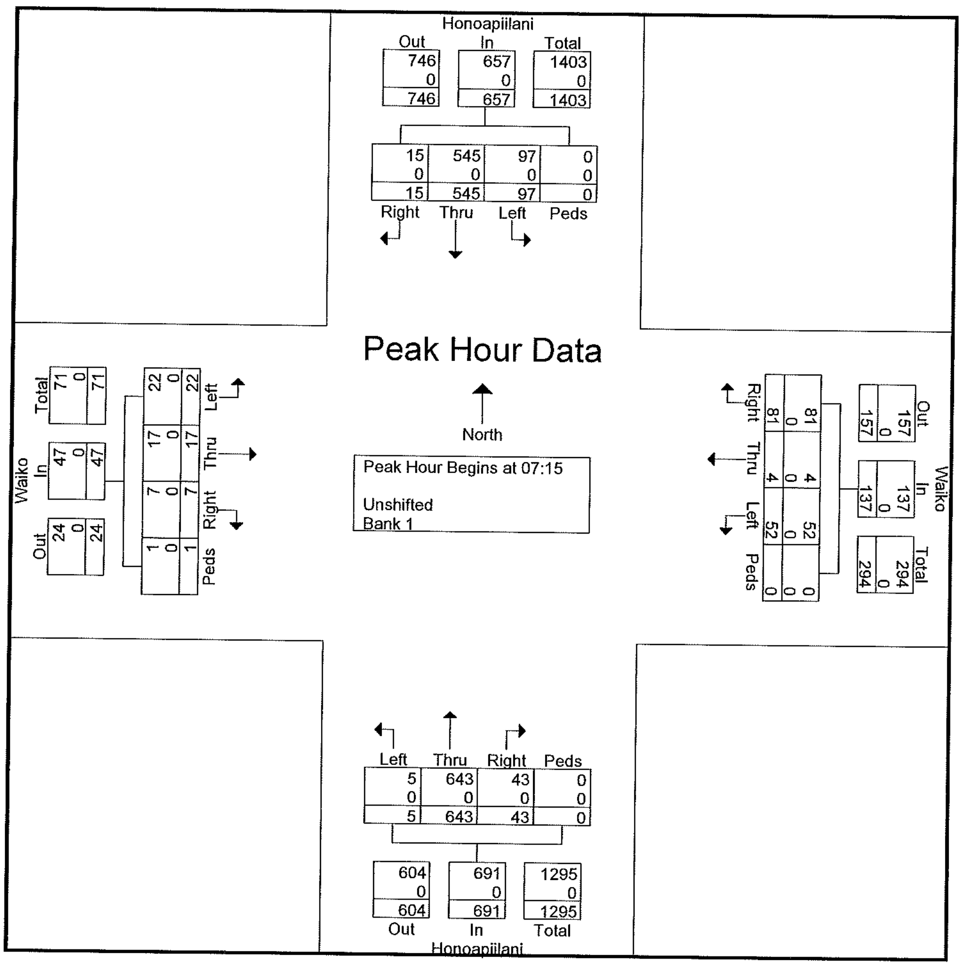
File Name : Honoapiilani - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009

	Honoapiilani From North					Waiko From East					Honoapiilani From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	2	133	27	0	162	13	1	**15**	0	29	11	168	0	0	179	**3**	**5**	**12**	0	**20**	390
07:30	3	141	**37**	0	**181**	25	**2**	14	0	41	**15**	**178**	**2**	0	**195**	2	4	1	**1**	8	**425**
07:45	3	**146**	21	0	170	**28**	1	14	0	**43**	7	158	1	0	166	0	3	5	0	8	387
08:00	**7**	125	12	0	144	15	0	9	0	24	10	139	2	0	151	2	5	4	0	11	330
Total Volume	15	545	97	0	657	81	4	52	0	137	43	643	5	0	691	7	17	22	1	47	1532
% App. Total	2.3	83	14.8	0		59.1	2.9	38	0		6.2	93.1	0.7	0		14.9	36.2	46.8	2.1		
PHF	.536	.933	.655	.000	.907	.723	.500	.867	.000	.797	.717	.903	.625	.000	.886	.583	.850	.458	.250	.588	.901
Unshifted	15	545	97	0	657	81	4	52	0	137	43	643	5	0	691	7	17	22	1	47	1532
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Plantation AM
Site Code : 00000000
Start Date : 1/28/2009

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Maui Tropical Plantation Driveway From East				Honoapiilani From South				Maui Tropical Plantation Driveway From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	1	132	0	0	0	0	0	0	0	85	0	0	0	0	0	0	218
06:45	2	145	0	0	0	0	0	0	0	80	0	0	0	0	1	0	228
Total	3	277	0	0	0	0	0	0	0	165	0	0	0	0	1	0	446
07:00	2	138	0	0	0	0	0	0	0	97	0	0	0	0	1	0	238
07:15	1	157	0	0	0	0	0	0	0	156	1	0	0	0	0	0	315
07:30	1	145	0	0	0	0	0	0	0	179	1	0	1	0	1	0	328
07:45	2	151	0	0	0	0	0	0	0	162	0	0	0	0	0	0	315
Total	6	591	0	0	0	0	0	0	0	594	2	0	1	0	2	0	1196
08:00	2	140	0	0	0	0	0	0	0	142	0	0	1	0	0	0	285
08:15	3	119	0	0	0	0	0	0	0	119	0	0	0	0	2	0	243
Grand Total	14	1127	0	0	0	0	0	0	0	1020	2	0	2	0	5	0	2170
Apprch %	1.2	98.8	0	0	0	0	0	0	0	99.8	0.2	0	28.6	0	71.4	0	
Total %	0.6	51.9	0	0	0	0	0	0	0	47	0.1	0	0.1	0	0.2	0	
Unshifted	14	1127	0	0	0	0	0	0	0	1020	2	0	2	0	5	0	2170
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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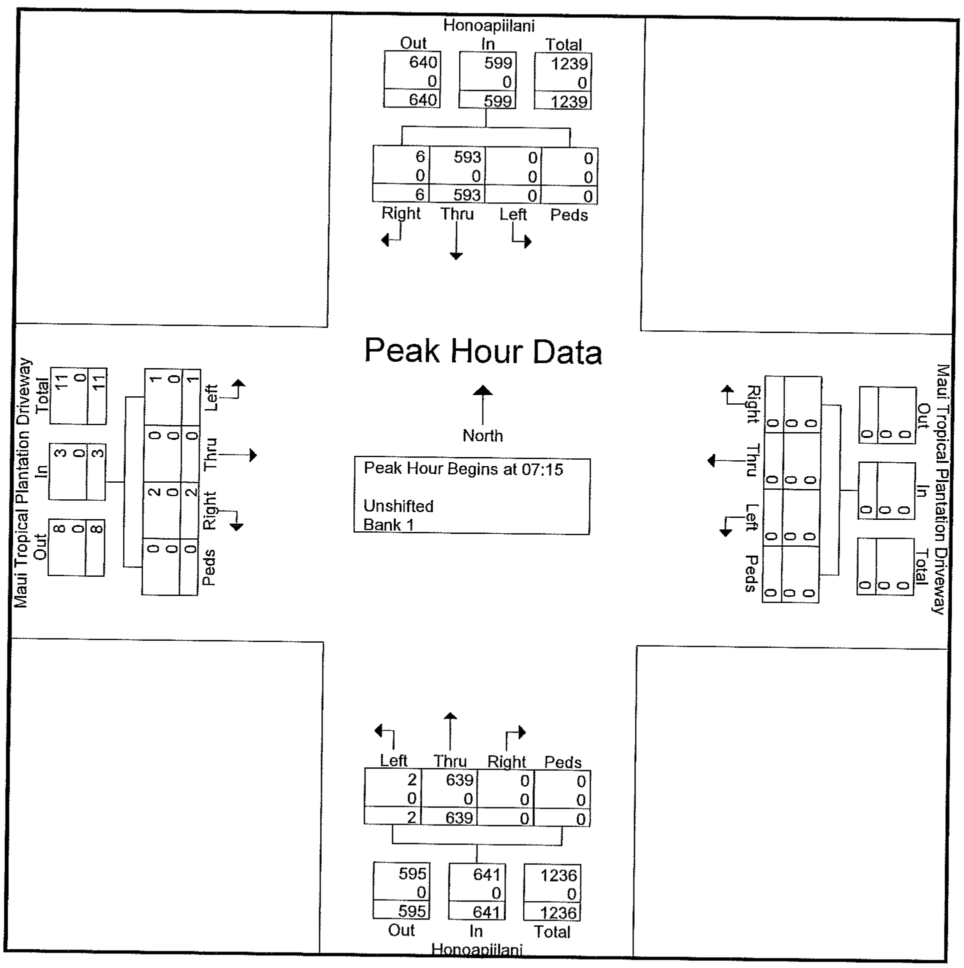
File Name : Honoapiilani - Plantation AM
Site Code : 00000000
Start Date : 1/28/2009

	Honoapiilani From North					Maui Tropical Plantation Driveway From East					Honoapiilani From South					Maui Tropical Plantation Driveway From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	1	**157**	0	0	**158**	0	0	0	0	0	0	156	**1**	0	157	0	0	0	0	0	315
07:30	1	145	0	0	146	0	0	0	0	0	0	**179**	1	0	**180**	**1**	0	**1**	0	**2**	**328**
07:45	**2**	151	0	0	153	0	0	0	0	0	0	162	0	0	162	0	0	0	0	0	315
08:00	2	140	0	0	142	0	0	0	0	0	0	142	0	0	142	1	0	0	0	1	285
Total Volume	6	593	0	0	599	0	0	0	0	0	0	639	2	0	641	2	0	1	0	3	1243
% App. Total	1	99	0	0		0	0	0	0		0	99.7	0.3	0		66.7	0	33.3	0		
PHF	.750	.944	.000	.000	.948	.000	.000	.000	.000	.000	.000	.892	.500	.000	.890	.500	.000	.250	.000	.375	.947
Unshifted	6	593	0	0	599	0	0	0	0	0	0	639	2	0	641	2	0	1	0	3	1243
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Golf Course AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				King Kamehameha GC Driveway From East				Honoapiilani From South				King Kamehameha GC Driveway From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	1	115	0	0	0	0	0	0	0	85	4	0	0	0	0	0	205
06:45	3	149	0	0	0	0	0	0	0	74	3	0	0	0	0	0	229
Total	4	264	0	0	0	0	0	0	0	159	7	0	0	0	0	0	434
07:00	1	143	0	0	0	0	0	0	0	102	1	0	1	0	0	0	248
07:15	2	156	0	0	0	0	0	0	0	158	2	0	0	0	0	0	318
07:30	2	137	0	0	0	0	0	0	0	177	4	0	0	0	0	0	320
07:45	4	140	0	0	0	0	0	0	0	156	8	0	0	0	1	0	309
Total	9	576	0	0	0	0	0	0	0	593	15	0	1	0	1	0	1195
08:00	3	144	0	0	0	0	0	0	0	127	5	0	0	0	0	0	279
08:15	4	111	0	0	0	0	0	0	0	110	6	0	0	0	0	0	231
Grand Total	20	1095	0	0	0	0	0	0	0	989	33	0	1	0	1	0	2139
Apprch %	1.8	98.2	0	0	0	0	0	0	0	96.8	3.2	0	50	0	50	0	
Total %	0.9	51.2	0	0	0	0	0	0	0	46.2	1.5	0	0	0	0	0	
Unshifted	20	1095	0	0	0	0	0	0	0	989	33	0	1	0	1	0	2139
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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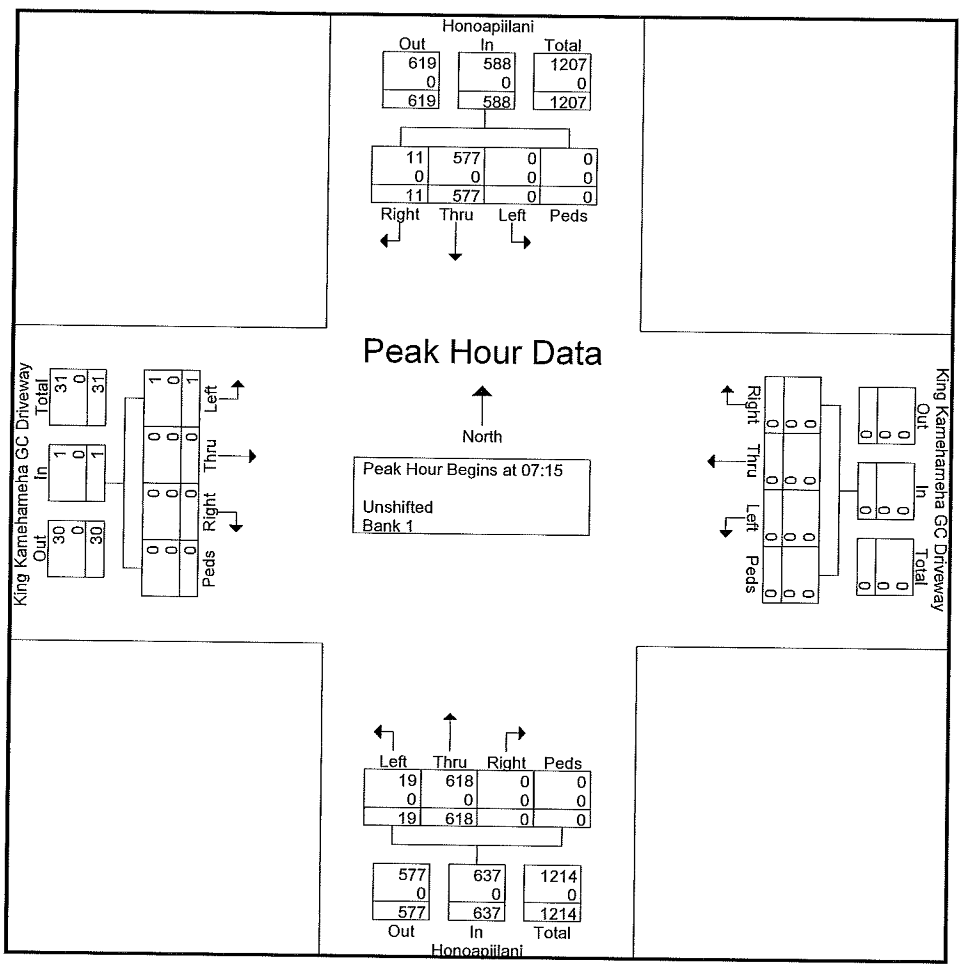
File Name : Honoapiilani - Golf Course AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 2

Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 07:15

	Honoapiilani From North					King Kamehameha GC Driveway From East					Honoapiilani From South					King Kamehameha GC Driveway From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:15	2	**156**	0	0	**158**	0	0	0	0	0	0	158	2	0	160	0	0	0	0	0	318
07:30	2	137	0	0	139	0	0	0	0	0	0	**177**	4	0	**181**	0	0	0	0	0	**320**
07:45	**4**	140	0	0	144	0	0	0	0	0	0	156	**8**	0	164	0	0	**1**	0	**1**	309
08:00	3	144	0	0	147	0	0	0	0	0	0	127	5	0	132	0	0	0	0	0	279
Total Volume	11	577	0	0	588	0	0	0	0	0	0	618	19	0	637	0	0	1	0	1	1226
% App. Total	1.9	98.1	0	0		0	0	0	0		0	97	3	0		0	0	100	0		
PHF	.688	.925	.000	.000	.930	.000	.000	.000	.000	.000	.000	.873	.594	.000	.880	.000	.000	.250	.000	.250	.958
Unshifted	11	577	0	0	588	0	0	0	0	0	0	618	19	0	637	0	0	1	0	1	1226
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Waiale - Kuikahi AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Waiale From North				Kuikahi From East				Waiale From South				Kuikahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	41	25	0	0	0	0	0	0	0	32	9	0	6	0	74	0	187
06:45	33	25	0	0	0	0	0	0	0	34	11	0	12	0	72	0	187
Total	74	50	0	0	0	0	0	0	0	66	20	0	18	0	146	0	374
07:00	58	30	0	0	0	0	0	0	0	40	7	0	8	0	67	0	210
07:15	58	27	0	0	0	0	0	0	0	57	12	0	11	0	127	0	292
07:30	77	42	0	0	0	0	0	0	0	73	7	0	6	0	146	0	351
07:45	87	33	0	0	0	0	0	0	0	44	9	0	7	0	109	0	289
Total	280	132	0	0	0	0	0	0	0	214	35	0	32	0	449	0	1142
08:00	54	21	0	0	0	0	0	0	0	34	11	0	11	0	77	0	208
08:15	45	26	1	0	0	0	0	0	0	18	4	0	3	0	65	0	162
Grand Total	453	229	1	0	0	0	0	0	0	332	70	0	64	0	737	0	1886
Apprch %	66.3	33.5	0.1	0	0	0	0	0	0	82.6	17.4	0	8	0	92	0	
Total %	24	12.1	0.1	0	0	0	0	0	0	17.6	3.7	0	3.4	0	39.1	0	
Unshifted	453	229	1	0	0	0	0	0	0	332	70	0	64	0	737	0	1886
% Unshifted	100	100	100	0	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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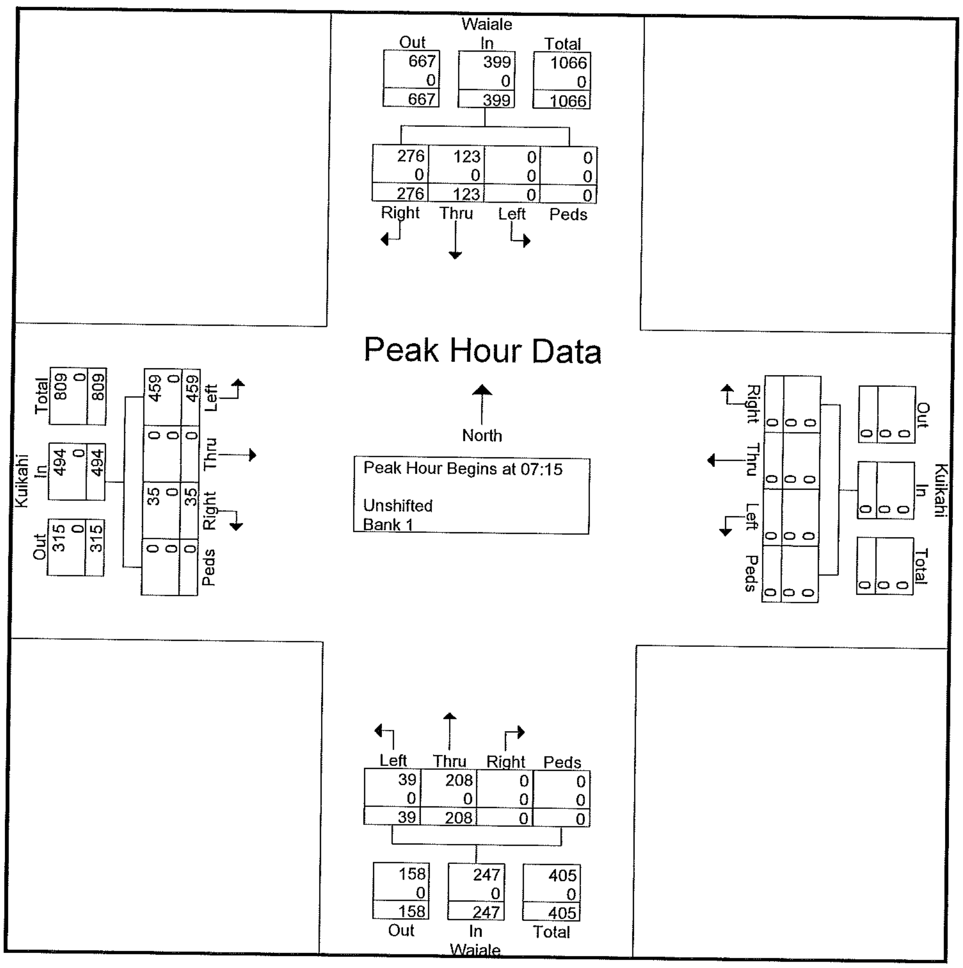
File Name : Waiale - Kuikahi AM
Site Code : 00000000
Start Date : 1/28/2009

	Waiale From North					Kuikahi From East					Waiale From South					Kuikahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	58	27	0	0	85	0	0	0	0	0	0	57	**12**	0	69	**11**	0	127	0	138	292
07:30	77	**42**	0	0	119	0	0	0	0	0	0	**73**	7	0	**80**	6	0	**146**	0	**152**	**351**
07:45	**87**	33	0	0	**120**	0	0	0	0	0	0	44	9	0	53	7	0	109	0	116	289
08:00	54	21	0	0	75	0	0	0	0	0	0	34	11	0	45	11	0	77	0	88	208
Total Volume	276	123	0	0	399	0	0	0	0	0	0	208	39	0	247	35	0	459	0	494	1140
% App. Total	69.2	30.8	0	0		0	0	0	0		0	84.2	15.8	0		7.1	0	92.9	0		
PHF	.793	.732	.000	.000	.831	.000	.000	.000	.000	.000	.000	.712	.813	.000	.772	.795	.000	.786	.000	.813	.812
Unshifted	276	123	0	0	399	0	0	0	0	0	0	208	39	0	247	35	0	459	0	494	1140
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Waiale - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Waiale From North				Waiko From East				Waiale From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	7	0	30	0	9	11	0	0	0	0	0	0	0	20	3	0	80
06:45	19	0	46	0	21	16	0	0	0	0	0	0	0	35	5	0	142
Total	26	0	76	0	30	27	0	0	0	0	0	0	0	55	8	0	222
07:00	23	0	55	0	17	16	0	0	0	0	0	0	0	32	4	0	147
07:15	12	0	72	0	31	16	0	0	0	0	0	0	0	39	11	0	181
07:30	12	0	68	0	44	36	0	0	0	0	0	0	0	46	8	0	214
07:45	4	0	43	0	45	37	0	0	0	0	0	0	0	33	3	0	165
Total	51	0	238	0	137	105	0	0	0	0	0	0	0	150	26	0	707
08:00	11	0	33	0	22	14	0	0	0	0	0	0	0	24	4	0	108
08:15	6	0	27	0	15	21	0	0	0	0	0	0	0	13	4	0	86
Grand Total	94	0	374	0	204	167	0	0	0	0	0	0	0	242	42	0	1123
Apprch %	20.1	0	79.9	0	55	45	0	0	0	0	0	0	0	85.2	14.8	0	
Total %	8.4	0	33.3	0	18.2	14.9	0	0	0	0	0	0	0	21.5	3.7	0	
Unshifted	94	0	374	0	204	167	0	0	0	0	0	0	0	242	42	0	1123
% Unshifted	100	0	100	0	100	100	0	0	0	0	0	0	0	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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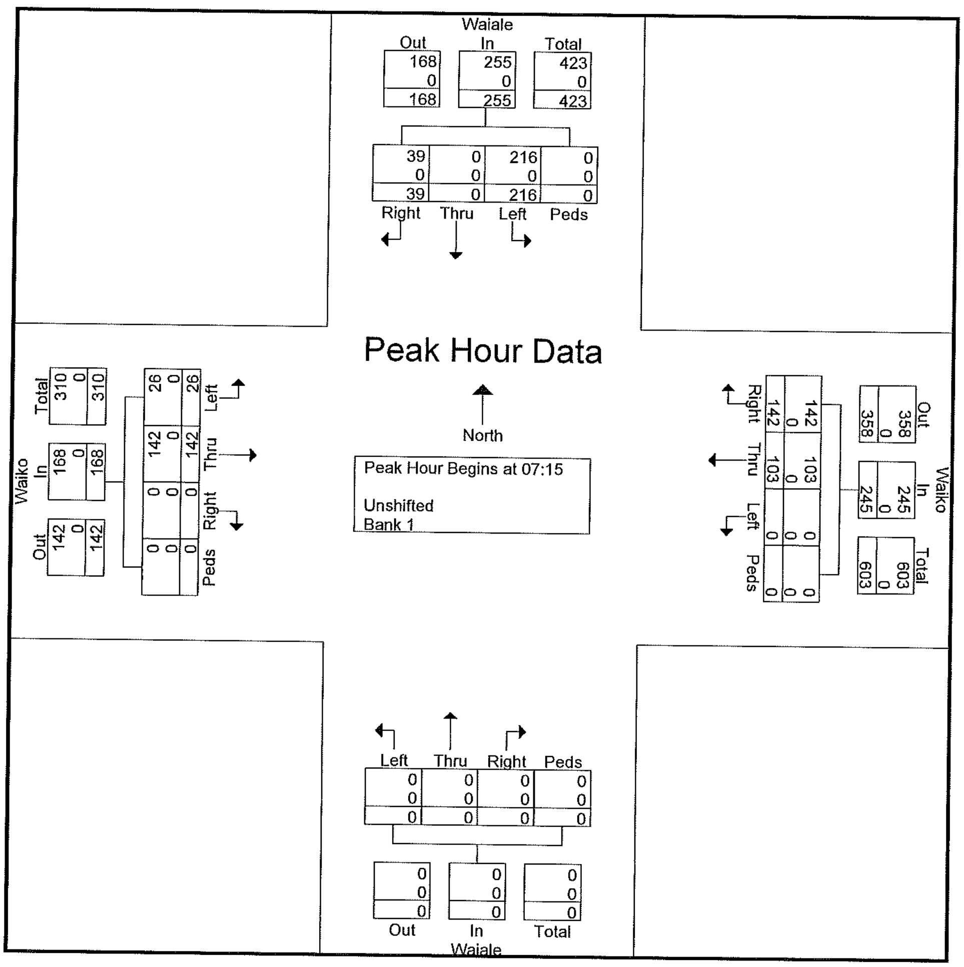
File Name : Waiale - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 2

	Waiale From North					Waiko From East					Waiale From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	**12**	0	**72**	0	**84**	31	16	0	0	47	0	0	0	0	0	0	39	**11**	0	50	181
07:30	12	0	68	0	80	44	36	0	0	80	0	0	0	0	0	0	**46**	8	0	**54**	**214**
07:45	4	0	43	0	47	**45**	**37**	0	0	**82**	0	0	0	0	0	0	33	3	0	36	165
08:00	11	0	33	0	44	22	14	0	0	36	0	0	0	0	0	0	24	4	0	28	108
Total Volume	39	0	216	0	255	142	103	0	0	245	0	0	0	0	0	0	142	26	0	168	668
% App. Total	15.3	0	84.7	0		58	42	0	0		0	0	0	0		0	84.5	15.5	0		
PHF	.813	.000	.750	.000	.759	.789	.696	.000	.000	.747	.000	.000	.000	.000	.000	.000	.772	.591	.000	.778	.780
Unshifted	39	0	216	0	255	142	103	0	0	245	0	0	0	0	0	0	142	26	0	168	668
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Kuihelani - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Kuihelani From North				Waiko From East				Kuihelani From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	28	116	0	0	0	0	0	0	0	39	0	0	1	0	39	0	223
06:45	45	120	0	0	0	0	0	0	0	40	3	0	4	0	72	1	285
Total	73	236	0	0	0	0	0	0	0	79	3	0	5	0	111	1	508
07:00	49	108	0	0	0	0	0	0	0	57	0	0	3	0	86	0	303
07:15	47	105	0	0	0	0	0	0	0	69	0	0	5	0	102	0	328
07:30	76	78	0	0	0	0	0	0	0	74	4	0	11	0	118	0	361
07:45	79	112	0	0	0	0	0	0	0	68	0	0	2	0	71	0	332
Total	251	403	0	0	0	0	0	0	0	268	4	0	21	0	377	0	1324
08:00	32	97	0	0	0	0	0	0	0	80	1	0	4	0	52	0	266
08:15	35	95	0	0	0	0	0	0	0	82	1	0	2	0	29	0	244
Grand Total	391	831	0	0	0	0	0	0	0	509	9	0	32	0	569	1	2342
Apprch %	32	68	0	0	0	0	0	0	0	98.3	1.7	0	5.3	0	94.5	0.2	
Total %	16.7	35.5	0	0	0	0	0	0	0	21.7	0.4	0	1.4	0	24.3	0	
Unshifted	391	831	0	0	0	0	0	0	0	509	9	0	32	0	569	1	2342
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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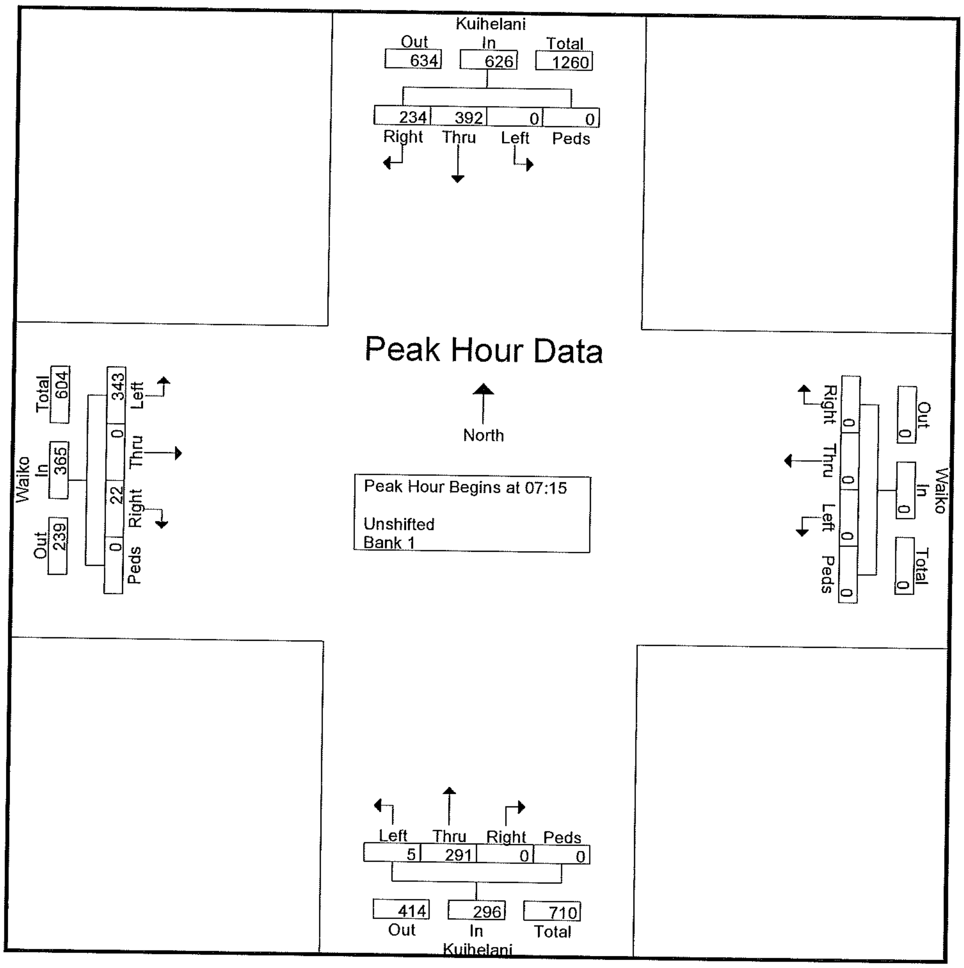
File Name : Kuihelani - Waiko AM
Site Code : 00000000
Start Date : 1/28/2009
Page No : 2

	Kuihelani From North					Waiko From East					Kuihelani From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:15 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	47	105	0	0	152	0	0	0	0	0	0	69	0	0	69	5	0	102	0	107	328
07:30	76	78	0	0	154	0	0	0	0	0	0	74	**4**	0	78	**11**	0	**118**	0	**129**	**361**
07:45	**79**	**112**	0	0	**191**	0	0	0	0	0	0	68	0	0	68	2	0	71	0	73	332
08:00	32	97	0	0	129	0	0	0	0	0	0	**80**	1	0	**81**	4	0	52	0	56	266
Total Volume	234	392	0	0	626	0	0	0	0	0	0	291	5	0	296	22	0	343	0	365	1287
% App. Total	37.4	62.6	0	0		0	0	0	0		0	98.3	1.7	0		6	0	94	0		
PHF	.741	.875	.000	.000	.819	.000	.000	.000	.000	.000	.000	.909	.313	.000	.914	.500	.000	.727	.000	.707	.891



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File Name : Honoapiilani - Kuikahi PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Kuikahi From East				Honoapiilani From South				Kuikahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:00	2	11	0	0	0	1	6	0	8	15	1	0	0	2	2	0	48
15:15	8	69	3	0	2	8	42	0	39	71	8	0	2	15	6	0	273
15:30	9	77	7	0	9	19	35	0	51	83	11	0	6	11	3	0	321
15:45	8	100	5	0	8	7	47	0	58	96	6	0	6	4	4	0	349
Total	27	257	15	0	19	35	130	0	156	265	26	0	14	32	15	0	991
16:00	8	75	8	0	3	14	63	0	64	75	10	0	5	11	6	0	342
16:15	10	75	15	0	6	19	56	0	43	90	10	0	8	16	7	0	355
16:30	8	122	11	0	4	20	61	0	39	90	15	0	7	4	6	0	387
16:45	9	98	3	0	5	22	57	0	49	77	19	0	8	9	3	0	359
Total	35	370	37	0	18	75	237	0	195	332	54	0	28	40	22	0	1443
17:00	17	96	9	0	6	22	38	0	41	90	10	0	6	11	1	0	347
Grand Total	79	723	61	0	43	132	405	0	392	687	90	0	48	83	38	0	2781
Apprch %	9.2	83.8	7.1	0	7.4	22.8	69.8	0	33.5	58.8	7.7	0	28.4	49.1	22.5	0	
Total %	2.8	26	2.2	0	1.5	4.7	14.6	0	14.1	24.7	3.2	0	1.7	3	1.4	0	
Unshifted	79	723	61	0	43	132	405	0	392	687	90	0	48	83	38	0	2781
% Unshifted	100	100	100	0	100	100	100	0	100	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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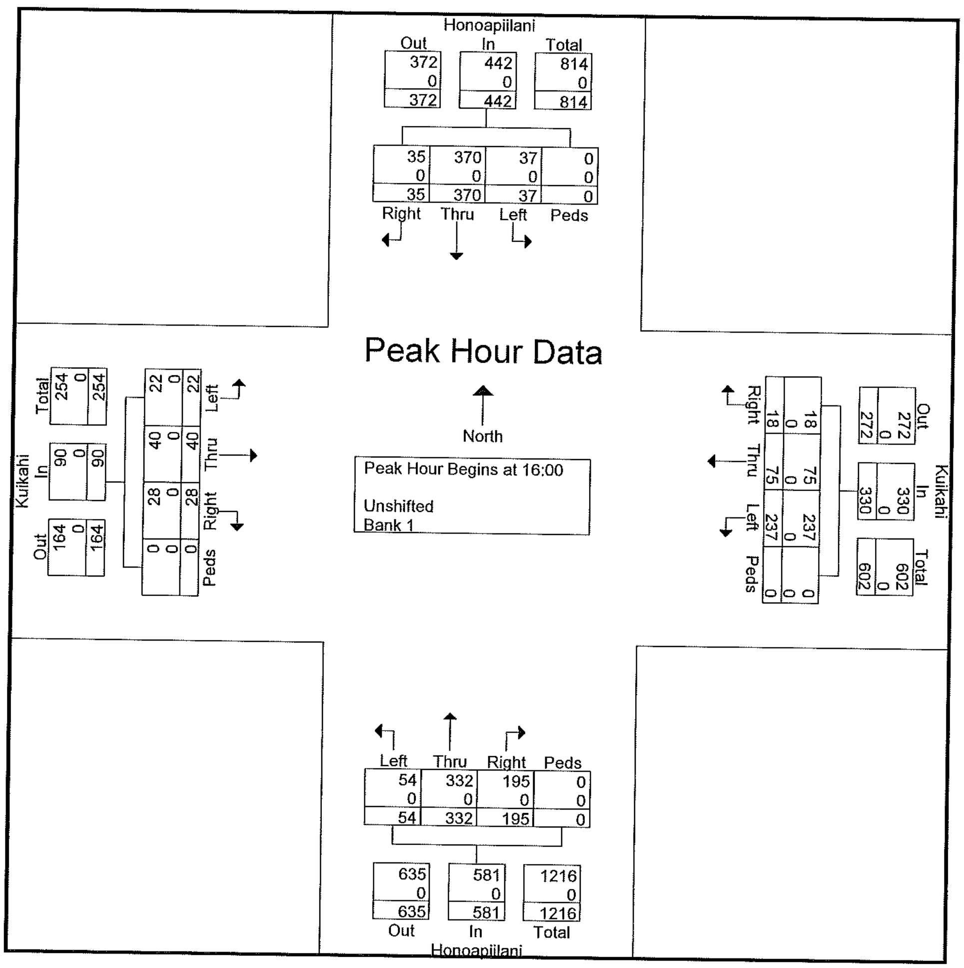
File Name : Honoapiilani - Kuikahi PM
Site Code : 00000000
Start Date : 1/27/2009

	Honoapiilani From North					Kuikahi From East					Honoapiilani From South					Kuikahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	8	75	8	0	91	3	14	**63**	0	80	**64**	75	10	0	**149**	5	11	6	0	22	342
16:15	**10**	75	**15**	0	100	**6**	19	56	0	81	43	**90**	10	0	143	**8**	**16**	**7**	0	**31**	355
16:30	8	**122**	11	0	**141**	4	20	61	0	**85**	39	90	15	0	144	7	4	6	0	17	**387**
16:45	9	98	3	0	110	5	**22**	57	0	84	49	77	**19**	0	145	8	9	3	0	20	359
Total Volume	35	370	37	0	442	18	75	237	0	330	195	332	54	0	581	28	40	22	0	90	1443
% App. Total	7.9	83.7	8.4	0		5.5	22.7	71.8	0		33.6	57.1	9.3	0		31.1	44.4	24.4	0		
PHF	.875	.758	.617	.000	.784	.750	.852	.940	.000	.971	.762	.922	.711	.000	.975	.875	.625	.786	.000	.726	.932
Unshifted	35	370	37	0	442	18	75	237	0	330	195	332	54	0	581	28	40	22	0	90	1443
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Pilikana PM
Site Code : 00000000
Start Date : 1/27/2009

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Pilikana From East				Honoapiilani From South				Pilikana From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:00	6	68	0	0	0	0	0	0	0	77	6	0	4	0	3	0	164
15:15	11	107	0	0	0	0	0	0	0	112	8	0	6	0	10	0	254
15:30	12	102	0	0	0	0	0	0	0	132	8	0	6	0	8	0	268
15:45	8	142	0	0	0	0	0	0	0	146	8	0	7	0	11	0	322
Total	37	419	0	0	0	0	0	0	0	467	30	0	23	0	32	0	1008
16:00	18	125	0	0	0	0	0	0	0	137	16	0	6	0	12	1	315
16:15	17	124	0	0	0	0	0	0	0	140	16	0	7	0	8	0	312
16:30	26	164	0	0	0	0	0	0	0	125	10	0	4	0	6	0	335
16:45	18	154	0	0	0	0	0	0	0	137	13	0	10	0	7	0	339
Total	79	567	0	0	0	0	0	0	0	539	55	0	27	0	33	1	1301
17:00	11	121	0	0	0	0	0	0	0	128	19	0	6	0	14	0	299
Grand Total	127	1107	0	0	0	0	0	0	0	1134	104	0	56	0	79	1	2608
Apprch %	10.3	89.7	0	0	0	0	0	0	0	91.6	8.4	0	41.2	0	58.1	0.7	
Total %	4.9	42.4	0	0	0	0	0	0	0	43.5	4	0	2.1	0	3	0	
Unshifted	127	1107	0	0	0	0	0	0	0	1134	104	0	56	0	79	1	2608
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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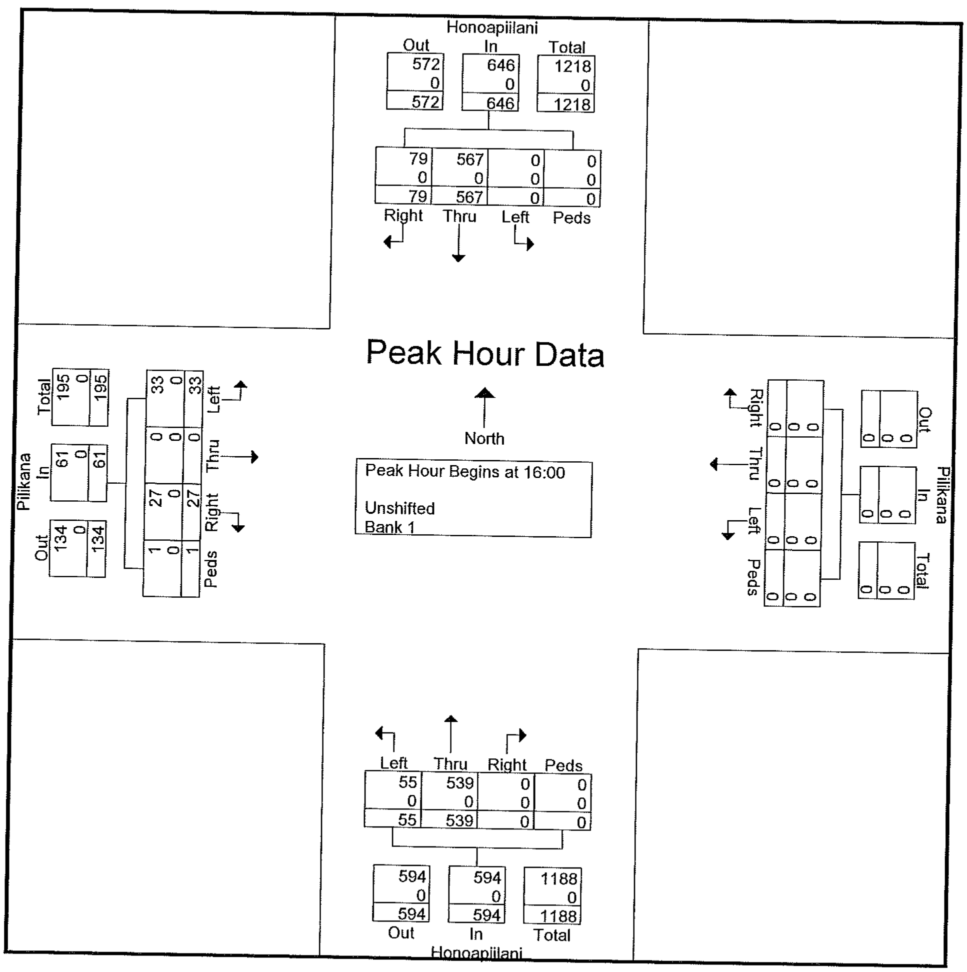
File Name : Honoapiilani - Pilikana PM
Site Code : 00000000
Start Date : 1/27/2009

	Honoapiilani From North					Pilikana From East					Honoapiilani From South					Pilikana From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	18	125	0	0	143	0	0	0	0	0	0	137	**16**	0	153	6	0	**12**	**1**	**19**	315
16:15	17	124	0	0	141	0	0	0	0	0	0	**140**	16	0	**156**	7	0	8	0	15	312
16:30	**26**	**164**	0	0	**190**	0	0	0	0	0	0	125	10	0	135	4	0	6	0	10	335
16:45	18	154	0	0	172	0	0	0	0	0	0	137	13	0	150	**10**	0	7	0	17	**339**
Total Volume	79	567	0	0	646	0	0	0	0	0	0	539	55	0	594	27	0	33	1	61	1301
% App. Total	12.2	87.8	0	0		0	0	0	0		0	90.7	9.3	0		44.3	0	54.1	1.6		
PHF	.760	.864	.000	.000	.850	.000	.000	.000	.000	.000	.000	.963	.859	.000	.952	.675	.000	.688	.250	.803	.959
Unshifted	79	567	0	0	646	0	0	0	0	0	0	539	55	0	594	27	0	33	1	61	1301
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Waiko From East				Honoapiilani From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:00	6	42	3	0	8	1	7	0	5	52	1	0	2	1	3	1	132
15:15	6	96	10	0	20	3	4	0	13	97	1	0	2	3	2	0	257
15:30	4	93	12	3	17	4	5	0	16	124	0	0	1	0	0	0	279
15:45	2	128	17	0	18	4	10	0	9	133	1	0	4	2	3	0	331
Total	18	359	42	3	63	12	26	0	43	406	3	0	9	6	8	1	999
16:00	6	115	10	0	25	1	8	0	15	127	2	0	1	0	2	0	312
16:15	2	112	10	0	27	14	9	0	7	125	2	0	5	6	4	1	324
16:30	5	147	12	0	18	3	9	0	16	110	1	0	0	2	1	0	324
16:45	7	135	21	0	26	6	13	0	8	120	2	0	4	3	1	2	348
Total	20	509	53	0	96	24	39	0	46	482	7	0	10	11	8	3	1308
17:00	5	103	17	0	29	1	6	0	13	115	3	0	2	5	4	0	303
Grand Total	43	971	112	3	188	37	71	0	102	1003	13	0	21	22	20	4	2610
Apprch %	3.8	86	9.9	0.3	63.5	12.5	24	0	9.1	89.7	1.2	0	31.3	32.8	29.9	6	
Total %	1.6	37.2	4.3	0.1	7.2	1.4	2.7	0	3.9	38.4	0.5	0	0.8	0.8	0.8	0.2	
Unshifted	43	971	112	3	188	37	71	0	102	1003	13	0	21	22	20	4	2610
% Unshifted	100	100	100	100	100	100	100	0	100	100	100	0	100	100	100	100	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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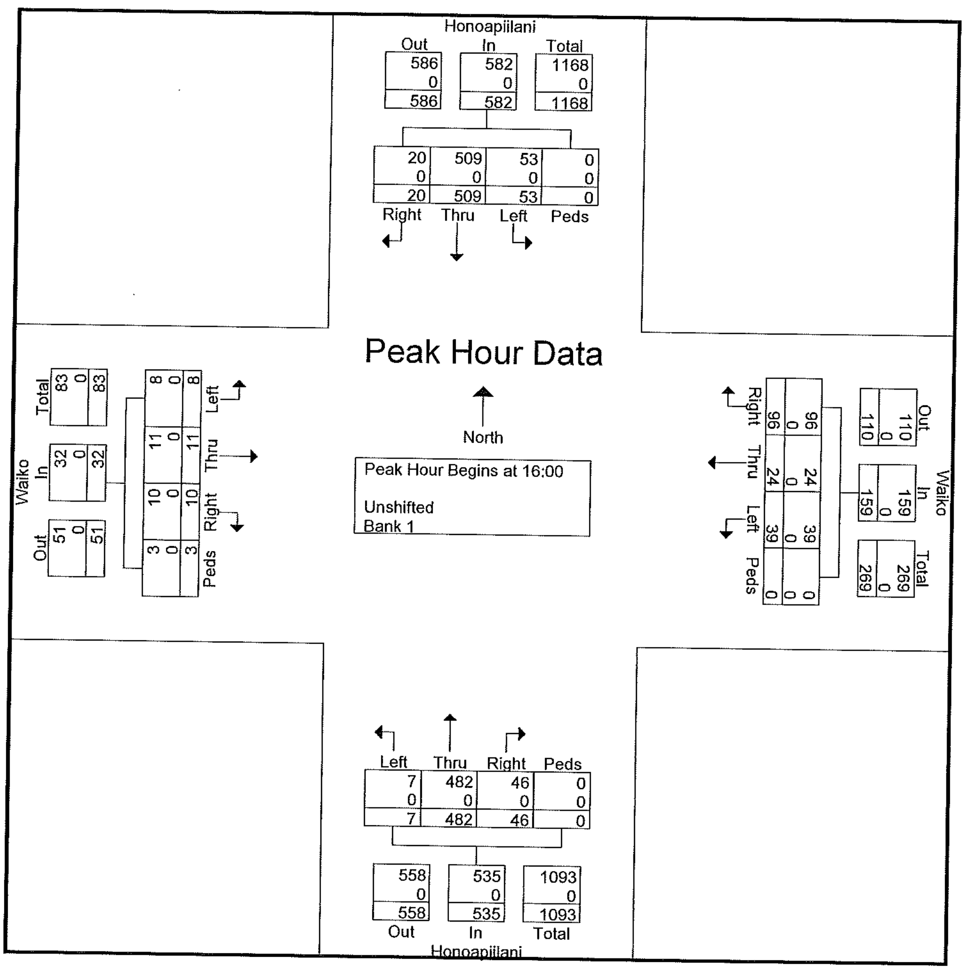
File Name : Honoapiilani - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009

	Honoapiilani From North					Waiko From East					Honoapiilani From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	6	115	10	0	131	25	1	8	0	34	15	127	2	0	144	1	0	2	0	3	312
16:15	2	112	10	0	124	27	14	9	0	50	7	125	2	0	134	5	6	4	1	16	324
16:30	5	147	12	0	164	18	3	9	0	30	16	110	1	0	127	0	2	1	0	3	324
16:45	7	135	21	0	163	26	6	13	0	45	8	120	2	0	130	4	3	1	2	10	348
Total Volume	20	509	53	0	582	96	24	39	0	159	46	482	7	0	535	10	11	8	3	32	1308
% App. Total	3.4	87.5	9.1	0		60.4	15.1	24.5	0		8.6	90.1	1.3	0		31.2	34.4	25	9.4		
PHF	.714	.866	.631	.000	.887	.889	.429	.750	.000	.795	.719	.949	.875	.000	.929	.500	.458	.500	.375	.500	.940
Unshifted	20	509	53	0	582	96	24	39	0	159	46	482	7	0	535	10	11	8	3	32	1308
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Plantation PM
Site Code : 00000000
Start Date : 1/27/2009

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				Maui Tropical Plantation Driveway From East				Honoapiilani From South				Maui Tropical Plantation Driveway From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:00	3	75	0	0	0	0	0	0	0	73	5	1	5	0	1	0	163
15:15	0	92	0	0	0	0	0	0	0	113	3	0	2	0	1	0	211
15:30	2	105	0	0	0	0	0	0	0	125	0	0	4	0	3	0	239
15:45	3	132	1	0	0	0	0	0	0	147	1	0	4	0	2	0	290
Total	8	404	1	0	0	0	0	0	0	458	9	1	15	0	7	0	903
16:00	1	116	0	0	0	0	0	0	0	142	1	0	9	0	4	0	273
16:15	3	132	0	0	0	0	0	0	0	128	3	0	5	0	1	0	272
16:30	0	139	0	0	0	0	0	0	0	134	1	0	5	0	3	0	282
16:45	1	151	0	0	0	0	0	0	0	128	1	0	0	0	0	0	281
Total	5	538	0	0	0	0	0	0	0	532	6	0	19	0	8	0	1108
17:00	1	107	0	0	0	0	0	0	0	152	0	0	2	0	0	0	262
Grand Total	14	1049	1	0	0	0	0	0	0	1142	15	1	36	0	15	0	2273
Apprch %	1.3	98.6	0.1	0	0	0	0	0	0	98.6	1.3	0.1	70.6	0	29.4	0	
Total %	0.6	46.2	0	0	0	0	0	0	0	50.2	0.7	0	1.6	0	0.7	0	
Unshifted	14	1049	1	0	0	0	0	0	0	1142	15	1	36	0	15	0	2273
% Unshifted	100	100	100	0	0	0	0	0	0	100	100	100	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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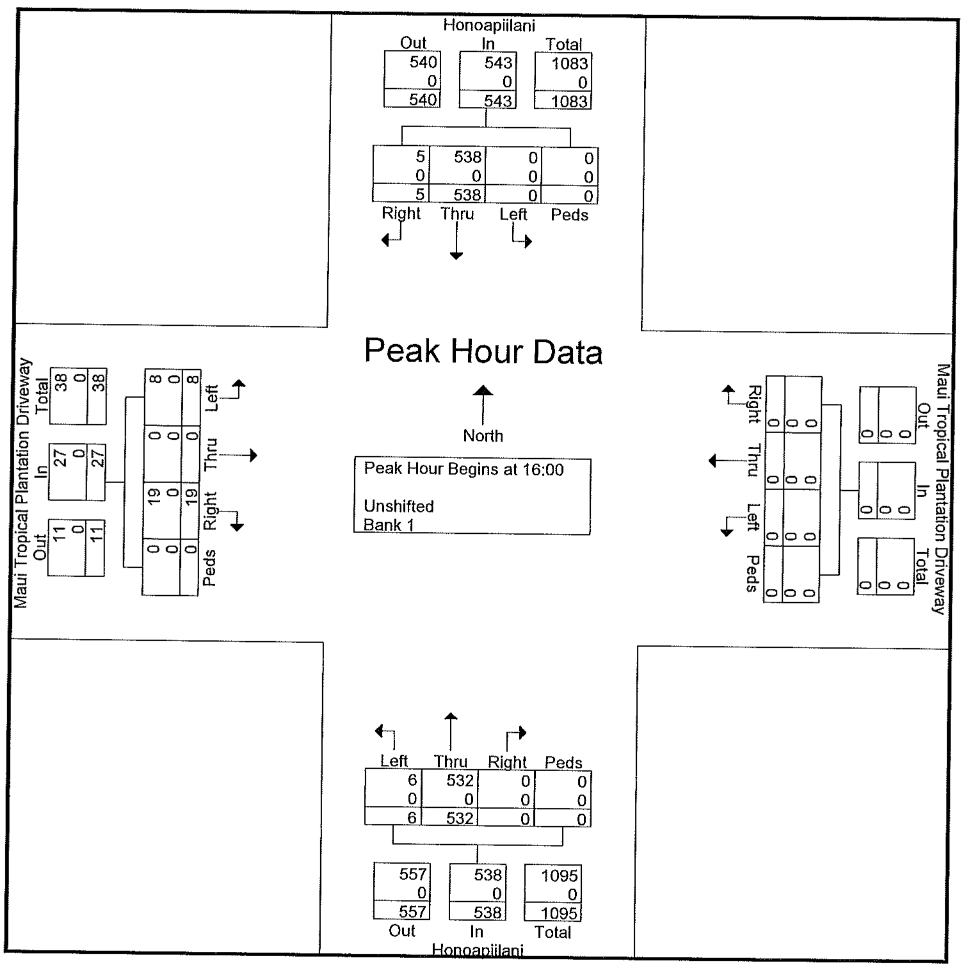
File Name : Honoapiilani - Plantation PM
Site Code : 00000000
Start Date : 1/27/2009

	Honoapiilani From North					Maui Tropical Plantation Driveway From East					Honoapiilani From South					Maui Tropical Plantation Driveway From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	1	116	0	0	117	0	0	0	0	0	0	**142**	1	0	**143**	**9**	0	**4**	0	**13**	273
16:15	**3**	132	0	0	135	0	0	0	0	0	0	128	**3**	0	131	5	0	1	0	6	272
16:30	0	139	0	0	139	0	0	0	0	0	0	134	1	0	135	5	0	3	0	8	**282**
16:45	1	**151**	0	0	**152**	0	0	0	0	0	0	128	1	0	129	0	0	0	0	0	281
Total Volume	5	538	0	0	543	0	0	0	0	0	0	532	6	0	538	19	0	8	0	27	1108
% App. Total	0.9	99.1	0	0		0	0	0	0		0	98.9	1.1	0		70.4	0	29.6	0		
PHF	.417	.891	.000	.000	.893	.000	.000	.000	.000	.000	.000	.937	.500	.000	.941	.528	.000	.500	.000	.519	.982
Unshifted	5	538	0	0	543	0	0	0	0	0	0	532	6	0	538	19	0	8	0	27	1108
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Honoapiilani - Golf Course PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Honoapiilani From North				King Kamehameha GC Driveway From East				Honoapiilani From South				King Kamehameha GC Driveway From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	2	92	0	0	0	0	0	0	0	108	1	0	5	0	3	0	211
15:30	3	89	0	0	0	0	0	0	0	139	0	0	2	0	2	0	235
15:45	1	126	0	1	0	0	0	0	0	141	2	0	1	0	4	0	276
Total	6	307	0	1	0	0	0	0	0	388	3	0	8	0	9	0	722
16:00	0	111	0	0	0	0	0	0	0	133	2	0	3	0	1	0	250
16:15	4	128	0	0	0	0	0	0	0	123	0	0	8	0	4	0	267
16:30	0	141	0	0	0	0	0	0	0	127	1	0	2	0	3	0	274
16:45	1	143	0	0	0	0	0	0	0	126	0	0	2	0	1	0	273
Total	5	523	0	0	0	0	0	0	0	509	3	0	15	0	9	0	1064
17:00	3	100	0	0	0	0	0	0	0	118	2	0	5	0	2	0	230
Grand Total	14	930	0	1	0	0	0	0	0	1015	8	0	28	0	20	0	2016
Apprch %	1.5	98.4	0	0.1	0	0	0	0	0	99.2	0.8	0	58.3	0	41.7	0	
Total %	0.7	46.1	0	0	0	0	0	0	0	50.3	0.4	0	1.4	0	1	0	
Unshifted	14	930	0	1	0	0	0	0	0	1015	8	0	28	0	20	0	2016
% Unshifted	100	100	0	100	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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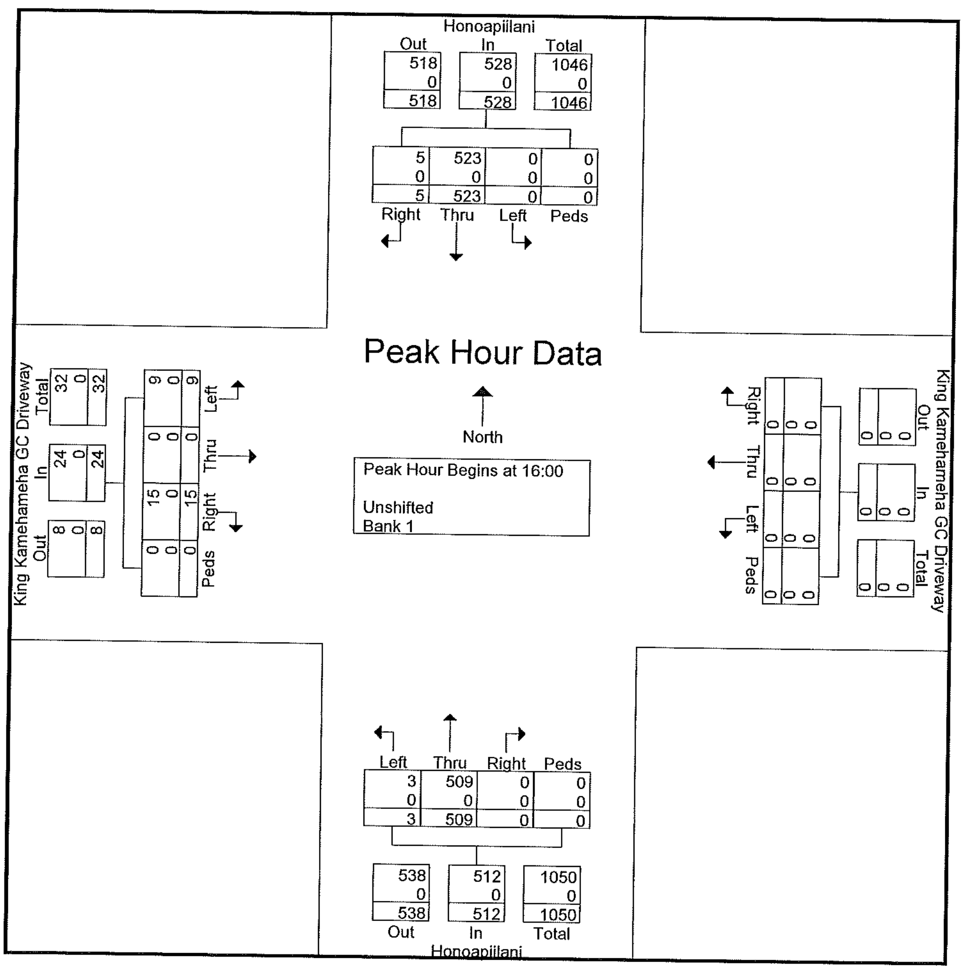
File Name : Honoapiilani - Golf Course PM
Site Code : 00000000
Start Date : 1/27/2009

	Honoapiilani From North					King Kamehameha GC Driveway From East					Honoapiilani From South					King Kamehameha GC Driveway From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	0	111	0	0	111	0	0	0	0	0	0	**133**	**2**	0	**135**	3	0	1	0	4	250
16:15	**4**	128	0	0	132	0	0	0	0	0	0	123	0	0	123	**8**	0	**4**	0	**12**	267
16:30	0	141	0	0	141	0	0	0	0	0	0	127	1	0	128	2	0	3	0	5	**274**
16:45	1	**143**	0	0	**144**	0	0	0	0	0	0	126	0	0	126	2	0	1	0	3	273
Total Volume	5	523	0	0	528	0	0	0	0	0	0	509	3	0	512	15	0	9	0	24	1064
% App. Total	0.9	99.1	0	0		0	0	0	0		0	99.4	0.6	0		62.5	0	37.5	0		
PHF	.313	.914	.000	.000	.917	.000	.000	.000	.000	.000	.000	.957	.375	.000	.948	.469	.000	.563	.000	.500	.971
Unshifted	5	523	0	0	528	0	0	0	0	0	0	509	3	0	512	15	0	9	0	24	1064
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Waiale - Kuikahi PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Waiale From North				Kuikahi From East				Waiale From South				Kuikahi From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	48	27	0	0	0	0	0	0	0	33	5	0	5	0	56	0	174
15:30	57	34	0	0	0	0	0	0	0	35	7	0	6	0	61	0	200
15:45	51	23	0	0	0	0	0	0	0	29	8	0	7	0	61	0	179
Total	156	84	0	0	0	0	0	0	0	97	20	0	18	0	178	0	553
16:00	73	24	0	0	0	0	0	0	0	22	8	0	11	0	70	0	208
16:15	72	32	0	0	0	0	0	0	0	29	10	0	14	0	62	0	219
16:30	80	45	0	0	0	0	0	0	0	28	9	0	11	0	36	0	209
16:45	72	33	0	0	0	0	0	0	0	31	6	0	5	0	63	0	210
Total	297	134	0	0	0	0	0	0	0	110	33	0	41	0	231	0	846
17:00	62	33	0	0	0	0	0	0	0	27	7	0	10	0	48	0	187
Grand Total	515	251	0	0	0	0	0	0	0	234	60	0	69	0	457	0	1586
Apprch %	67.2	32.8	0	0	0	0	0	0	0	79.6	20.4	0	13.1	0	86.9	0	
Total %	32.5	15.8	0	0	0	0	0	0	0	14.8	3.8	0	4.4	0	28.8	0	
Unshifted	515	251	0	0	0	0	0	0	0	234	60	0	69	0	457	0	1586
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	0	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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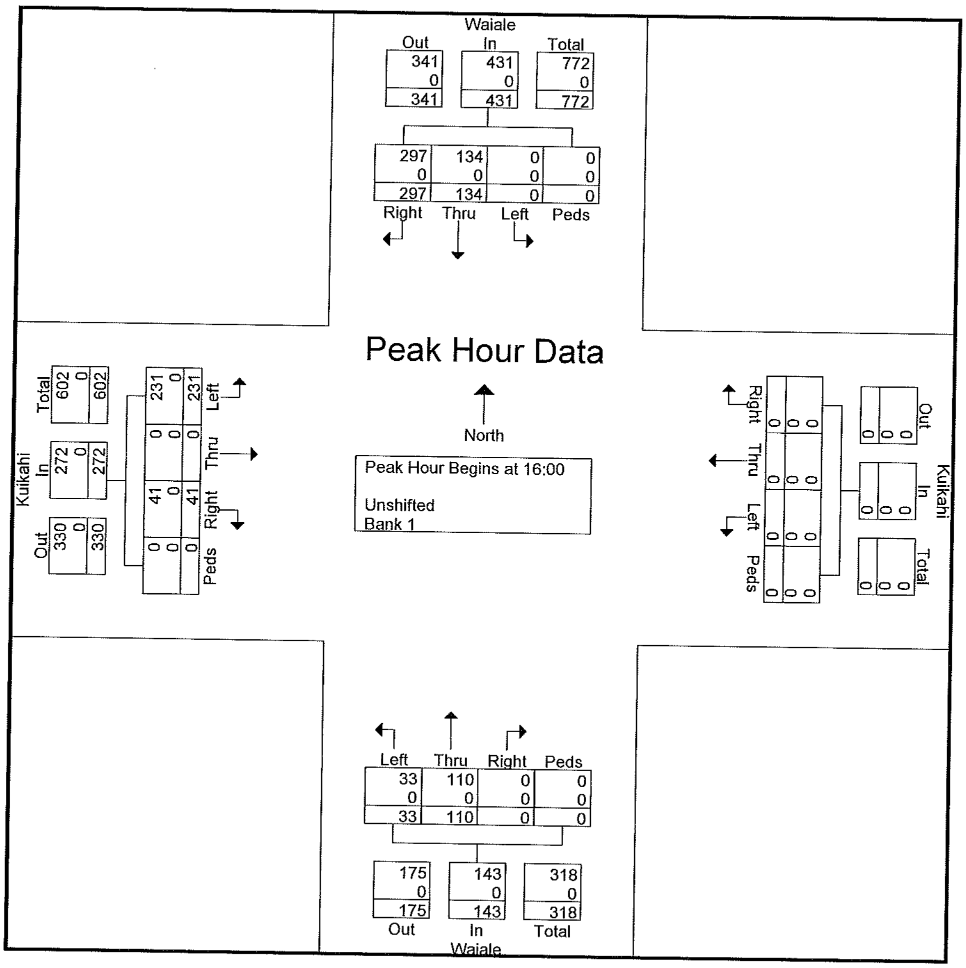
File Name : Waiale - Kuikahi PM
Site Code : 00000000
Start Date : 1/27/2009

	Waiale From North					Kuikahi From East					Waiale From South					Kuikahi From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	73	24	0	0	97	0	0	0	0	0	0	22	8	0	30	11	0	**70**	0	**81**	208
16:15	72	32	0	0	104	0	0	0	0	0	0	29	**10**	0	**39**	**14**	0	62	0	76	**219**
16:30	**80**	**45**	0	0	**125**	0	0	0	0	0	0	28	9	0	37	11	0	36	0	47	209
16:45	72	33	0	0	105	0	0	0	0	0	0	**31**	6	0	37	5	0	63	0	68	210
Total Volume	297	134	0	0	431	0	0	0	0	0	0	110	33	0	143	41	0	231	0	272	846
% App. Total	68.9	31.1	0	0		0	0	0	0		0	76.9	23.1	0		15.1	0	84.9	0		
PHF	.928	.744	.000	.000	.862	.000	.000	.000	.000	.000	.000	.887	.825	.000	.917	.732	.000	.825	.000	.840	.966
Unshifted	297	134	0	0	431	0	0	0	0	0	0	110	33	0	143	41	0	231	0	272	846
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Waiale - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Waiale From North				Waiko From East				Waiale From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	4	0	30	0	28	26	0	0	0	0	0	0	0	18	6	0	112
15:30	4	0	22	0	46	19	0	0	0	0	0	0	0	19	11	0	121
15:45	11	0	29	0	33	23	0	0	0	0	0	0	0	19	8	0	123
Total	19	0	81	0	107	68	0	0	0	0	0	0	0	56	25	0	356
16:00	7	0	27	0	49	31	0	0	0	0	0	0	0	15	10	0	139
16:15	8	0	31	0	35	33	0	0	0	0	0	0	0	14	4	0	125
16:30	3	0	36	0	40	28	0	0	0	0	0	0	0	19	7	0	133
16:45	8	0	33	0	48	34	0	0	0	0	0	0	0	29	9	0	161
Total	26	0	127	0	172	126	0	0	0	0	0	0	0	77	30	0	558
17:00	2	0	33	0	43	38	0	0	0	0	0	0	0	21	14	0	151
Grand Total	47	0	241	0	322	232	0	0	0	0	0	0	0	154	69	0	1065
Apprch %	16.3	0	83.7	0	58.1	41.9	0	0	0	0	0	0	0	69.1	30.9	0	
Total %	4.4	0	22.6	0	30.2	21.8	0	0	0	0	0	0	0	14.5	6.5	0	
Unshifted	47	0	241	0	322	232	0	0	0	0	0	0	0	154	69	0	1065
% Unshifted	100	0	100	0	100	100	0	0	0	0	0	0	0	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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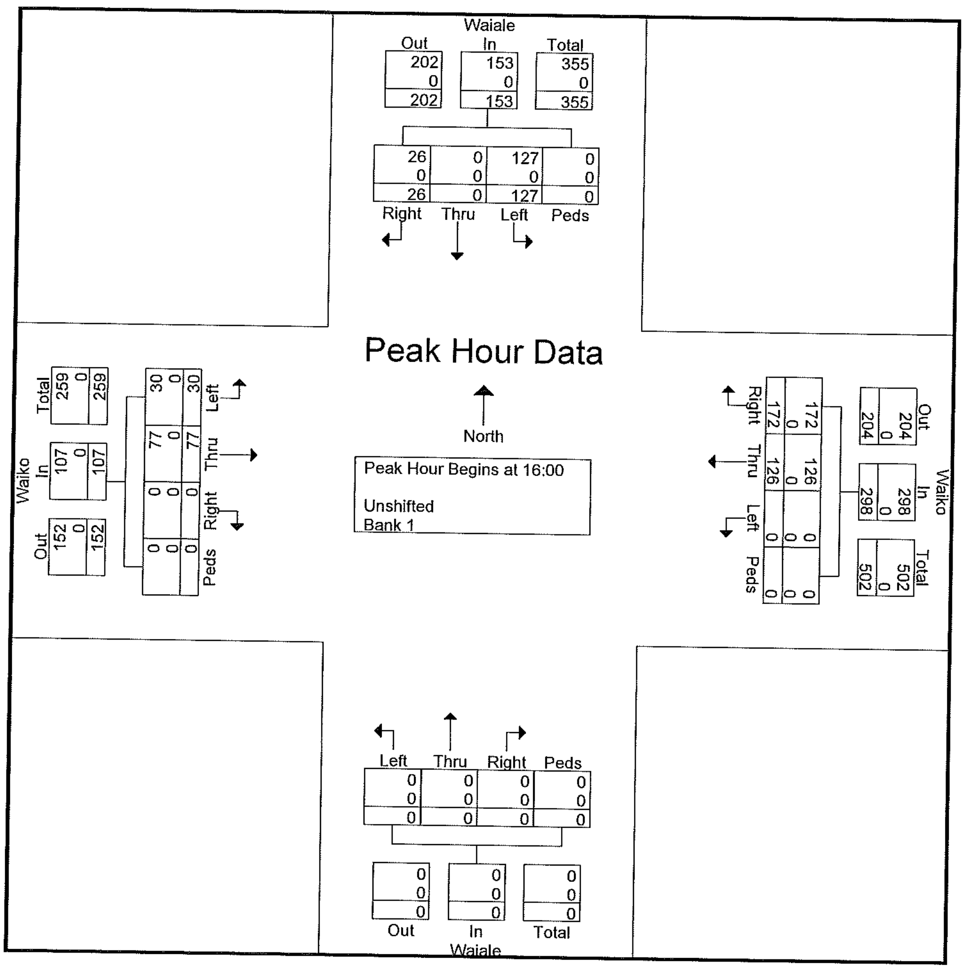
File Name : Waiale - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 2

	Waiale From North					Waiko From East					Waiale From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	7	0	27	0	34	**49**	31	0	0	80	0	0	0	0	0	0	15	**10**	0	25	139
16:15	**8**	0	31	0	39	35	33	0	0	68	0	0	0	0	0	0	14	4	0	18	125
16:30	3	0	**36**	0	39	40	28	0	0	68	0	0	0	0	0	0	19	7	0	26	133
16:45	8	0	33	0	**41**	48	**34**	0	0	**82**	0	0	0	0	0	0	**29**	9	0	**38**	**161**
Total Volume	26	0	127	0	153	172	126	0	0	298	0	0	0	0	0	0	77	30	0	107	558
% App. Total	17	0	83	0		57.7	42.3	0	0		0	0	0	0		0	72	28	0		
PHF	.813	.000	.882	.000	.933	.878	.926	.000	.000	.909	.000	.000	.000	.000	.000	.000	.664	.750	.000	.704	.866
Unshifted	26	0	127	0	153	172	126	0	0	298	0	0	0	0	0	0	77	30	0	107	558
% Unshifted																					
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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File Name : Kuihelani - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 1

Groups Printed- Unshifted - Bank 1

	Kuihelani From North				Waiko From East				Kuihelani From South				Waiko From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:15	58	145	0	0	0	0	0	0	0	94	1	0	4	1	44	0	347
15:30	57	130	0	0	0	0	0	0	0	125	1	0	4	0	42	0	359
15:45	54	148	0	0	0	0	0	0	0	121	0	0	1	0	39	0	363
Total	169	423	0	0	0	0	0	0	0	340	2	0	9	1	125	0	1069
16:00	78	130	0	0	0	0	0	0	0	139	1	0	4	0	45	0	397
16:15	61	118	0	0	0	0	0	0	0	132	2	0	5	0	38	0	356
16:30	62	139	0	0	0	0	0	0	0	149	1	0	1	0	41	0	393
16:45	80	100	0	0	0	0	0	0	0	127	2	0	2	0	65	0	376
Total	281	487	0	0	0	0	0	0	0	547	6	0	12	0	189	0	1522
17:00	79	103	0	0	0	0	0	0	0	113	1	0	3	0	50	0	349
Grand Total	529	1013	0	0	0	0	0	0	0	1000	9	0	24	1	364	0	2940
Apprch %	34.3	65.7	0	0	0	0	0	0	0	99.1	0.9	0	6.2	0.3	93.6	0	
Total %	18	34.5	0	0	0	0	0	0	0	34	0.3	0	0.8	0	12.4	0	
Unshifted	529	1013	0	0	0	0	0	0	0	1000	9	0	24	1	364	0	2940
% Unshifted	100	100	0	0	0	0	0	0	0	100	100	0	100	100	100	0	100
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bank 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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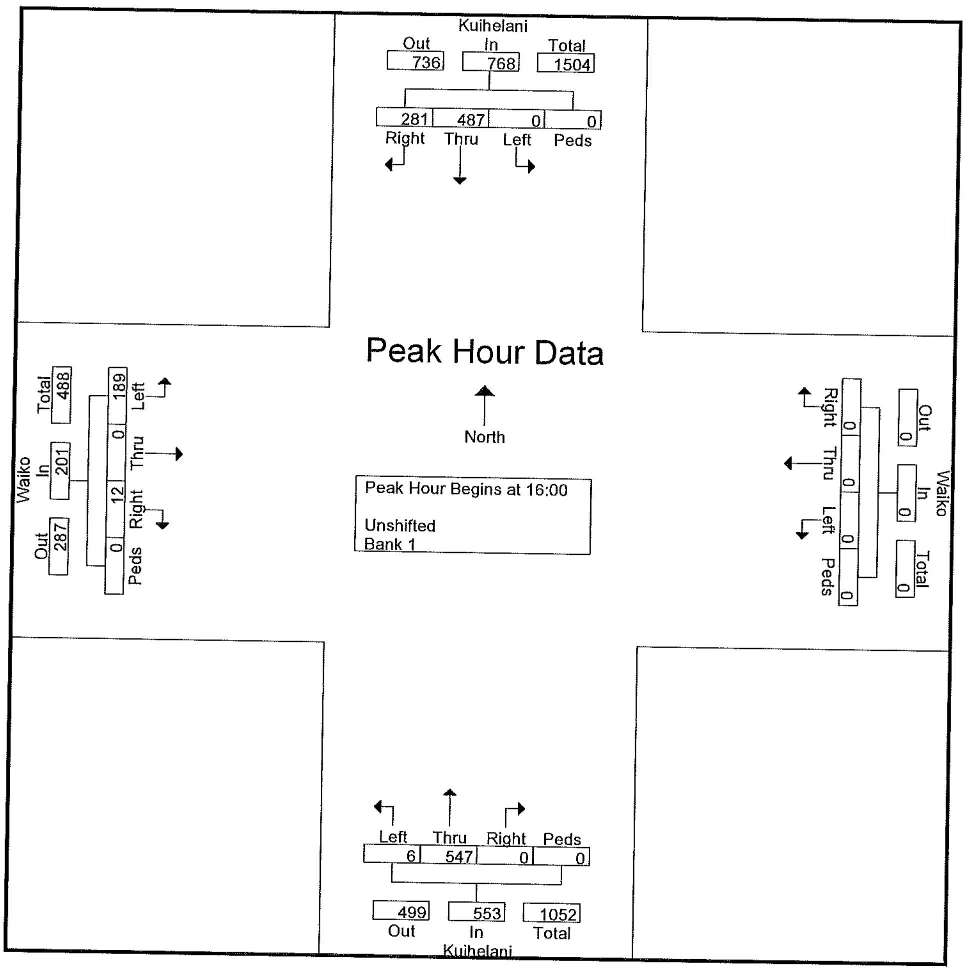
File Name : Kuihelani - Waiko PM
Site Code : 00000000
Start Date : 1/27/2009
Page No : 2

	Kuihelani From North					Waiko From East					Kuihelani From South					Waiko From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 16:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	78	130	0	0	**208**	0	0	0	0	0	0	139	1	0	140	4	0	45	0	49	**397**
16:15	61	118	0	0	179	0	0	0	0	0	0	132	**2**	0	134	**5**	0	38	0	43	356
16:30	62	**139**	0	0	201	0	0	0	0	0	0	**149**	1	0	**150**	1	0	41	0	42	393
16:45	**80**	100	0	0	180	0	0	0	0	0	0	127	2	0	129	2	0	**65**	0	**67**	376
Total Volume	281	487	0	0	768	0	0	0	0	0	0	547	6	0	553	12	0	189	0	201	1522
% App. Total	36.6	63.4	0	0		0	0	0	0		0	98.9	1.1	0		6	0	94	0		
PHF	.878	.876	.000	.000	.923	.000	.000	.000	.000	.000	.000	.918	.750	.000	.922	.600	.000	.727	.000	.750	.958



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2000)

Level of service for signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2000)

The level of service criteria for unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

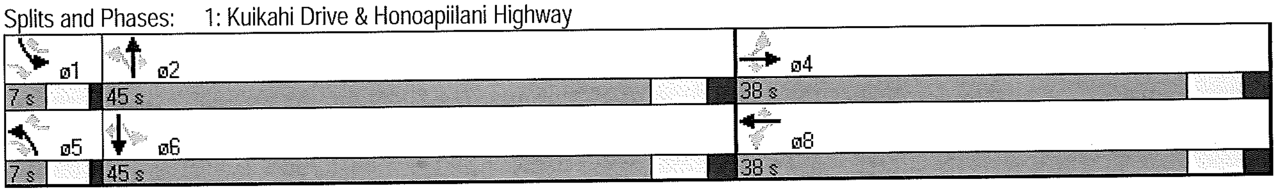
- Existing Conditions AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	58	124	61	246	35	40	27	445	324	50	334	12
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	24.0	24.0		24.0	24.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	38.0	38.0	52.0	38.0	38.0	52.0	7.0	45.0	45.0	7.0	45.0	45.0
Total Split (%)	42.2%	42.2%	57.8%	42.2%	42.2%	57.8%	7.8%	50.0%	50.0%	7.8%	50.0%	50.0%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	Min	Min	None	Min	Min

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 83
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
1: Kuikahi Drive & Honoapiilani Highway

10/23/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	58	124	61	246	35	40	27	445	324	50	334	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.98	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1879	1623		1787	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.67	1.00		0.53	1.00	0.42	1.00	1.00	0.23	1.00	1.00
Satd. Flow (perm)		1286	1623		981	1583	779	1863	1583	419	1863	1583
Peak-hour factor, PHF	0.66	0.66	0.76	0.81	0.62	0.91	0.68	0.80	0.77	0.73	0.89	0.43
Adj. Flow (vph)	88	188	80	304	56	44	40	556	421	68	375	28
RTOR Reduction (vph)	0	0	31	0	0	23	0	0	255	0	0	17
Lane Group Flow (vph)	0	276	49	0	360	21	40	556	166	68	375	11
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		32.5	40.8		32.5	40.8	35.3	33.0	33.0	35.3	33.0	33.0
Effective Green, g (s)		32.5	40.8		32.5	40.8	35.3	33.0	33.0	35.3	33.0	33.0
Actuated g/C Ratio		0.39	0.49		0.39	0.49	0.42	0.39	0.39	0.42	0.39	0.39
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		499	790		380	771	355	734	623	214	734	623
v/s Ratio Prot							0.00	c0.30		c0.01	0.20	
v/s Ratio Perm		0.21	0.03		c0.37	0.01	0.04		0.10	0.13		0.01
v/c Ratio		0.55	0.06		0.95	0.03	0.11	0.76	0.27	0.32	0.51	0.02
Uniform Delay, d1		20.0	11.4		24.8	11.2	14.7	21.9	17.2	16.4	19.3	15.5
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.8	0.0		32.2	0.0	0.1	5.3	0.5	0.3	1.2	0.0
Delay (s)		20.7	11.4		57.0	11.2	14.7	27.3	17.7	16.7	20.5	15.5
Level of Service		C	B		E	B	B	C	B	B	C	B
Approach Delay (s)		18.6			52.0			22.8			19.6	
Approach LOS		B			D			C			B	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	83.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		

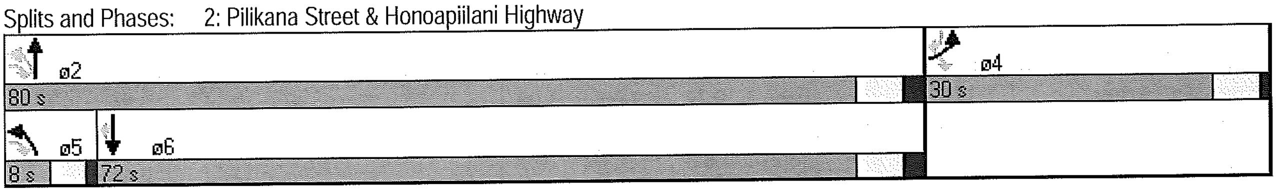
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	79	52	21	722	596	36
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	30.0	118.0	8.0	80.0	72.0	102.0
Total Split (%)	27.3%	107.3%	7.3%	72.7%	65.5%	92.7%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	79	52	21	722	596	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.33	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	621	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	104	80	23	1046	677	42
RTOR Reduction (vph)	0	0	0	0	0	5
Lane Group Flow (vph)	104	80	23	1046	677	37
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	10.8	110.0	88.2	88.2	81.0	97.8
Effective Green, g (s)	10.8	104.0	88.2	88.2	81.0	97.8
Actuated g/C Ratio	0.10	0.95	0.80	0.80	0.74	0.89
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	176	1519	531	1494	1372	1407
v/s Ratio Prot	c0.06		0.00	c0.56	0.36	
v/s Ratio Perm		0.05	0.03			0.02
v/c Ratio	0.59	0.05	0.04	0.70	0.49	0.03
Uniform Delay, d1	47.5	0.2	3.3	4.9	6.0	0.7
Progression Factor	1.00	1.00	0.95	0.77	1.00	1.00
Incremental Delay, d2	3.5	0.0	0.0	2.5	1.3	0.0
Delay (s)	51.0	0.2	3.2	6.3	7.3	0.7
Level of Service	D	A	A	A	A	A
Approach Delay (s)	28.9			6.2	6.9	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	8.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

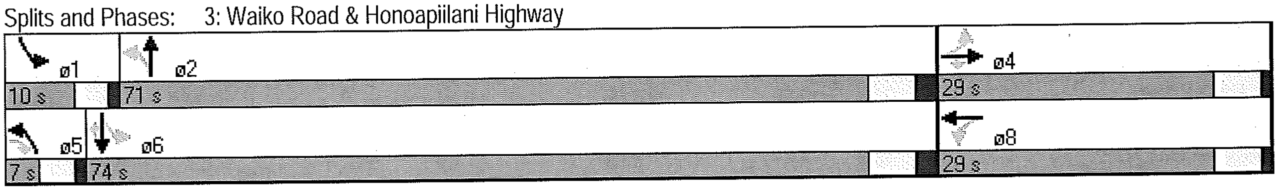
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	22	17	7	52	4	5	643	97	545	15
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	24.0	24.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	29.0	29.0	36.0	29.0	29.0	7.0	71.0	10.0	74.0	74.0
Total Split (%)	26.4%	26.4%	32.7%	26.4%	26.4%	6.4%	64.5%	9.1%	67.3%	67.3%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
3: Waiko Road & Honoapiilani Highway

10/23/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	17	7	52	4	81	5	643	43	97	545	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.92		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1871	1647		1678		1768	1838		1770	1863	1542
Flt Permitted		0.50	1.00		0.86		0.42	1.00		0.26	1.00	1.00
Satd. Flow (perm)		964	1647		1471		786	1838		490	1863	1542
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	48	20	12	60	8	112	8	714	60	147	586	28
RTOR Reduction (vph)	0	0	10	0	61	0	0	2	0	0	0	5
Lane Group Flow (vph)	0	68	2	0	119	0	8	772	0	147	586	23
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		13.1	19.3		13.1		77.4	76.2		85.9	80.7	80.7
Effective Green, g (s)		13.1	19.3		13.1		77.4	76.2		85.9	80.7	80.7
Actuated g/C Ratio		0.12	0.18		0.12		0.70	0.69		0.78	0.73	0.73
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		115	289		175		564	1273		449	1367	1131
v/s Ratio Prot							0.00	c0.42		c0.02	0.31	
v/s Ratio Perm		0.07	0.00		c0.08		0.01			0.24		0.01
v/c Ratio		0.59	0.01		0.68		0.01	0.61		0.33	0.43	0.02
Uniform Delay, d1		45.9	37.4		46.4		4.9	9.0		6.1	5.7	4.0
Progression Factor		1.00	1.00		1.00		1.00	1.00		0.98	0.80	0.91
Incremental Delay, d2		5.3	0.0		8.4		0.0	2.2		0.1	0.9	0.0
Delay (s)		51.2	37.4		54.8		4.9	11.1		6.1	5.4	3.6
Level of Service		D	D		D		A	B		A	A	A
Approach Delay (s)		49.2			54.8			11.0			5.5	
Approach LOS		D			D			B			A	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	69.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	1	2	2	639	593	6
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.50	0.50	0.89	0.94	0.75
Hourly flow rate (vph)	4	4	4	718	631	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		2				
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1357	631	639			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1357	631	639			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	164	481	945			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	8	4	718	631	8
Volume Left	4	4	0	0	0
Volume Right	4	0	0	0	8
cSH	327	945	1700	1700	1700
Volume to Capacity	0.02	0.00	0.42	0.37	0.00
Queue Length 95th (ft)	2	0	0	0	0
Control Delay (s)	20.0	8.8	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	20.0	0.0		0.0	
Approach LOS	C				

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	459	35	39	208	123	276
Peak Hour Factor	0.79	0.80	0.81	0.71	0.73	0.79
Hourly flow rate (vph)	581	44	48	293	168	349

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	625	341	518
Volume Left (vph)	581	48	0
Volume Right (vph)	44	0	349
Hadj (s)	0.18	0.06	-0.37
Departure Headway (s)	6.7	6.9	6.2
Degree Utilization, x	1.16	0.66	0.89
Capacity (veh/h)	551	506	570
Control Delay (s)	114.8	22.1	40.4
Approach Delay (s)	114.8	22.1	40.4
Approach LOS	F	C	E

Intersection Summary			
Delay	67.5		
HCM Level of Service	F		
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	26	142	103	142	216	39
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.59	0.77	0.70	0.79	0.75	0.81
Hourly flow rate (vph)	44	184	147	180	288	48
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	327				510	237
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	327				510	237
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				43	94
cM capacity (veh/h)	1233				505	802

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	228	327	336
Volume Left	44	0	288
Volume Right	0	180	48
cSH	1233	1700	533
Volume to Capacity	0.04	0.19	0.63
Queue Length 95th (ft)	3	0	109
Control Delay (s)	1.8	0.0	22.6
Lane LOS	A		C
Approach Delay (s)	1.8	0.0	22.6
Approach LOS			C

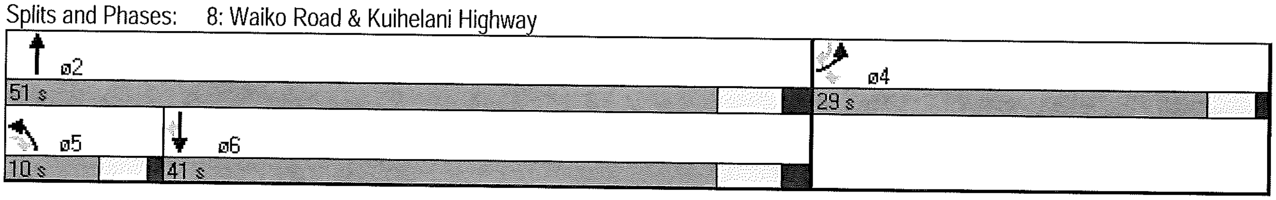
Intersection Summary			
Average Delay	9.0		
Intersection Capacity Utilization	47.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	343	22	5	291	392	234
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 52.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	343	22	5	291	392	234
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	470	44	16	320	445	316
RTOR Reduction (vph)	0	11	0	0	0	63
Lane Group Flow (vph)	470	33	16	320	445	253
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	19.1	25.8	2.7	24.5	17.8	42.9
Effective Green, g (s)	19.1	25.8	2.7	24.5	17.8	42.9
Actuated g/C Ratio	0.36	0.48	0.05	0.46	0.33	0.80
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	631	762	89	1618	1175	1267
v/s Ratio Prot	c0.27		0.01	c0.09	c0.13	
v/s Ratio Perm		0.02				0.16
v/c Ratio	0.74	0.04	0.18	0.20	0.38	0.20
Uniform Delay, d1	15.1	7.4	24.4	8.7	13.7	1.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.2	0.0	0.4	0.1	0.4	0.2
Delay (s)	19.3	7.4	24.7	8.8	14.1	1.4
Level of Service	B	A	C	A	B	A
Approach Delay (s)	18.3			9.6	8.8	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	53.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	38.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions PM

Timings
1: Kuikahi Drive & Honoapiilani Highway

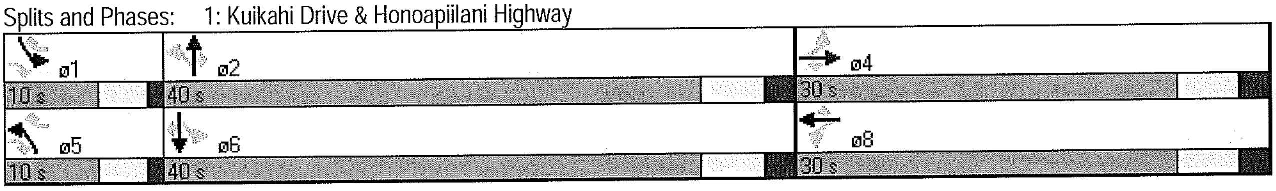
9/9/2009

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	40	28	237	75	18	54	332	195	37	370	35
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	27.0	27.0		27.0	27.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	30.0	30.0	50.0	30.0	30.0	50.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	37.5%	37.5%	62.5%	37.5%	37.5%	62.5%	12.5%	50.0%	50.0%	12.5%	50.0%	50.0%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	Min	Min	None	Min	Min

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 65.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		↰↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	22	40	28	237	75	18	54	332	195	37	370	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		6.0	6.0		6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1881	1623		1796	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.84	1.00		0.72	1.00	0.31	1.00	1.00	0.46	1.00	1.00
Satd. Flow (perm)		1599	1623		1346	1583	576	1863	1583	852	1863	1583
Peak-hour factor, PHF	0.79	0.62	0.88	0.94	0.85	0.75	0.71	0.92	0.76	0.62	0.76	0.88
Adj. Flow (vph)	28	65	32	252	88	24	76	361	257	60	487	40
RTOR Reduction (vph)	0	0	17	0	0	13	0	0	158	0	0	25
Lane Group Flow (vph)	0	93	15	0	340	11	76	361	99	60	487	15
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		20.4	30.6		20.4	30.6	29.4	25.2	25.2	29.2	25.1	25.1
Effective Green, g (s)		20.4	30.6		20.4	30.6	29.4	25.2	25.2	29.2	25.1	25.1
Actuated g/C Ratio		0.31	0.47		0.31	0.47	0.45	0.38	0.38	0.44	0.38	0.38
Clearance Time (s)		6.0			6.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		496	756		418	737	334	715	607	436	712	605
v/s Ratio Prot							c0.01	0.19		0.01	c0.26	
v/s Ratio Perm		0.06	0.01		c0.25	0.01	0.09		0.06	0.05		0.01
v/c Ratio		0.19	0.02		0.81	0.02	0.23	0.50	0.16	0.14	0.68	0.03
Uniform Delay, d1		16.6	9.5		20.9	9.4	11.2	15.5	13.3	10.6	17.0	12.7
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.1	0.0		10.9	0.0	0.1	1.2	0.3	0.1	3.5	0.0
Delay (s)		16.6	9.5		31.8	9.4	11.3	16.7	13.6	10.7	20.5	12.7
Level of Service		B	A		C	A	B	B	B	B	C	B
Approach Delay (s)		14.8			30.3			14.9			19.0	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	65.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	59.9%	ICU Level of Service	B
Analysis Period (min)	15		

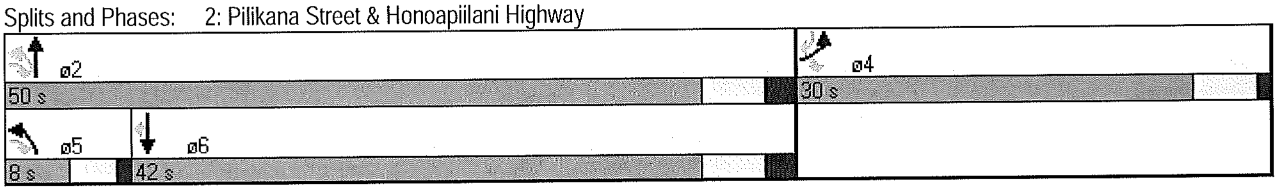
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	33	27	55	539	567	79
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	30.0		7.0	16.0	16.0	
Total Split (s)	30.0	88.0	8.0	50.0	42.0	72.0
Total Split (%)	37.5%	110.0%	10.0%	62.5%	52.5%	90.0%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
2: Pilikana Street & Honoapiilani Highway 9/9/2009

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	33	27	55	539	567	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1769	1863	1863	1551
Flt Permitted	0.95	1.00	0.32	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	588	1863	1863	1551
Peak-hour factor, PHF	0.69	0.68	0.86	0.96	0.86	0.76
Adj. Flow (vph)	48	40	64	561	659	104
RTOR Reduction (vph)	0	0	0	0	0	16
Lane Group Flow (vph)	48	40	64	561	659	88
Confl. Peds. (#/hr)			1			1
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	8.8	80.0	60.2	60.2	53.0	67.8
Effective Green, g (s)	8.8	74.0	60.2	60.2	53.0	67.8
Actuated g/C Ratio	0.11	0.92	0.75	0.75	0.66	0.85
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	198	1486	490	1402	1234	1314
v/s Ratio Prot	c0.03		0.01	c0.30	c0.35	
v/s Ratio Perm		0.02	0.09			0.06
v/c Ratio	0.24	0.03	0.13	0.40	0.53	0.07
Uniform Delay, d1	32.6	0.2	3.8	3.5	7.1	1.0
Progression Factor	1.00	1.00	1.43	1.35	1.00	1.00
Incremental Delay, d2	0.2	0.0	0.0	0.8	1.7	0.0
Delay (s)	32.8	0.2	5.5	5.5	8.7	1.0
Level of Service	C	A	A	A	A	A
Approach Delay (s)	18.0			5.5	7.7	
Approach LOS	B			A	A	

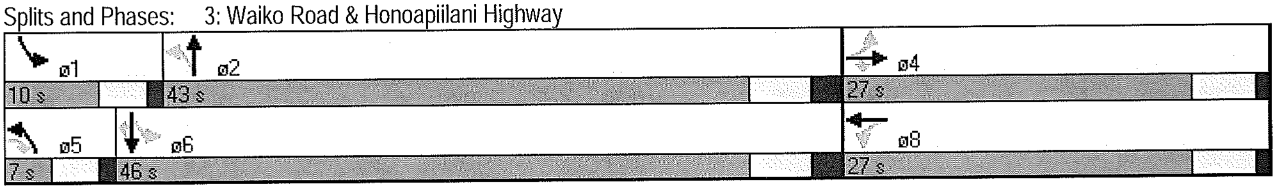
Intersection Summary			
HCM Average Control Delay	7.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	8	11	10	39	24	7	482	53	509	20
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		27.0	27.0	7.0	31.0	7.0	26.0	26.0
Total Split (s)	27.0	27.0	34.0	27.0	27.0	7.0	43.0	10.0	46.0	46.0
Total Split (%)	33.8%	33.8%	42.5%	33.8%	33.8%	8.8%	53.8%	12.5%	57.5%	57.5%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
3: Waiko Road & Honoapiilani Highway

9/9/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	11	10	39	24	96	7	482	46	53	509	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.98	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1899	1647		1716		1768	1831		1770	1863	1541
Flt Permitted		0.78	1.00		0.91		0.40	1.00		0.34	1.00	1.00
Satd. Flow (perm)		1503	1647		1572		749	1831		640	1863	1541
Peak-hour factor, PHF	0.50	0.46	0.50	0.75	0.43	0.89	0.88	0.95	0.72	0.63	0.87	0.71
Adj. Flow (vph)	16	24	20	52	56	108	8	507	64	84	585	28
RTOR Reduction (vph)	0	0	15	0	52	0	0	4	0	0	0	8
Lane Group Flow (vph)	0	40	5	0	164	0	8	567	0	84	585	20
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		12.4	18.6		12.4		49.3	48.1		55.9	51.4	51.4
Effective Green, g (s)		12.4	18.6		12.4		49.3	48.1		55.9	51.4	51.4
Actuated g/C Ratio		0.16	0.23		0.16		0.62	0.60		0.70	0.64	0.64
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		233	383		244		477	1101		511	1197	990
v/s Ratio Prot							0.00	c0.31		c0.01	c0.31	
v/s Ratio Perm		0.03	0.00		c0.10		0.01			0.11		0.01
v/c Ratio		0.17	0.01		0.67		0.02	0.51		0.16	0.49	0.02
Uniform Delay, d1		29.3	23.6		31.9		6.0	9.2		4.8	7.5	5.2
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.59	1.25	1.90
Incremental Delay, d2		0.1	0.0		5.6		0.0	1.7		0.0	1.3	0.0
Delay (s)		29.5	23.6		37.5		6.0	10.9		7.7	10.6	9.9
Level of Service		C	C		D		A	B		A	B	A
Approach Delay (s)		27.5			37.5			10.9			10.2	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM Average Control Delay	14.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	8	19	6	532	538	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.50	0.53	0.50	0.94	0.89	0.42
Hourly flow rate (vph)	16	36	12	566	604	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		2				
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1194	604	616			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1194	604	616			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	93	99			
cM capacity (veh/h)	203	498	963			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	52	12	566	604	12
Volume Left	16	12	0	0	0
Volume Right	36	0	0	0	12
cSH	659	963	1700	1700	1700
Volume to Capacity	0.08	0.01	0.33	0.36	0.01
Queue Length 95th (ft)	6	1	0	0	0
Control Delay (s)	16.3	8.8	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	16.3	0.2		0.0	
Approach LOS	C				

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	231	41	33	110	134	297
Peak Hour Factor	0.82	0.73	0.82	0.89	0.74	0.93
Hourly flow rate (vph)	282	56	40	124	181	319

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	338	164	500
Volume Left (vph)	282	40	0
Volume Right (vph)	56	0	319
Hadj (s)	0.10	0.08	-0.35
Departure Headway (s)	5.7	5.7	4.9
Degree Utilization, x	0.53	0.26	0.68
Capacity (veh/h)	597	581	716
Control Delay (s)	15.0	10.8	17.4
Approach Delay (s)	15.0	10.8	17.4
Approach LOS	B	B	C

Intersection Summary			
Delay	15.5		
HCM Level of Service	C		
Intersection Capacity Utilization	56.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	30	77	126	172	127	26
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.75	0.66	0.93	0.79	0.88	0.81
Hourly flow rate (vph)	40	117	135	218	144	32
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	353				441	244
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	353				441	244
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				74	96
cM capacity (veh/h)	1206				555	794

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	157	353	176
Volume Left	40	0	144
Volume Right	0	218	32
cSH	1206	1700	587
Volume to Capacity	0.03	0.21	0.30
Queue Length 95th (ft)	3	0	31
Control Delay (s)	2.3	0.0	13.7
Lane LOS	A		B
Approach Delay (s)	2.3	0.0	13.7
Approach LOS			B

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	41.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Volume (vph)	189	12	6	547	487	281
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		4.0	10.0	10.0	
Minimum Split (s)	28.0		8.0	16.0	24.0	
Total Split (s)	29.0	39.0	10.0	51.0	41.0	70.0
Total Split (%)	36.3%	48.8%	12.5%	63.8%	51.3%	87.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary

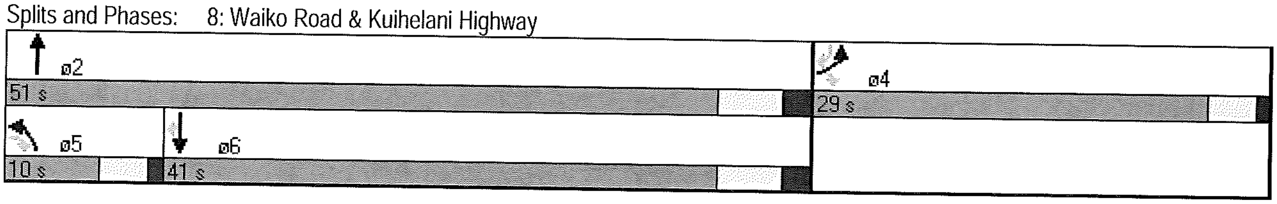
Cycle Length: 80

Actuated Cycle Length: 46.2

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	189	12	6	547	487	281
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.60	0.75	0.92	0.88	0.88
Adj. Flow (vph)	259	20	8	595	553	319
RTOR Reduction (vph)	0	12	0	0	0	64
Lane Group Flow (vph)	259	8	8	595	553	255
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	11.9	17.5	1.6	26.2	20.6	38.5
Effective Green, g (s)	11.9	17.5	1.6	26.2	20.6	38.5
Actuated g/C Ratio	0.25	0.36	0.03	0.54	0.43	0.80
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	438	576	59	1928	1516	1267
v/s Ratio Prot	c0.15		0.00	c0.17	c0.16	
v/s Ratio Perm		0.00				0.16
v/c Ratio	0.59	0.01	0.14	0.31	0.36	0.20
Uniform Delay, d1	16.0	9.8	22.6	6.0	9.3	1.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4	0.0	0.4	0.2	0.3	0.2
Delay (s)	17.4	9.8	23.0	6.2	9.6	1.3
Level of Service	B	A	C	A	A	A
Approach Delay (s)	16.8			6.4	6.6	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	48.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

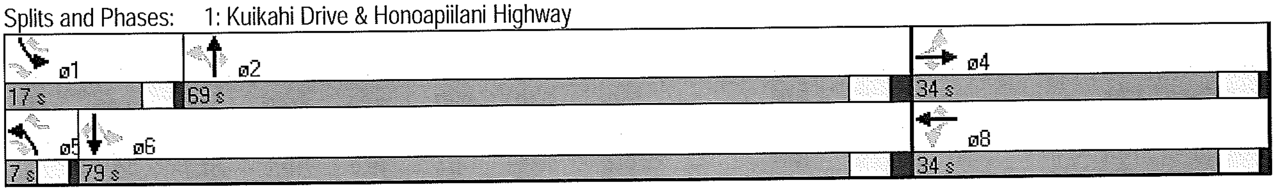
- Base Year 2030 AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	400	75	225	50	890	595	155	510	25
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	34.0	34.0	58.0	34.0	34.0	58.0	7.0	69.0	69.0	17.0	79.0	79.0
Total Split (%)	28.3%	28.3%	48.3%	28.3%	28.3%	48.3%	5.8%	57.5%	57.5%	14.2%	65.8%	65.8%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Min	C-Min	None	C-Min	C-Min

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 59 (49%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 140
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
1: Kuikahi Drive & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	400	75	225	50	890	595	155	510	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1882	1623		1791	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.09	1.00		0.12	1.00	0.40	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)		170	1623		232	1583	745	1863	1583	110	1863	1583
Peak-hour factor, PHF	0.66	0.66	0.76	0.81	0.62	0.91	0.68	0.80	0.77	0.73	0.89	0.43
Adj. Flow (vph)	159	394	145	494	121	247	74	1112	773	212	573	58
RTOR Reduction (vph)	0	0	23	0	0	39	0	0	63	0	0	23
Lane Group Flow (vph)	0	553	122	0	615	208	74	1112	710	212	573	35
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		29.0	46.0		29.0	46.0	67.0	64.0	64.0	80.0	73.0	73.0
Effective Green, g (s)		29.0	46.0		29.0	46.0	67.0	64.0	64.0	80.0	73.0	73.0
Actuated g/C Ratio		0.24	0.38		0.24	0.38	0.56	0.53	0.53	0.67	0.61	0.61
Clearance Time (s)		5.0			5.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		41	622		56	607	442	994	844	239	1133	963
v/s Ratio Prot							0.00	c0.60		c0.09	0.31	
v/s Ratio Perm		c3.26	0.07		2.65	0.13	0.09		0.45	0.50		0.02
v/c Ratio		13.49	0.20		10.98	0.34	0.17	1.12	0.84	0.89	0.51	0.04
Uniform Delay, d1		45.5	24.7		45.5	26.3	12.4	28.0	23.7	39.3	13.3	9.4
Progression Factor		1.00	1.00		0.79	0.40	0.52	0.70	0.59	1.00	1.00	1.00
Incremental Delay, d2		5666.5	0.1		4504.5	0.0	0.0	54.9	1.0	29.4	1.6	0.1
Delay (s)		5712.0	24.7		4540.6	10.6	6.5	74.5	15.1	68.7	14.9	9.5
Level of Service		F	C		F	B	A	E	B	E	B	A
Approach Delay (s)		4530.6			3242.6			48.5			28.1	
Approach LOS		F			F			D			C	

Intersection Summary			
HCM Average Control Delay	1392.9	HCM Level of Service	F
HCM Volume to Capacity ratio	4.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	117.7%	ICU Level of Service	H
Analysis Period (min)	15		

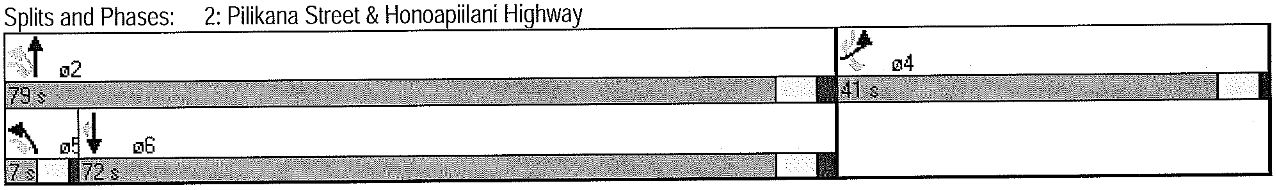
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	1355	930	55
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	41.0	127.0	7.0	79.0	72.0	113.0
Total Split (%)	34.2%	105.8%	5.8%	65.8%	60.0%	94.2%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 105 (88%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	1355	930	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.15	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	274	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	151	115	32	1964	1057	64
RTOR Reduction (vph)	0	0	0	0	0	6
Lane Group Flow (vph)	151	115	32	1964	1057	58
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	14.6	120.0	94.4	94.4	87.4	108.0
Effective Green, g (s)	14.6	114.0	94.4	94.4	87.4	108.0
Actuated g/C Ratio	0.12	0.95	0.79	0.79	0.73	0.90
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	219	1527	253	1466	1357	1425
v/s Ratio Prot	c0.08		0.00	c1.05	0.57	
v/s Ratio Perm		0.07	0.10			0.04
v/c Ratio	0.69	0.08	0.13	1.34	0.78	0.04
Uniform Delay, d1	50.5	0.2	11.5	12.8	10.2	0.6
Progression Factor	1.00	1.00	0.67	0.45	0.51	0.00
Incremental Delay, d2	7.0	0.0	0.0	153.3	0.4	0.0
Delay (s)	57.5	0.2	7.8	159.1	5.6	0.0
Level of Service	E	A	A	F	A	A
Approach Delay (s)	32.7			156.6	5.3	
Approach LOS	C			F	A	

Intersection Summary			
HCM Average Control Delay	96.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		

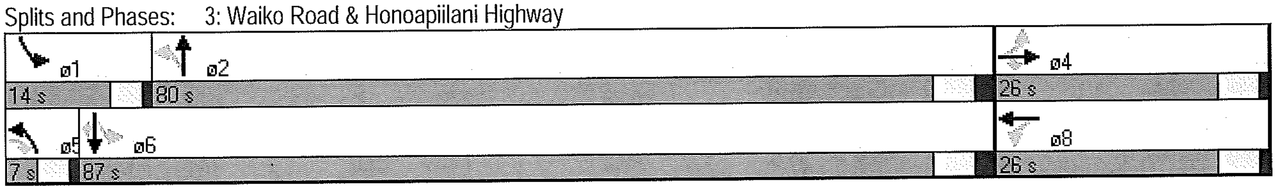
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	45	35	15	150	10	10	1195	145	870	30
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	26.0	26.0	33.0	26.0	26.0	7.0	80.0	14.0	87.0	87.0
Total Split (%)	21.7%	21.7%	27.5%	21.7%	21.7%	5.8%	66.7%	11.7%	72.5%	72.5%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 71 (59%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis

3: Waiko Road & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	35	15	150	10	110	10	1195	310	145	870	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	0.99		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Frt		1.00	0.85		0.94		1.00	0.96		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1871	1647		1709		1770	1784		1770	1863	1541
Flt Permitted		0.59	1.00		0.65		0.20	1.00		0.05	1.00	1.00
Satd. Flow (perm)		1134	1647		1140		382	1784		96	1863	1541
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	98	41	26	172	20	153	16	1328	431	220	935	56
RTOR Reduction (vph)	0	0	17	0	24	0	0	10	0	0	0	9
Lane Group Flow (vph)	0	139	9	0	321	0	16	1749	0	220	935	47
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		21.0	27.8		21.0		75.8	74.0		88.0	82.2	82.2
Effective Green, g (s)		21.0	27.8		21.0		75.8	74.0		88.0	82.2	82.2
Actuated g/C Ratio		0.18	0.23		0.18		0.63	0.62		0.73	0.69	0.69
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		198	382		200		262	1100		210	1276	1056
v/s Ratio Prot							0.00	c0.98		c0.09	0.50	
v/s Ratio Perm		0.12	0.01		c0.28		0.04			0.68		0.03
v/c Ratio		0.70	0.02		1.61		0.06	1.59		1.05	0.73	0.04
Uniform Delay, d1		46.6	35.6		49.5		11.3	23.0		43.5	12.0	6.1
Progression Factor		1.00	1.00		1.00		0.59	0.87		0.79	1.38	1.68
Incremental Delay, d2		8.8	0.0		294.2		0.0	268.3		65.6	2.7	0.1
Delay (s)		55.4	35.6		343.9		6.7	288.3		99.9	19.2	10.4
Level of Service		E	D		F		A	F		F	B	B
Approach Delay (s)		52.3			343.9			285.8			33.5	
Approach LOS		D			F			F			C	

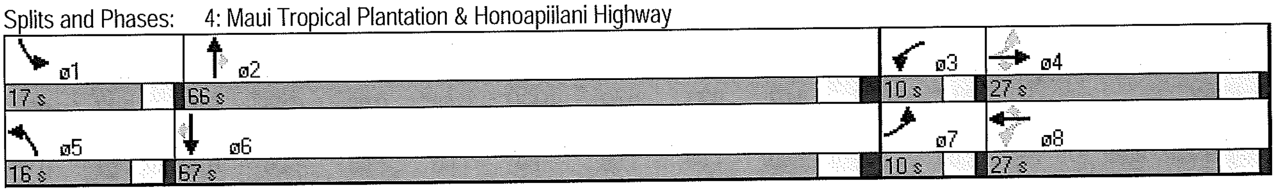
Intersection Summary			
HCM Average Control Delay	193.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.54		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	124.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	5	35	210	5	390	55	860	85	160	740	100
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	26.0	8.0	26.0	26.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	10.0	27.0	27.0	10.0	27.0	27.0	16.0	66.0	66.0	17.0	67.0	67.0
Total Split (%)	8.3%	22.5%	22.5%	8.3%	22.5%	22.5%	13.3%	55.0%	55.0%	14.2%	55.8%	55.8%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 18 (15%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 110
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	145	5	35	210	5	390	55	860	85	160	740	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1538
Flt Permitted	0.75	1.00	1.00	0.57	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1405	1863	1583	1065	1863	1583	1770	1863	1583	1770	1863	1538
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.50	0.89	0.92	0.92	0.94	0.75
Adj. Flow (vph)	158	5	38	228	5	424	110	966	92	174	787	133
RTOR Reduction (vph)	0	0	34	0	0	222	0	0	40	0	0	42
Lane Group Flow (vph)	158	5	4	228	5	202	110	966	52	174	787	91
Confl. Peds. (#/hr)							3					3
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	18.5	12.5	12.5	28.5	18.5	18.5	11.0	63.5	63.5	13.0	65.5	65.5
Effective Green, g (s)	18.5	12.5	12.5	28.5	18.5	18.5	11.0	63.5	63.5	13.0	65.5	65.5
Actuated g/C Ratio	0.15	0.10	0.10	0.24	0.15	0.15	0.09	0.53	0.53	0.11	0.55	0.55
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	235	194	165	323	287	244	162	986	838	192	1017	839
v/s Ratio Prot	0.03	0.00		c0.07	0.00		0.06	c0.52		c0.10	0.42	
v/s Ratio Perm	0.07		0.00	0.10		c0.13			0.03			0.06
v/c Ratio	0.67	0.03	0.02	0.71	0.02	0.83	0.68	0.98	0.06	0.91	0.77	0.11
Uniform Delay, d1	47.3	48.3	48.3	40.6	43.0	49.2	52.8	27.6	13.7	52.9	21.4	13.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.01	0.93
Incremental Delay, d2	7.4	0.1	0.1	6.9	0.0	19.9	10.8	24.2	0.1	25.2	3.1	0.1
Delay (s)	54.7	48.3	48.3	47.4	43.1	69.1	63.6	51.8	13.9	71.9	24.6	12.4
Level of Service	D	D	D	D	D	E	E	D	B	E	C	B
Approach Delay (s)		53.3			61.4			49.9			30.7	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	45.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

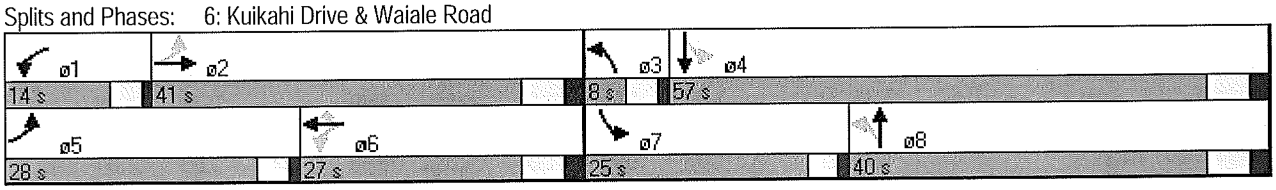
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	355	615	210	165	260	55	300	195	220
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	5	2	1	6		3	8	7	4
Permitted Phases	2		6		6	8		4	
Detector Phase	5	2	1	6	6	3	8	7	4
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	22.0	24.0	8.0	24.0	24.0	8.0	24.0	8.0	24.0
Total Split (s)	28.0	41.0	14.0	27.0	27.0	8.0	40.0	25.0	57.0
Total Split (%)	23.3%	34.2%	11.7%	22.5%	22.5%	6.7%	33.3%	20.8%	47.5%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	C-Max	None	None	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 59 (49%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 130
Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



HCM Signalized Intersection Capacity Analysis
6: Kuikahi Drive & Waiale Road

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Volume (vph)	355	615	50	210	165	260	55	300	150	195	220	460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.96		1.00	0.90	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1765	1834		1770	1863	1536	1770	1770		1770	1646	
Flt Permitted	0.43	1.00		0.18	1.00	1.00	0.10	1.00		0.09	1.00	
Satd. Flow (perm)	805	1834		328	1863	1536	189	1770		171	1646	
Peak-hour factor, PHF	0.79	0.92	0.80	0.92	0.92	0.92	0.81	0.71	0.92	0.92	0.73	0.79
Adj. Flow (vph)	449	668	62	228	179	283	68	423	163	212	301	582
RTOR Reduction (vph)	0	3	0	0	0	229	0	11	0	0	58	0
Lane Group Flow (vph)	449	727	0	228	179	54	68	575	0	212	825	0
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	49.8	35.8		32.7	22.7	22.7	42.7	39.5		58.2	51.0	
Effective Green, g (s)	49.8	35.8		32.7	22.7	22.7	42.7	39.5		58.2	51.0	
Actuated g/C Ratio	0.41	0.30		0.27	0.19	0.19	0.36	0.33		0.49	0.42	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	519	547		210	352	291	109	583		279	700	
v/s Ratio Prot	0.17	c0.40		c0.09	0.10		0.02	0.32		c0.09	c0.50	
v/s Ratio Perm	0.19			0.21		0.03	0.20			0.28		
v/c Ratio	0.87	1.33		1.09	0.51	0.18	0.62	0.99		0.76	1.18	
Uniform Delay, d1	28.3	42.1		40.0	43.6	40.9	31.3	40.0		29.9	34.5	
Progression Factor	1.01	1.01		1.00	1.00	1.00	1.04	0.96		1.00	1.00	
Incremental Delay, d2	1.5	149.4		86.8	5.2	1.4	6.0	24.3		11.3	94.7	
Delay (s)	30.2	191.7		126.8	48.8	42.3	38.5	62.8		41.2	129.2	
Level of Service	C	F		F	D	D	D	E		D	F	
Approach Delay (s)		130.2			71.9			60.3			112.2	
Approach LOS		F			E			E			F	

Intersection Summary			
HCM Average Control Delay	101.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	107.1%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	195	310	175	265	565	115
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.59	0.77	0.70	0.79	0.75	0.81
Hourly flow rate (vph)	331	403	250	335	753	142
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	585				1481	418
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	585				1481	418
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	67				0	78
cM capacity (veh/h)	989				92	635

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	733	585	895
Volume Left	331	0	753
Volume Right	0	335	142
cSH	989	1700	106
Volume to Capacity	0.33	0.34	8.42
Queue Length 95th (ft)	37	0	Err
Control Delay (s)	7.2	0.0	Err
Lane LOS	A		F
Approach Delay (s)	7.2	0.0	Err
Approach LOS			F

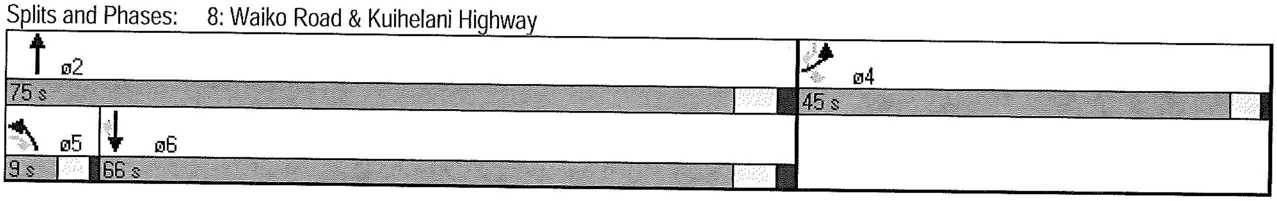
Intersection Summary			
Average Delay	4046.1		
Intersection Capacity Utilization	100.9%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	565	402	10	510	690	375
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	24.0	24.0	
Total Split (s)	45.0	54.0	9.0	75.0	66.0	111.0
Total Split (%)	37.5%	45.0%	7.5%	62.5%	55.0%	92.5%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Min	C-Min	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 65
Control Type: Actuated-Coordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	565	402	10	510	690	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	774	804	32	560	784	507
RTOR Reduction (vph)	0	63	0	0	0	96
Lane Group Flow (vph)	774	741	32	560	784	411
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	41.0	65.3	20.3	69.0	44.7	91.7
Effective Green, g (s)	41.0	65.3	20.3	69.0	44.7	91.7
Actuated g/C Ratio	0.34	0.54	0.17	0.58	0.37	0.76
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	605	861	299	2035	1318	1210
v/s Ratio Prot	c0.44		0.02	0.16	c0.22	
v/s Ratio Perm		c0.47				0.26
v/c Ratio	1.28	0.86	0.11	0.28	0.59	0.34
Uniform Delay, d1	39.5	23.5	42.2	12.9	30.4	4.5
Progression Factor	0.98	0.91	1.00	1.00	1.00	1.00
Incremental Delay, d2	137.7	8.2	0.1	0.3	2.0	0.1
Delay (s)	176.3	29.5	42.2	13.2	32.3	4.6
Level of Service	F	C	D	B	C	A
Approach Delay (s)	101.5			14.8	21.4	
Approach LOS	F			B	C	

Intersection Summary			
HCM Average Control Delay	56.8	HCM Level of Service	E
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

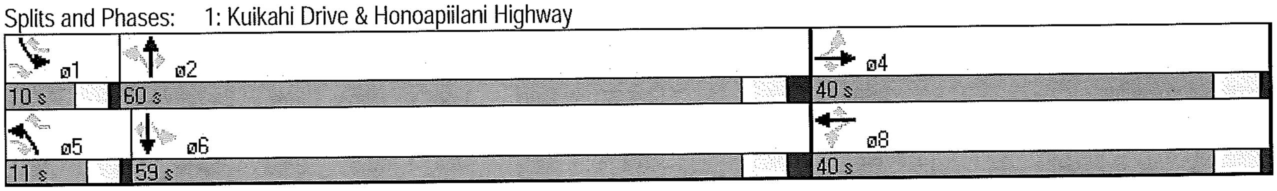
- Base Year 2030 PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	100	55	455	185	145	100	850	515	100	1010	65
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Detector Phase	4	4	4 1 5	8	8	8 5 1	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0		7.0	24.0	24.0	7.0	24.0	24.0
Total Split (s)	40.0	40.0	61.0	40.0	40.0	61.0	11.0	60.0	60.0	10.0	59.0	59.0
Total Split (%)	36.4%	36.4%	55.5%	36.4%	36.4%	55.5%	10.0%	54.5%	54.5%	9.1%	53.6%	53.6%
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Min	C-Min	None	C-Min	C-Min

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 48 (44%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 130
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
1: Kuikahi Drive & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	100	55	455	185	145	100	850	515	100	1010	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99	1.00		0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1882	1623		1804	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.14	1.00		0.58	1.00	0.07	1.00	1.00	0.08	1.00	1.00
Satd. Flow (perm)		262	1623		1083	1583	138	1863	1583	141	1863	1583
Peak-hour factor, PHF	0.66	0.66	0.76	0.81	0.62	0.91	0.68	0.80	0.77	0.73	0.89	0.43
Adj. Flow (vph)	61	152	72	562	298	159	147	1062	669	137	1135	151
RTOR Reduction (vph)	0	0	26	0	0	35	0	0	185	0	0	39
Lane Group Flow (vph)	0	213	46	0	860	124	147	1062	484	137	1135	112
Turn Type	Perm		custom	Perm		custom	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 1 5	8		8 5 1	2		2	6		6
Actuated Green, G (s)		35.0	47.0		35.0	47.0	61.0	54.0	54.0	59.0	53.0	53.0
Effective Green, g (s)		35.0	47.0		35.0	47.0	61.0	54.0	54.0	59.0	53.0	53.0
Actuated g/C Ratio		0.32	0.43		0.32	0.43	0.55	0.49	0.49	0.54	0.48	0.48
Clearance Time (s)		5.0			5.0		4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0	5.0	2.0	5.0	5.0
Lane Grp Cap (vph)		83	693		345	676	180	915	777	164	898	763
v/s Ratio Prot							c0.05	0.57		0.05	c0.61	
v/s Ratio Perm		c0.81	0.03		0.79	0.08	0.40		0.31	0.40		0.07
v/c Ratio		2.57	0.07		2.49	0.18	0.82	1.16	0.62	0.84	1.26	0.15
Uniform Delay, d1		37.5	18.6		37.5	19.6	25.8	28.0	20.5	24.6	28.5	15.9
Progression Factor		1.00	1.00		0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		738.7	0.0		676.7	0.0	22.9	84.5	3.7	28.0	127.7	0.4
Delay (s)		776.2	18.6		712.4	19.5	48.8	112.5	24.3	52.6	156.2	16.3
Level of Service		F	B		F	B	D	F	C	D	F	B
Approach Delay (s)		584.8			604.3			76.1			131.4	
Approach LOS		F			F			E			F	

Intersection Summary			
HCM Average Control Delay	241.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.71		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	112.8%	ICU Level of Service	H
Analysis Period (min)	15		

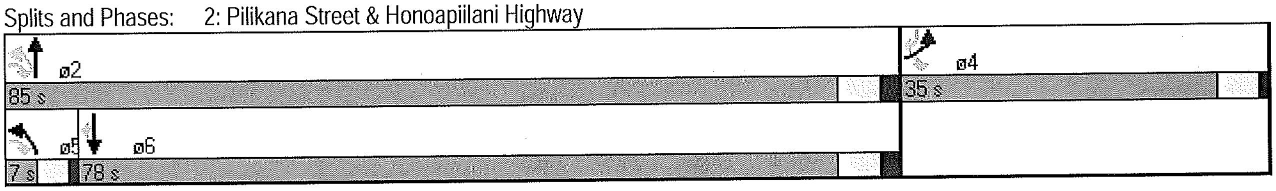
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	1270	1380	115
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	35.0	127.0	7.0	85.0	78.0	113.0
Total Split (%)	29.2%	105.8%	5.8%	70.8%	65.0%	94.2%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 87 (73%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	1270	1380	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1551
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	77	1863	1863	1551
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	66	62	86	1841	1568	134
RTOR Reduction (vph)	0	0	0	0	0	13
Lane Group Flow (vph)	66	62	86	1841	1568	121
Confl. Peds. (#/hr)			1			1
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	9.0	120.0	100.0	100.0	93.0	108.0
Effective Green, g (s)	9.0	114.0	100.0	100.0	93.0	108.0
Actuated g/C Ratio	0.08	0.95	0.83	0.83	0.78	0.90
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	135	1527	106	1553	1444	1396
v/s Ratio Prot	c0.04		0.02	c0.99	0.84	
v/s Ratio Perm		0.04	0.65			0.08
v/c Ratio	0.49	0.04	0.81	1.19	1.09	0.09
Uniform Delay, d1	53.3	0.2	41.3	10.0	13.5	0.7
Progression Factor	1.00	1.00	0.97	2.21	1.00	1.00
Incremental Delay, d2	1.0	0.0	4.1	84.1	50.7	0.0
Delay (s)	54.3	0.2	44.2	106.2	64.2	0.7
Level of Service	D	A	D	F	E	A
Approach Delay (s)	28.1			103.5	59.2	
Approach LOS	C			F	E	

Intersection Summary			
HCM Average Control Delay	80.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	15	25	20	240	45	15	1085	75	1330	40
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	41.0	41.0	48.0	41.0	41.0	7.0	69.0	10.0	72.0	72.0
Total Split (%)	34.2%	34.2%	40.0%	34.2%	34.2%	5.8%	57.5%	8.3%	60.0%	60.0%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120

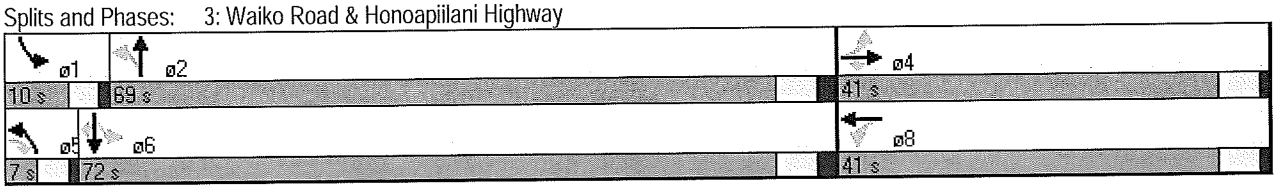
Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection

Natural Cycle: 150

Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
3: Waiko Road & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		↰↑↱		↰	↑↱		↰	↑	↱
Volume (vph)	15	25	20	240	45	155	15	1085	410	75	1330	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.95		1.00	0.95		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1887	1647		1729		1770	1773		1770	1863	1536
Flt Permitted		0.71	1.00		0.82		0.06	1.00		0.06	1.00	1.00
Satd. Flow (perm)		1376	1647		1447		118	1773		112	1863	1536
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	33	29	34	276	90	215	24	1206	569	114	1430	74
RTOR Reduction (vph)	0	0	20	0	18	0	0	14	0	0	0	8
Lane Group Flow (vph)	0	62	14	0	564	0	24	1761	0	114	1430	66
Confl. Peds. (#/hr)							3					3
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		36.0	43.4		36.0		65.4	63.0		72.6	66.6	66.6
Effective Green, g (s)		36.0	43.4		36.0		65.4	63.0		72.6	66.6	66.6
Actuated g/C Ratio		0.30	0.36		0.30		0.55	0.52		0.60	0.55	0.55
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		413	596		434		97	931		151	1034	852
v/s Ratio Prot							0.00	c0.99		c0.04	0.77	
v/s Ratio Perm		0.05	0.01		c0.39		0.13			0.42		0.04
v/c Ratio		0.15	0.02		1.30		0.25	1.89		0.75	1.38	0.08
Uniform Delay, d1		30.8	24.7		42.0		27.3	28.5		27.9	26.7	12.4
Progression Factor		1.00	1.00		0.93		0.48	0.81		1.27	0.57	0.29
Incremental Delay, d2		0.1	0.0		147.7		0.0	401.4		1.8	172.9	0.0
Delay (s)		30.8	24.7		186.6		13.1	424.4		37.1	188.0	3.6
Level of Service		C	C		F		B	F		D	F	A
Approach Delay (s)		28.7			186.6			418.9			168.9	
Approach LOS		C			F			F			F	

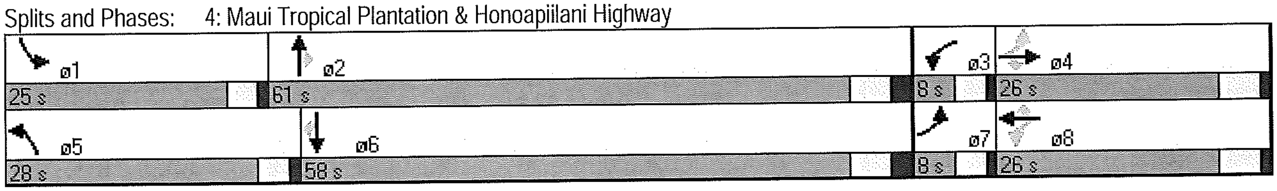
Intersection Summary			
HCM Average Control Delay	278.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	123.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	245	5	75	220	5	410	170	925	305	560	680	305
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	26.0	8.0	26.0	26.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	8.0	26.0	26.0	8.0	26.0	26.0	28.0	61.0	61.0	25.0	58.0	58.0
Total Split (%)	6.7%	21.7%	21.7%	6.7%	21.7%	21.7%	23.3%	50.8%	50.8%	20.8%	48.3%	48.3%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 62 (52%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	245	5	75	220	5	410	170	925	305	560	680	305
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.75	1.00	1.00	0.65	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1405	1863	1583	1205	1863	1583	1770	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.50	0.89	0.92	0.92	0.94	0.75
Adj. Flow (vph)	266	5	82	239	5	446	340	1039	332	609	723	407
RTOR Reduction (vph)	0	0	73	0	0	297	0	0	131	0	0	139
Lane Group Flow (vph)	266	5	9	239	5	149	340	1039	201	609	723	268
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.2	13.2	13.2	21.6	15.4	15.4	24.0	60.6	60.6	21.0	57.6	57.6
Effective Green, g (s)	17.2	13.2	13.2	21.6	15.4	15.4	24.0	60.6	60.6	21.0	57.6	57.6
Actuated g/C Ratio	0.14	0.11	0.11	0.18	0.13	0.13	0.20	0.51	0.51	0.18	0.48	0.48
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	214	205	174	246	239	203	354	941	799	310	894	760
v/s Ratio Prot	0.04	0.00		c0.05	0.00		0.19	c0.56		c0.34	0.39	
v/s Ratio Perm	c0.14		0.01	0.12		0.09			0.13			0.17
v/c Ratio	1.24	0.02	0.05	0.97	0.02	0.73	0.96	1.10	0.25	1.96	0.81	0.35
Uniform Delay, d1	51.0	47.7	47.8	48.7	45.7	50.3	47.5	29.7	16.8	49.5	26.5	19.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.19	0.72	0.45
Incremental Delay, d2	142.4	0.0	0.1	49.2	0.0	12.8	37.3	62.2	0.8	435.1	0.8	0.1
Delay (s)	193.4	47.7	47.9	97.8	45.7	63.1	84.9	91.9	17.6	493.9	19.9	8.9
Level of Service	F	D	D	F	D	E	F	F	B	F	B	A
Approach Delay (s)		157.6			75.0			76.1			183.3	
Approach LOS		F			E			E			F	

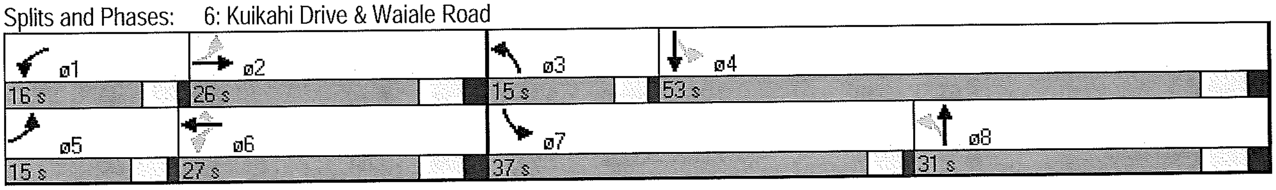
Intersection Summary			
HCM Average Control Delay	123.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Volume (vph)	210	480	275	160	545	50	130	410	130
Turn Type	pm+pt		pm+pt		Perm	pm+pt		pm+pt	
Protected Phases	5	2	1	6		3	8	7	4
Permitted Phases	2		6		6	8		4	
Detector Phase	5	2	1	6	6	3	8	7	4
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	24.0	8.0	24.0	24.0	8.0	24.0	8.0	24.0
Total Split (s)	15.0	26.0	16.0	27.0	27.0	15.0	31.0	37.0	53.0
Total Split (%)	13.6%	23.6%	14.5%	24.5%	24.5%	13.6%	28.2%	33.6%	48.2%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	6.0	4.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	C-Max	None	None	None	None

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 108 (98%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 140
Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



HCM Signalized Intersection Capacity Analysis
6: Kuikahi Drive & Waiale Road

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Volume (vph)	210	480	60	275	160	545	50	130	160	410	130	545
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.93		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1763	1821		1770	1863	1537	1770	1702		1770	1603	
Flt Permitted	0.60	1.00		0.16	1.00	1.00	0.14	1.00		0.24	1.00	
Satd. Flow (perm)	1106	1821		291	1863	1537	262	1702		448	1603	
Peak-hour factor, PHF	0.79	0.92	0.80	0.92	0.92	0.92	0.81	0.71	0.92	0.92	0.73	0.79
Adj. Flow (vph)	266	522	75	299	174	592	62	183	174	446	178	690
RTOR Reduction (vph)	0	5	0	0	0	454	0	30	0	0	126	0
Lane Group Flow (vph)	266	592	0	299	174	138	62	327	0	446	742	0
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	35.4	24.5		37.6	25.6	25.6	34.5	28.4		57.5	47.4	
Effective Green, g (s)	35.4	24.5		37.6	25.6	25.6	34.5	28.4		57.5	47.4	
Actuated g/C Ratio	0.32	0.22		0.34	0.23	0.23	0.31	0.26		0.52	0.43	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	421	406		261	434	358	166	439		536	691	
v/s Ratio Prot	0.06	c0.33		c0.13	0.09		0.02	0.19		c0.19	c0.46	
v/s Ratio Perm	0.14			0.27		0.09	0.10			0.25		
v/c Ratio	0.63	1.46		1.15	0.40	0.38	0.37	0.75		0.83	1.07	
Uniform Delay, d1	30.2	42.8		31.1	35.7	35.6	29.7	37.5		19.4	31.3	
Progression Factor	0.88	0.94		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	207.8		100.8	2.7	3.1	1.4	6.8		10.6	55.6	
Delay (s)	26.8	247.9		131.9	38.5	38.7	31.1	44.2		30.0	86.9	
Level of Service	C	F		F	D	D	C	D		C	F	
Approach Delay (s)		179.8			64.8			42.3			67.6	
Approach LOS		F			E			D			E	

Intersection Summary			
HCM Average Control Delay	90.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	104.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	260	250	330	255	345	95
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.59	0.77	0.70	0.79	0.75	0.81
Hourly flow rate (vph)	441	325	471	323	460	117
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	794				1839	633
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	794				1839	633
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	47				0	76
cM capacity (veh/h)	827				39	480

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	765	794	577
Volume Left	441	0	460
Volume Right	0	323	117
cSH	827	1700	48
Volume to Capacity	0.53	0.47	12.11
Queue Length 95th (ft)	80	0	Err
Control Delay (s)	12.1	0.0	Err
Lane LOS	B		F
Approach Delay (s)	12.1	0.0	Err
Approach LOS			F

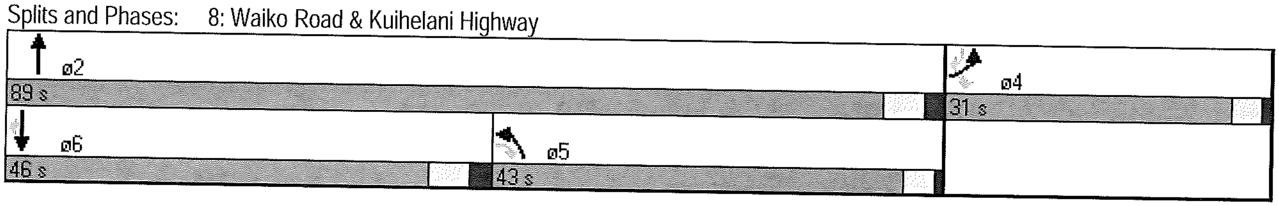
Intersection Summary			
Average Delay	2705.6		
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	375	215	145	960	855	515
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	24.0	24.0	
Total Split (s)	31.0	74.0	43.0	89.0	46.0	77.0
Total Split (%)	25.8%	61.7%	35.8%	74.2%	38.3%	64.2%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	C-Min	C-Min	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 40 (33%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	375	215	145	960	855	515
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	514	430	468	1055	972	696
RTOR Reduction (vph)	0	9	0	0	0	67
Lane Group Flow (vph)	514	421	468	1055	972	629
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	27.0	65.9	34.9	83.0	44.1	75.1
Effective Green, g (s)	27.0	65.9	34.9	83.0	44.1	71.1
Actuated g/C Ratio	0.22	0.55	0.29	0.69	0.37	0.59
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	398	869	515	2448	1301	938
v/s Ratio Prot	c0.29		c0.26	0.30	c0.27	
v/s Ratio Perm		0.27				0.40
v/c Ratio	1.29	0.48	0.91	0.43	0.75	0.67
Uniform Delay, d1	46.5	16.6	41.0	8.1	33.1	16.5
Progression Factor	0.87	0.73	1.00	1.00	1.00	1.00
Incremental Delay, d2	146.7	0.1	19.4	0.6	4.0	1.5
Delay (s)	187.2	12.2	60.4	8.7	37.0	18.0
Level of Service	F	B	E	A	D	B
Approach Delay (s)	107.5			24.6	29.1	
Approach LOS	F			C	C	

Intersection Summary			
HCM Average Control Delay	45.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

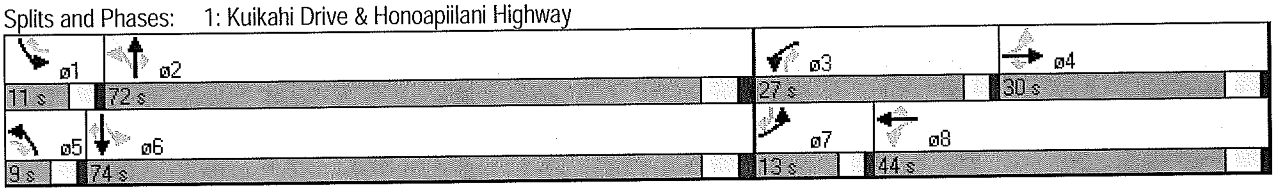
- Base Year 2020 with Mitigative Measures AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	400	75	225	50	890	595	155	510	25
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	30.0		7.0	30.0	
Total Split (s)	13.0	30.0	39.0	27.0	44.0	55.0	9.0	72.0	99.0	11.0	74.0	87.0
Total Split (%)	9.3%	21.4%	27.9%	19.3%	31.4%	39.3%	6.4%	51.4%	70.7%	7.9%	52.9%	62.1%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 112 (80%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	105	260	110	400	75	225	50	890	595	155	510	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1547	1770	1863	1543
Flt Permitted	0.68	1.00	1.00	0.14	1.00	1.00	0.27	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	1297	1909	1623	257	1863	1583	511	1863	1547	110	1863	1543
Peak-hour factor, PHF	0.66	0.66	0.76	0.81	0.62	0.91	0.68	0.80	0.77	0.73	0.89	0.43
Adj. Flow (vph)	159	394	145	494	121	247	74	1112	773	212	573	58
RTOR Reduction (vph)	0	0	84	0	0	55	0	0	17	0	0	23
Lane Group Flow (vph)	159	394	61	494	121	192	74	1112	756	212	573	35
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	33.9	25.0	35.0	52.0	39.1	51.1	71.0	66.0	95.0	75.0	68.0	82.9
Effective Green, g (s)	33.9	25.0	35.0	52.0	39.1	51.1	71.0	66.0	95.0	75.0	68.0	82.9
Actuated g/C Ratio	0.24	0.18	0.25	0.37	0.28	0.37	0.51	0.47	0.68	0.54	0.49	0.59
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	347	341	406	344	520	578	304	878	1050	142	905	914
v/s Ratio Prot	0.03	0.21		c0.24	0.06		0.01	0.60		c0.07	0.31	
v/s Ratio Perm	0.08		0.04	c0.30		0.12	0.11		0.49	c0.73		0.02
v/c Ratio	0.46	1.16	0.15	1.44	0.23	0.33	0.24	1.27	0.72	1.49	0.63	0.04
Uniform Delay, d1	44.1	57.5	40.9	42.8	38.9	32.1	20.3	37.0	14.1	40.1	26.7	11.9
Progression Factor	1.00	1.00	1.00	0.98	1.01	0.98	0.62	0.79	1.08	1.00	1.00	1.00
Incremental Delay, d2	0.4	98.0	0.1	210.7	0.1	0.1	0.0	120.8	0.2	255.2	3.4	0.0
Delay (s)	44.4	155.5	41.0	252.7	39.3	31.5	12.6	150.1	15.5	295.3	30.1	11.9
Level of Service	D	F	D	F	D	C	B	F	B	F	C	B
Approach Delay (s)		106.4			159.4			91.8			95.5	
Approach LOS		F			F			F			F	

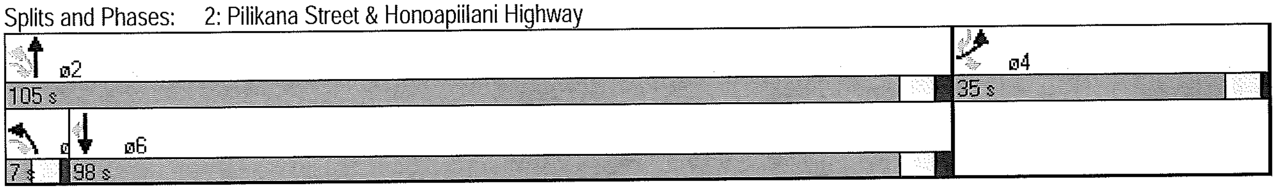
Intersection Summary			
HCM Average Control Delay	108.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.44		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	107.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	1355	930	55
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	35.0	147.0	7.0	105.0	98.0	133.0
Total Split (%)	25.0%	105.0%	5.0%	75.0%	70.0%	95.0%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 19 (14%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	1355	930	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1551
Flt Permitted	0.95	1.00	0.16	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	306	1863	1863	1551
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	151	115	32	1964	1057	64
RTOR Reduction (vph)	0	0	0	0	0	5
Lane Group Flow (vph)	151	115	32	1964	1057	59
Confl. Peds. (#/hr)			1			1
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	16.2	140.0	112.8	112.8	105.8	128.0
Effective Green, g (s)	16.2	134.0	112.8	112.8	105.8	128.0
Actuated g/C Ratio	0.12	0.96	0.81	0.81	0.76	0.91
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	208	1538	278	1501	1408	1418
v/s Ratio Prot	c0.08		0.00	c1.05	0.57	
v/s Ratio Perm		0.07	0.09			0.04
v/c Ratio	0.73	0.07	0.12	1.31	0.75	0.04
Uniform Delay, d1	59.8	0.1	11.0	13.6	9.7	0.5
Progression Factor	1.00	1.00	0.65	0.57	0.97	4.82
Incremental Delay, d2	10.2	0.0	0.0	139.3	1.5	0.0
Delay (s)	69.9	0.1	7.1	147.0	10.9	2.6
Level of Service	E	A	A	F	B	A
Approach Delay (s)	39.8			144.8	10.4	
Approach LOS	D			F	B	

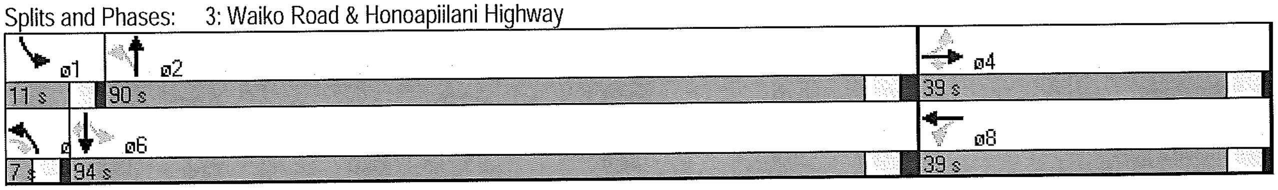
Intersection Summary			
HCM Average Control Delay	92.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	45	35	15	150	10	10	1195	145	870	30
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	39.0	39.0	46.0	39.0	39.0	7.0	90.0	11.0	94.0	94.0
Total Split (%)	27.9%	27.9%	32.9%	27.9%	27.9%	5.0%	64.3%	7.9%	67.1%	67.1%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
3: Waiko Road & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	35	15	150	10	110	10	1195	310	145	870	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	0.99		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.94		1.00	0.96		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1871	1647		1709		1770	1784		1770	1863	1540
Flt Permitted		0.59	1.00		0.68		0.15	1.00		0.05	1.00	1.00
Satd. Flow (perm)		1140	1647		1197		286	1784		85	1863	1540
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	98	41	26	172	20	153	16	1328	431	220	935	56
RTOR Reduction (vph)	0	0	14	0	20	0	0	8	0	0	0	8
Lane Group Flow (vph)	0	139	12	0	325	0	16	1751	0	220	935	48
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		34.0	40.8		34.0		85.8	84.0		95.0	89.2	89.2
Effective Green, g (s)		34.0	40.8		34.0		85.8	84.0		95.0	89.2	89.2
Actuated g/C Ratio		0.24	0.29		0.24		0.61	0.60		0.68	0.64	0.64
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		277	480		291		194	1070		142	1187	981
v/s Ratio Prot							0.00	c0.98		c0.08	0.50	
v/s Ratio Perm		0.12	0.01		c0.27		0.05			0.98		0.03
v/c Ratio		0.50	0.02		1.12		0.08	1.64		1.55	0.79	0.05
Uniform Delay, d1		45.7	35.4		53.0		17.6	28.0		47.6	18.5	9.5
Progression Factor		1.00	1.00		1.00		0.92	0.83		1.18	1.03	1.43
Incremental Delay, d2		0.5	0.0		87.4		0.0	289.0		271.4	4.0	0.1
Delay (s)		46.2	35.4		140.4		16.3	312.1		327.3	23.1	13.7
Level of Service		D	D		F		B	F		F	C	B
Approach Delay (s)		44.5			140.4			309.4			77.9	
Approach LOS		D			F			F			E	

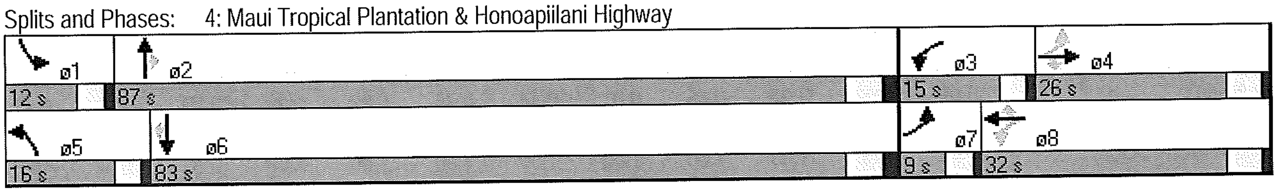
Intersection Summary			
HCM Average Control Delay	200.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.49		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	124.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	5	35	210	5	390	55	860	85	160	740	100
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	26.0	8.0	26.0	26.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	9.0	26.0	26.0	15.0	32.0	32.0	16.0	87.0	87.0	12.0	83.0	83.0
Total Split (%)	6.4%	18.6%	18.6%	10.7%	22.9%	22.9%	11.4%	62.1%	62.1%	8.6%	59.3%	59.3%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 129 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰↰	↑	↱
Volume (vph)	145	5	35	210	5	390	55	860	85	160	740	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1536
Flt Permitted	0.75	1.00	1.00	0.61	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1405	1863	1583	1133	1863	1583	1770	1863	1583	3433	1863	1536
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.50	0.89	0.92	0.92	0.94	0.75
Adj. Flow (vph)	158	5	38	228	5	424	110	966	92	174	787	133
RTOR Reduction (vph)	0	0	33	0	0	177	0	0	12	0	0	38
Lane Group Flow (vph)	158	5	5	228	5	247	110	966	80	174	787	95
Confl. Peds. (#/hr)							3					3
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	21.6	16.6	16.6	35.1	26.1	26.1	11.4	81.9	81.9	8.0	78.5	78.5
Effective Green, g (s)	21.6	16.6	16.6	35.1	26.1	26.1	11.4	81.9	81.9	8.0	78.5	78.5
Actuated g/C Ratio	0.15	0.12	0.12	0.25	0.19	0.19	0.08	0.59	0.59	0.06	0.56	0.56
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	230	221	188	350	347	295	144	1090	926	196	1045	861
v/s Ratio Prot	0.02	0.00		c0.07	0.00		c0.06	c0.52		0.05	0.42	
v/s Ratio Perm	0.08		0.00	0.10		c0.16			0.05			0.06
v/c Ratio	0.69	0.02	0.02	0.65	0.01	0.84	0.76	0.89	0.09	0.89	0.75	0.11
Uniform Delay, d1	55.4	54.5	54.5	45.4	46.5	54.9	63.0	25.0	12.7	65.6	23.4	14.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	1.11	1.63
Incremental Delay, d2	8.2	0.0	0.1	4.3	0.0	18.4	21.1	10.6	0.2	22.7	2.9	0.1
Delay (s)	63.7	54.6	54.6	49.7	46.5	73.4	84.0	35.7	12.9	77.3	28.8	23.6
Level of Service	E	D	D	D	D	E	F	D	B	E	C	C
Approach Delay (s)		61.7			65.0			38.4			35.9	
Approach LOS		E			E			D			D	

Intersection Summary			
HCM Average Control Delay	44.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

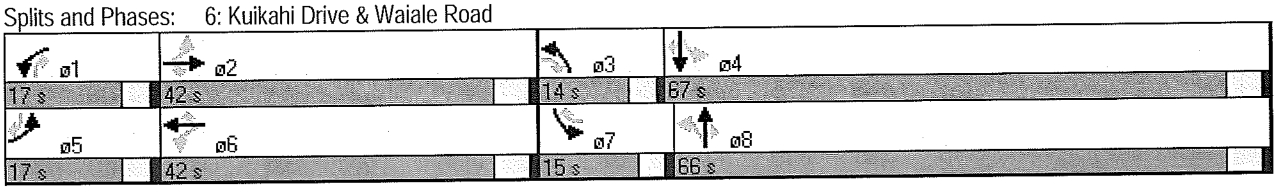
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	355	615	50	210	165	260	55	300	150	195	220	460
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	29.0		8.0	29.0		8.0	29.0		8.0	29.0	
Total Split (s)	17.0	42.0	56.0	17.0	42.0	57.0	14.0	66.0	83.0	15.0	67.0	84.0
Total Split (%)	12.1%	30.0%	40.0%	12.1%	30.0%	40.7%	10.0%	47.1%	59.3%	10.7%	47.9%	60.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max		None	C-Max		None	None		None	None	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 17 (12%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	355	615	50	210	165	260	55	300	150	195	220	460
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1763	1863	1538	1770	1863	1538	1767	1863	1538	1770	1863	1538
Flt Permitted	0.60	1.00	1.00	0.11	1.00	1.00	0.39	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	1116	1863	1538	210	1863	1538	728	1863	1538	332	1863	1538
Peak-hour factor, PHF	0.79	0.92	0.80	0.92	0.92	0.92	0.81	0.73	0.92	0.92	0.73	0.79
Adj. Flow (vph)	449	668	62	228	179	283	68	411	163	212	301	582
RTOR Reduction (vph)	0	0	9	0	0	130	0	0	42	0	0	296
Lane Group Flow (vph)	449	668	53	228	179	153	68	411	122	212	301	286
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	72.0	59.0	72.7	72.0	59.0	75.0	47.7	39.0	57.0	52.3	41.3	59.3
Effective Green, g (s)	72.0	59.0	72.7	72.0	59.0	75.0	47.7	39.0	57.0	52.3	41.3	59.3
Actuated g/C Ratio	0.51	0.42	0.52	0.51	0.42	0.54	0.34	0.28	0.41	0.37	0.29	0.42
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0		4.0	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)	634	785	799	253	785	824	313	519	626	237	550	651
v/s Ratio Prot	0.07	0.36		c0.08	0.10		0.01	0.22		c0.07	0.16	
v/s Ratio Perm	0.30		0.03	c0.38		0.10	0.06		0.08	c0.26		0.19
v/c Ratio	0.71	0.85	0.07	0.90	0.23	0.19	0.22	0.79	0.19	0.89	0.55	0.44
Uniform Delay, d1	24.4	36.5	16.8	30.8	25.9	16.8	32.2	46.7	26.7	36.3	41.5	28.6
Progression Factor	0.75	0.80	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	3.5	0.0	31.8	0.7	0.1	0.4	8.1	0.2	31.8	1.1	0.5
Delay (s)	19.3	32.8	11.7	62.6	26.6	16.9	32.6	54.8	26.9	68.1	42.6	29.1
Level of Service	B	C	B	E	C	B	C	D	C	E	D	C
Approach Delay (s)		26.5			34.5			45.4			40.3	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	35.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Right Turn Channelized						
Volume (veh/h)	195	310	175	265	565	115
Peak Hour Factor	0.59	0.77	0.70	0.79	0.75	0.81
Hourly flow rate (vph)	331	403	250	335	753	142
Approach Volume (veh/h)		733	585		895	
Crossing Volume (veh/h)		753	331		250	
High Capacity (veh/h)		761	1068		1138	
High v/c (veh/h)		0.96	0.55		0.79	
Low Capacity (veh/h)		603	875		938	
Low v/c (veh/h)		1.22	0.67		0.95	

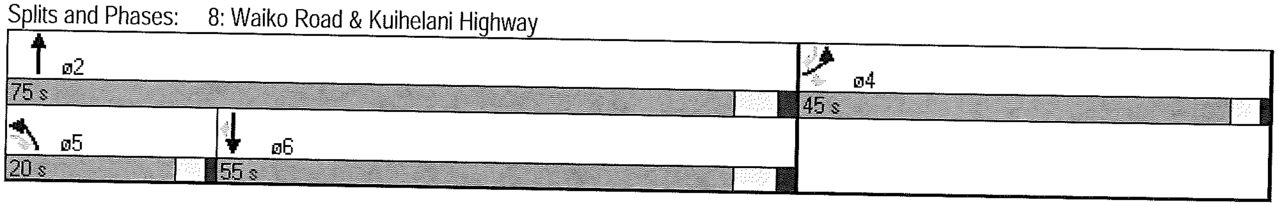
Intersection Summary			
Maximum v/c High	0.96		
Maximum v/c Low	1.22		
Intersection Capacity Utilization	100.9%	ICU Level of Service	G

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	565	402	10	510	690	375
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	24.0	24.0	
Total Split (s)	45.0	65.0	20.0	75.0	55.0	100.0
Total Split (%)	37.5%	54.2%	16.7%	62.5%	45.8%	83.3%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Min	C-Min	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	565	402	10	510	690	375
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	774	804	32	560	784	507
RTOR Reduction (vph)	0	42	0	0	0	101
Lane Group Flow (vph)	774	762	32	560	784	406
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	41.0	61.0	16.0	69.0	49.0	96.0
Effective Green, g (s)	41.0	61.0	16.0	69.0	49.0	96.0
Actuated g/C Ratio	0.34	0.51	0.13	0.58	0.41	0.80
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	1173	805	236	2035	1445	1266
v/s Ratio Prot	0.23		0.02	0.16	c0.22	
v/s Ratio Perm		c0.48				0.26
v/c Ratio	0.66	0.95	0.14	0.28	0.54	0.32
Uniform Delay, d1	33.6	28.0	45.9	12.9	27.0	3.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	19.5	0.1	0.3	1.5	0.1
Delay (s)	34.6	47.5	46.0	13.2	28.4	3.3
Level of Service	C	D	D	B	C	A
Approach Delay (s)	41.2			15.0	18.6	
Approach LOS	D			B	B	

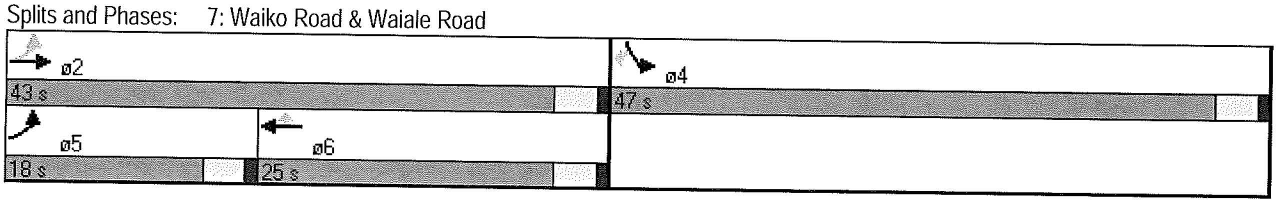
Intersection Summary			
HCM Average Control Delay	28.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	195	310	175	265	565	115
Turn Type	pm+pt			Perm		Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Detector Phase	5	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	8.0	22.0	22.0	22.0	22.0
Total Split (s)	18.0	43.0	25.0	25.0	47.0	47.0
Total Split (%)	20.0%	47.8%	27.8%	27.8%	52.2%	52.2%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	None	None	None	None	None

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 80.2
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	195	310	175	265	565	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.31	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	571	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.59	0.77	0.70	0.79	0.75	0.81
Adj. Flow (vph)	331	403	250	335	753	142
RTOR Reduction (vph)	0	0	0	265	0	38
Lane Group Flow (vph)	331	403	250	70	753	104
Turn Type	pm+pt			Perm		Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	34.4	34.4	16.7	16.7	37.5	37.5
Effective Green, g (s)	34.4	34.4	16.7	16.7	37.5	37.5
Actuated g/C Ratio	0.43	0.43	0.21	0.21	0.47	0.47
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	451	802	389	331	831	743
v/s Ratio Prot	c0.13	0.22	0.13		c0.43	
v/s Ratio Perm	c0.19			0.04		0.07
v/c Ratio	0.73	0.50	0.64	0.21	0.91	0.14
Uniform Delay, d1	16.9	16.5	28.9	26.2	19.6	12.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.1	0.5	3.6	0.3	13.3	0.1
Delay (s)	23.0	17.0	32.5	26.5	32.9	12.1
Level of Service	C	B	C	C	C	B
Approach Delay (s)		19.7	29.0		29.6	
Approach LOS		B	C		C	

Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	79.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

```
*************************************************************************
*                                                                       *
*   9:2:10                08+557 WAIALE+WAIKO   BY 2030 AM          13  *
*                                                                       *
*************************************************************************
*                                             *                         *
* E     (m)    4.60   4.60   4.60             * TIME PERIOD    min    90 *
* L'    (m)   10.00  10.00  10.00             * TIME SLICE     min    15 *
* V     (m)    3.70   3.70   3.70             * RESULTS PERIOD min 15 75 *
* RAD   (m)   20.00  20.00  20.00             * TIME COST    $/hr 15.00 *
* PHI   (d)   30.00  30.00  30.00             * FLOW PERIOD    min 15 75 *
* DIA   (m)   37.00  37.00  37.00             * FLOW TYPE  pcu/veh   VEH *
* GRAD SEP        0      0      0             * FLOW PEAK am/op/pm    AM *
*                                             *                         *
*************************************************************************
 LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO  *FLOW TIME*
*         *    *                            *    *  *              *          *
*WB WAIKO *1.05*  295  135    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*SB WAIALE *1.05* 115  565    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB WAIKO *1.05*  310  195    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*         *    *                            *    *  *              *          *
*         *    *                            *    *  *              *          *
*         *    *                            *    *  *              *          *
*         *    *                            *    *  *              *          *
*************************************************************************
*                                                      *                *
* FLOW        veh     430    680    505                *                *
* CAPACITY    veh    1029   1063    817                * AVDEL s    9.3 *
* AVE DELAY  mins    0.10   0.16   0.20                * L O S        A *
* MAX DELAY  mins    0.13   0.23   0.31                * VEH HRS    4.2 *
* AVE QUEUE   veh       1      2      2                * COST $    62.7 *
* MAX QUEUE   veh       1      2      2                *                *
*                                                      *                *
*************************************************************************
```

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2020 with Mitigative Measures PM

Timings

1: Kuikahi Drive & Honoapiilani Highway

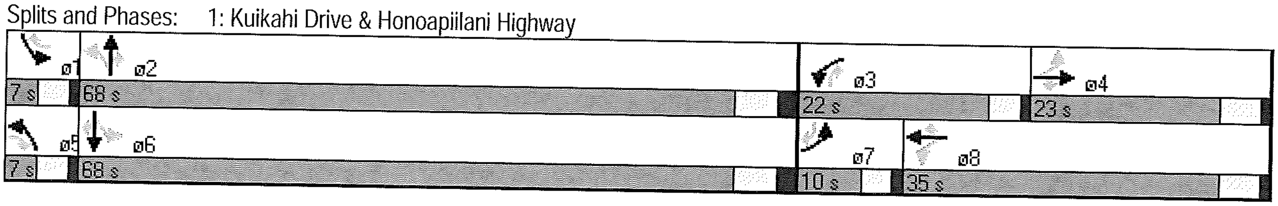
1/21/2010

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	100	55	455	185	145	100	850	515	100	1010	65
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	30.0		7.0	30.0	
Total Split (s)	10.0	23.0	30.0	22.0	35.0	42.0	7.0	68.0	90.0	7.0	68.0	78.0
Total Split (%)	8.3%	19.2%	25.0%	18.3%	29.2%	35.0%	5.8%	56.7%	75.0%	5.8%	56.7%	65.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 50 (42%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	40	100	55	455	185	145	100	850	515	100	1010	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1548	1770	1863	1544
Flt Permitted	0.50	1.00	1.00	0.33	1.00	1.00	0.06	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	963	1909	1623	614	1863	1583	112	1863	1548	112	1863	1544
Peak-hour factor, PHF	0.66	0.66	0.76	0.81	0.62	0.91	0.68	0.80	0.77	0.73	0.89	0.43
Adj. Flow (vph)	61	152	72	562	298	159	147	1062	669	137	1135	151
RTOR Reduction (vph)	0	0	43	0	0	85	0	0	63	0	0	31
Lane Group Flow (vph)	61	152	29	562	298	74	147	1062	606	137	1135	120
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	19.6	13.6	21.6	35.6	25.6	33.6	69.4	66.4	90.4	69.4	66.4	78.4
Effective Green, g (s)	19.6	13.6	21.6	35.6	25.6	33.6	69.4	66.4	90.4	69.4	66.4	78.4
Actuated g/C Ratio	0.16	0.11	0.18	0.30	0.21	0.28	0.58	0.55	0.75	0.58	0.55	0.65
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	200	216	292	356	397	443	106	1031	1166	106	1031	1009
v/s Ratio Prot	0.02	0.08		c0.24	0.16		c0.03	0.57		0.03	0.61	
v/s Ratio Perm	0.03		0.02	c0.23		0.05	c0.76		0.39	0.71		0.08
v/c Ratio	0.30	0.70	0.10	1.58	0.75	0.17	1.39	1.03	0.52	1.29	1.10	0.12
Uniform Delay, d1	43.5	51.3	41.1	39.1	44.2	32.6	30.5	26.8	6.0	30.5	26.8	7.8
Progression Factor	1.00	1.00	1.00	0.99	1.00	0.98	1.38	0.92	0.47	1.00	1.00	1.00
Incremental Delay, d2	0.3	8.2	0.1	271.8	6.0	0.1	179.4	17.7	0.0	185.0	59.8	0.0
Delay (s)	43.8	59.5	41.1	310.5	50.2	31.9	221.3	42.2	2.9	215.5	86.6	7.8
Level of Service	D	E	D	F	D	C	F	D	A	F	F	A
Approach Delay (s)		51.5			190.9			42.2			90.7	
Approach LOS		D			F			D			F	

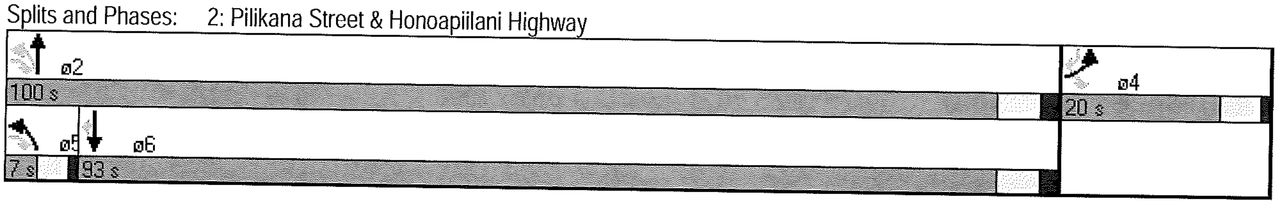
Intersection Summary			
HCM Average Control Delay	90.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.40		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	104.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	1270	1380	115
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	20.0	127.0	7.0	100.0	93.0	113.0
Total Split (%)	16.7%	105.8%	5.8%	83.3%	77.5%	94.2%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 107 (89%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	1270	1380	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1551
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	77	1863	1863	1551
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	66	62	86	1841	1568	134
RTOR Reduction (vph)	0	0	0	0	0	13
Lane Group Flow (vph)	66	62	86	1841	1568	121
Confl. Peds. (#/hr)			1			1
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	9.0	120.0	100.0	100.0	93.0	108.0
Effective Green, g (s)	9.0	114.0	100.0	100.0	93.0	108.0
Actuated g/C Ratio	0.08	0.95	0.83	0.83	0.78	0.90
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	135	1527	106	1553	1444	1396
v/s Ratio Prot	c0.04		0.02	c0.99	0.84	
v/s Ratio Perm		0.04	0.65			0.08
v/c Ratio	0.49	0.04	0.81	1.19	1.09	0.09
Uniform Delay, d1	53.3	0.2	41.3	10.0	13.5	0.7
Progression Factor	1.00	1.00	0.93	1.16	0.80	3.36
Incremental Delay, d2	1.0	0.0	4.1	84.1	40.0	0.0
Delay (s)	54.3	0.2	42.6	95.7	50.8	2.2
Level of Service	D	A	D	F	D	A
Approach Delay (s)	28.1			93.4	47.0	
Approach LOS	C			F	D	

Intersection Summary			
HCM Average Control Delay	70.1	HCM Level of Service	E
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

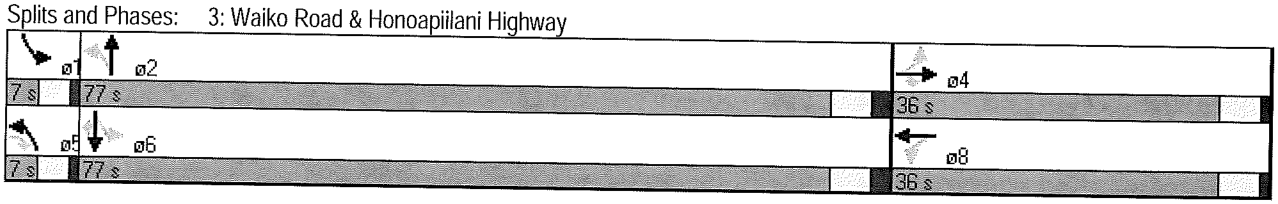
3: Waiko Road & Honoapiilani Highway

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	15	25	20	240	45	15	1085	75	1330	40
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	36.0	36.0	43.0	36.0	36.0	7.0	77.0	7.0	77.0	77.0
Total Split (%)	30.0%	30.0%	35.8%	30.0%	30.0%	5.8%	64.2%	5.8%	64.2%	64.2%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		✥		↰	↑↱		↰	↑	↱
Volume (vph)	15	25	20	240	45	155	15	1085	410	75	1330	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	0.99		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.95		1.00	0.95		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1887	1647		1729		1770	1760		1770	1863	1541
Flt Permitted		0.72	1.00		0.82		0.06	1.00		0.06	1.00	1.00
Satd. Flow (perm)		1385	1647		1447		105	1760		104	1863	1541
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	33	29	34	276	90	215	24	1206	569	114	1430	74
RTOR Reduction (vph)	0	0	23	0	18	0	0	14	0	0	0	8
Lane Group Flow (vph)	0	62	11	0	563	0	24	1761	0	114	1430	66
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		31.0	38.4		31.0		73.4	71.0		74.6	71.6	71.6
Effective Green, g (s)		31.0	38.4		31.0		73.4	71.0		74.6	71.6	71.6
Actuated g/C Ratio		0.26	0.32		0.26		0.61	0.59		0.62	0.60	0.60
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		358	527		374		98	1041		106	1112	919
v/s Ratio Prot							0.00	c1.00		c0.03	0.77	
v/s Ratio Perm		0.04	0.01		c0.39		0.15			0.64		0.04
v/c Ratio		0.17	0.02		1.51		0.24	1.69		1.08	1.29	0.07
Uniform Delay, d1		34.5	27.9		44.5		28.1	24.5		29.9	24.2	10.2
Progression Factor		1.00	1.00		1.00		0.43	0.79		1.61	0.78	1.11
Incremental Delay, d2		0.1	0.0		241.2		0.1	312.3		49.0	129.3	0.0
Delay (s)		34.6	27.9		285.7		12.3	331.7		97.1	148.1	11.3
Level of Service		C	C		F		B	F		F	F	B
Approach Delay (s)		32.3			285.7			327.4			138.3	
Approach LOS		C			F			F			F	

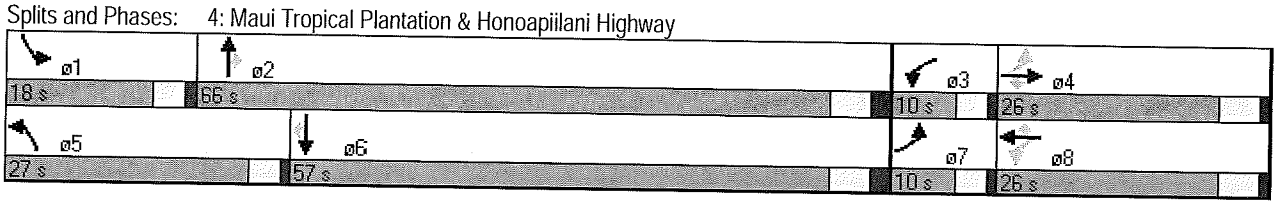
Intersection Summary			
HCM Average Control Delay	239.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.62		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	123.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰↰	↑	↱
Volume (vph)	245	5	75	220	5	410	170	925	305	560	680	305
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	26.0	8.0	26.0	26.0	8.0	27.0	27.0	8.0	27.0	27.0
Total Split (s)	10.0	26.0	26.0	10.0	26.0	26.0	27.0	66.0	66.0	18.0	57.0	57.0
Total Split (%)	8.3%	21.7%	21.7%	8.3%	21.7%	21.7%	22.5%	55.0%	55.0%	15.0%	47.5%	47.5%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 67 (56%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 150
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰↰	↑	↱
Volume (vph)	245	5	75	220	5	410	170	925	305	560	680	305
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	3433	1863	1538
Flt Permitted	0.75	1.00	1.00	0.75	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1405	1863	1583	1405	1863	1583	1770	1863	1583	3433	1863	1538
Peak-hour factor, PHF	0.92	0.92	0.50	0.92	0.92	0.92	0.50	0.89	0.92	0.92	0.94	0.75
Adj. Flow (vph)	266	5	150	239	5	446	340	1039	332	609	723	407
RTOR Reduction (vph)	0	0	127	0	0	225	0	0	46	0	0	146
Lane Group Flow (vph)	266	5	23	239	5	221	340	1039	286	609	723	261
Confl. Peds. (#/hr)							3					3
Turn Type	pm+pt		Perm	pm+pt		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	24.5	18.5	18.5	24.5	18.5	18.5	23.0	62.5	62.5	14.0	53.5	53.5
Effective Green, g (s)	24.5	18.5	18.5	24.5	18.5	18.5	23.0	62.5	62.5	14.0	53.5	53.5
Actuated g/C Ratio	0.20	0.15	0.15	0.20	0.15	0.15	0.19	0.52	0.52	0.12	0.45	0.45
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	305	287	244	305	287	244	339	970	824	401	831	686
v/s Ratio Prot	c0.04	0.00		0.04	0.00		c0.19	c0.56		c0.18	0.39	
v/s Ratio Perm	0.13		0.01	0.12		c0.14			0.18			0.17
v/c Ratio	0.87	0.02	0.09	0.78	0.02	0.91	1.00	1.07	0.35	1.52	0.87	0.38
Uniform Delay, d1	45.6	43.0	43.6	44.6	43.0	49.9	48.5	28.8	16.8	53.0	30.1	22.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.16	0.77	0.48
Incremental Delay, d2	22.8	0.0	0.2	12.4	0.0	33.3	49.6	49.9	1.2	234.6	1.3	0.1
Delay (s)	68.4	43.1	43.7	57.0	43.1	83.2	98.1	78.7	18.0	296.0	24.5	10.9
Level of Service	E	D	D	E	D	F	F	E	B	F	C	B
Approach Delay (s)		59.3			73.8			70.8			116.4	
Approach LOS		E			E			E			F	

Intersection Summary			
HCM Average Control Delay	87.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	15		

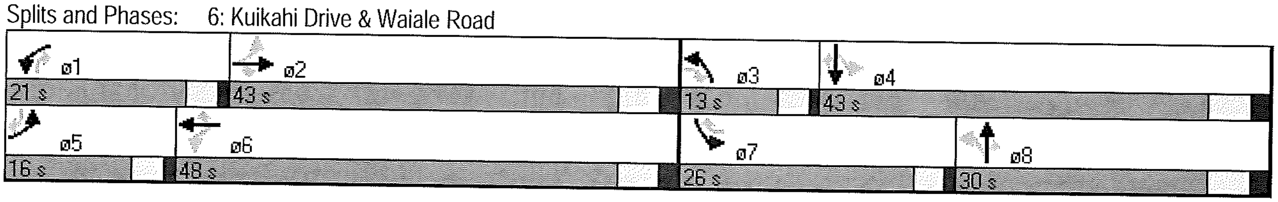
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	480	60	275	160	545	50	130	160	410	130	545
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	30.0		8.0	30.0		8.0	30.0		8.0	30.0	
Total Split (s)	16.0	43.0	56.0	21.0	48.0	74.0	13.0	30.0	51.0	26.0	43.0	59.0
Total Split (%)	13.3%	35.8%	46.7%	17.5%	40.0%	61.7%	10.8%	25.0%	42.5%	21.7%	35.8%	49.2%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Max		None	C-Max		None	None		None	None	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 62 (52%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	480	60	275	160	545	50	130	160	410	130	545
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1763	1863	1540	1770	1863	1540	1763	1863	1540	1767	1863	1540
Flt Permitted	0.65	1.00	1.00	0.18	1.00	1.00	0.64	1.00	1.00	0.37	1.00	1.00
Satd. Flow (perm)	1201	1863	1540	327	1863	1540	1197	1863	1540	682	1863	1540
Peak-hour factor, PHF	0.79	0.92	0.80	0.92	0.92	0.92	0.81	0.71	0.92	0.92	0.73	0.79
Adj. Flow (vph)	266	522	75	299	174	592	62	183	174	446	178	690
RTOR Reduction (vph)	0	0	20	0	0	123	0	0	90	0	0	346
Lane Group Flow (vph)	266	522	55	299	174	469	62	183	84	446	178	344
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	54.6	43.0	55.7	63.8	48.2	76.2	24.9	18.2	41.0	44.2	33.5	51.1
Effective Green, g (s)	54.6	43.0	55.7	63.8	48.2	76.2	24.9	18.2	41.0	44.2	33.5	51.1
Actuated g/C Ratio	0.46	0.36	0.46	0.53	0.40	0.64	0.21	0.15	0.34	0.37	0.28	0.43
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	601	668	715	376	748	978	280	283	526	450	520	656
v/s Ratio Prot	0.04	0.28		c0.11	0.09		0.01	0.10		c0.18	0.10	
v/s Ratio Perm	0.16		0.04	c0.31		0.30	0.03		0.05	c0.18		0.22
v/c Ratio	0.44	0.78	0.08	0.80	0.23	0.48	0.22	0.65	0.16	0.99	0.34	0.52
Uniform Delay, d1	21.0	34.3	17.9	21.3	23.7	11.5	39.1	47.9	27.5	34.1	34.5	25.5
Progression Factor	0.94	0.94	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	6.8	0.0	11.1	0.7	0.4	0.4	5.0	0.1	39.9	0.4	0.8
Delay (s)	20.1	39.1	15.9	32.4	24.4	11.9	39.5	52.9	27.6	74.0	34.9	26.2
Level of Service	C	D	B	C	C	B	D	D	C	E	C	C
Approach Delay (s)		31.2			19.7			40.4			43.6	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM Average Control Delay	33.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Right Turn Channelized						
Volume (veh/h)	260	250	330	255	345	95
Peak Hour Factor	0.59	0.77	0.70	0.79	0.75	0.81
Hourly flow rate (vph)	441	325	471	323	460	117
Approach Volume (veh/h)		765	794		577	
Crossing Volume (veh/h)		460	441		471	
High Capacity (veh/h)		964	979		955	
High v/c (veh/h)		0.79	0.81		0.60	
Low Capacity (veh/h)		781	795		774	
Low v/c (veh/h)		0.98	1.00		0.75	

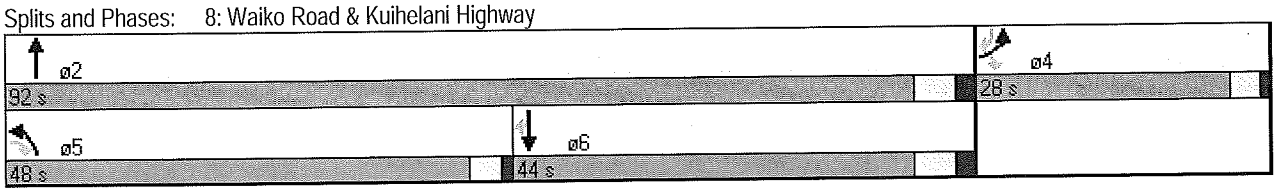
Intersection Summary			
Maximum v/c High	0.81		
Maximum v/c Low	1.00		
Intersection Capacity Utilization	95.4%	ICU Level of Service	F

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	375	215	145	960	855	515
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	24.0	24.0	
Total Split (s)	28.0	76.0	48.0	92.0	44.0	72.0
Total Split (%)	23.3%	63.3%	40.0%	76.7%	36.7%	60.0%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	375	215	145	960	855	515
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	514	430	468	1055	972	696
RTOR Reduction (vph)	0	8	0	0	0	76
Lane Group Flow (vph)	514	422	468	1055	972	620
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	23.5	63.7	36.2	86.5	46.3	75.8
Effective Green, g (s)	23.5	63.7	36.2	86.5	46.3	75.8
Actuated g/C Ratio	0.20	0.53	0.30	0.72	0.39	0.63
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	672	840	534	2551	1365	1000
v/s Ratio Prot	c0.15		c0.26	0.30	c0.27	
v/s Ratio Perm		0.27				0.39
v/c Ratio	0.76	0.50	0.88	0.41	0.71	0.62
Uniform Delay, d1	45.6	18.0	39.8	6.7	31.2	13.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	0.2	14.5	0.5	3.2	0.9
Delay (s)	50.3	18.2	54.3	7.2	34.4	14.2
Level of Service	D	B	D	A	C	B
Approach Delay (s)	35.7			21.6	26.0	
Approach LOS	D			C	C	

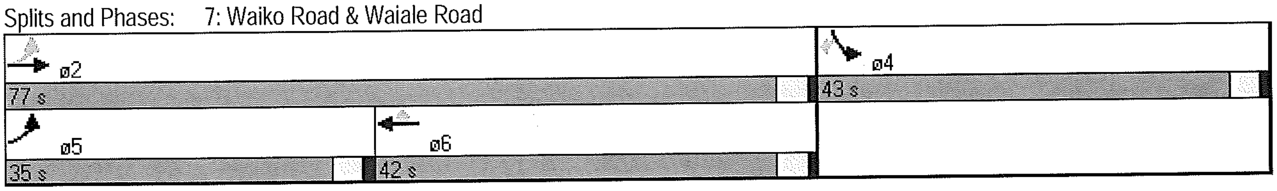
Intersection Summary			
HCM Average Control Delay	26.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	260	250	330	255	345	95
Turn Type	pm+pt			Perm		Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Detector Phase	5	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	8.0	22.0	22.0	22.0	22.0
Total Split (s)	35.0	77.0	42.0	42.0	43.0	43.0
Total Split (%)	29.2%	64.2%	35.0%	35.0%	35.8%	35.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	None	None	None	None	None

Intersection Summary

Cycle Length: 120
Actual Cycle Length: 102.8
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	260	250	330	255	345	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.15	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	271	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.59	0.77	0.70	0.79	0.75	0.81
Adj. Flow (vph)	441	325	471	323	460	117
RTOR Reduction (vph)	0	0	0	104	0	40
Lane Group Flow (vph)	441	325	471	219	460	77
Turn Type	pm+pt			Perm		Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	63.6	63.6	31.6	31.6	30.8	30.8
Effective Green, g (s)	63.6	63.6	31.6	31.6	30.8	30.8
Actuated g/C Ratio	0.62	0.62	0.31	0.31	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	578	1157	575	489	532	476
v/s Ratio Prot	c0.21	0.17	0.25		c0.26	
v/s Ratio Perm	c0.26			0.14		0.05
v/c Ratio	0.76	0.28	0.82	0.45	0.86	0.16
Uniform Delay, d1	22.1	8.9	32.8	28.4	33.8	26.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.9	0.1	8.9	0.7	13.7	0.2
Delay (s)	28.0	9.0	41.7	29.0	47.5	26.5
Level of Service	C	A	D	C	D	C
Approach Delay (s)		20.0	36.5		43.3	
Approach LOS		B	D		D	

Intersection Summary			
HCM Average Control Delay	32.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	102.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

```
*****************************************************************************
*                                                                           *
*  15:1:10                 08+557 WAIALE+WAIKO   BY 2030 PM             11  *
*                                                                           *
*****************************************************************************
*                                                   *                       *
* E      (m)    4.60   4.60   4.60                  * TIME PERIOD   min   90  *
* L'     (m)   10.00  10.00  10.00                  * TIME SLICE    min   15  *
* V      (m)    3.70   3.70   3.70                  * RESULTS PERIOD min 15 75 *
* RAD    (m)   20.00  20.00  20.00                  * TIME COST    $/hr 15.00 *
* PHI    (d)   30.00  30.00  30.00                  * FLOW PERIOD   min 15 75 *
* DIA    (m)   37.00  37.00  37.00                  * FLOW TYPE  pcu/veh  VEH *
* GRAD SEP         0      0      0                  * FLOW PEAK am/op/pm   PM *
*                                                   *                       *
*****************************************************************************
  LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO  *FLOW TIME*
*          *    *                            *    *  *              *         *
*WB WAIKO  *1.05*  255  330    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*SB WAIALE *1.05*   95  345    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*EB WAIKO  *1.05*  250  260    0             *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *              *         *
*          *    *                            *    *  *              *         *
*          *    *                            *    *  *              *         *
*          *    *                            *    *  *              *         *
*****************************************************************************
*                                                         *                 *
* FLOW          veh     585    440    510                 *                 *
* CAPACITY      veh     992    951    943                 * AVDEL s    8.1  *
* AVE DELAY    mins    0.15   0.12   0.14                 * L  O  S      A  *
* MAX DELAY    mins    0.22   0.16   0.20                 * VEH HRS    3.5  *
* AVE QUEUE     veh       1      1      1                 * COST  $   52.1  *
* MAX QUEUE     veh       2      1      2                 *                 *
*                                                         *                 *
*****************************************************************************
```

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

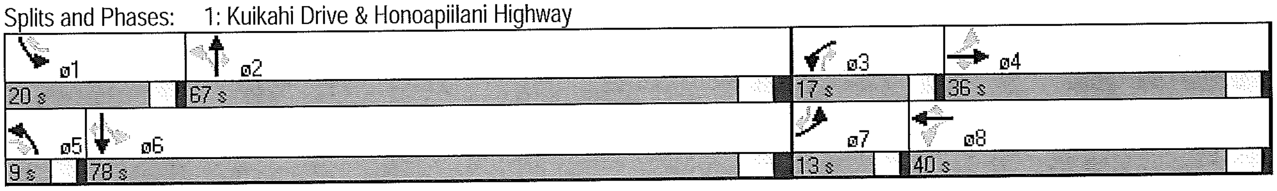
- Year 2030 with Alternative 1 AM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	200	75	225	50	690	430	155	495	25
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	24.0		7.0	24.0	
Total Split (s)	13.0	36.0	45.0	17.0	40.0	60.0	9.0	67.0	84.0	20.0	78.0	91.0
Total Split (%)	9.3%	25.7%	32.1%	12.1%	28.6%	42.9%	6.4%	47.9%	60.0%	14.3%	55.7%	65.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	40.7	31.0	40.0	49.0	35.3	55.3	68.0	61.0	78.0	83.0	72.0	84.7
Actuated g/C Ratio	0.29	0.22	0.29	0.35	0.25	0.40	0.49	0.44	0.56	0.59	0.51	0.60
v/c Ratio	0.32	0.99	0.23	0.97	0.19	0.41	0.24	0.92	0.61	0.97	0.68	0.03
Control Delay	35.1	95.4	12.3	88.9	35.5	10.3	15.8	49.0	17.7	89.1	29.9	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.1	95.4	12.3	88.9	35.5	10.3	15.8	49.0	17.7	89.1	29.9	4.4
LOS	D	F	B	F	D	B	B	D	B	F	C	A
Approach Delay		68.2			41.9			34.5			45.1	
Approach LOS		E			D			C			D	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 64 (46%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 44.8 Intersection LOS: D
Intersection Capacity Utilization 85.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	200	75	225	50	690	430	155	495	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.70	1.00	1.00	0.11	1.00	1.00	0.27	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	1336	1909	1623	213	1863	1583	503	1863	1583	115	1863	1583
Peak-hour factor, PHF	0.79	0.62	0.88	0.94	0.85	0.75	0.71	0.92	0.76	0.62	0.76	0.88
Adj. Flow (vph)	133	419	125	213	88	300	70	750	566	250	651	28
RTOR Reduction (vph)	0	0	69	0	0	99	0	0	41	0	0	10
Lane Group Flow (vph)	133	419	56	213	88	201	70	750	525	250	651	18
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	39.7	31.0	41.0	48.0	35.3	56.3	66.0	61.0	80.0	81.0	72.0	86.7
Effective Green, g (s)	39.7	31.0	41.0	48.0	35.3	56.3	66.0	61.0	80.0	81.0	72.0	86.7
Actuated g/C Ratio	0.28	0.22	0.29	0.34	0.25	0.40	0.47	0.44	0.57	0.58	0.51	0.62
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	409	423	475	218	470	637	282	812	905	256	958	980
v/s Ratio Prot	0.02	0.22		c0.09	0.05		0.01	0.40		c0.11	0.35	
v/s Ratio Perm	0.07		0.03	c0.24		0.13	0.11		0.33	c0.45		0.01
v/c Ratio	0.33	0.99	0.12	0.98	0.19	0.32	0.25	0.92	0.58	0.98	0.68	0.02
Uniform Delay, d1	38.8	54.4	36.3	38.3	41.1	28.7	22.2	37.3	19.2	46.3	25.4	10.3
Progression Factor	1.00	1.00	1.00	0.98	0.83	0.65	1.12	1.03	0.94	1.00	1.00	1.00
Incremental Delay, d2	0.2	41.1	0.0	52.4	0.1	0.1	0.1	10.1	0.3	49.0	3.9	0.0
Delay (s)	38.9	95.4	36.3	89.7	34.2	18.7	25.0	48.5	18.4	95.4	29.3	10.3
Level of Service	D	F	D	F	C	B	C	D	B	F	C	B
Approach Delay (s)		73.4			46.2			35.0			46.5	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM Average Control Delay	47.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

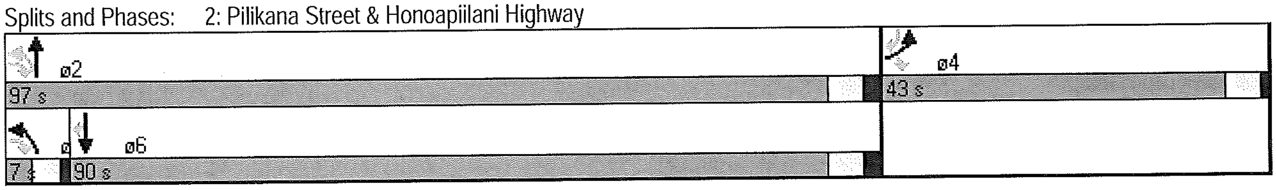
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Volume (vph)	115	75	30	950	745	55
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	43.0	147.0	7.0	97.0	90.0	133.0
Total Split (%)	30.7%	105.0%	5.0%	69.3%	64.3%	95.0%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	
Act Effct Green (s)	16.2	140.0	114.8	112.8	105.8	127.0
Actuated g/C Ratio	0.12	1.00	0.82	0.81	0.76	0.91
v/c Ratio	0.73	0.07	0.08	0.92	0.60	0.04
Control Delay	78.7	0.1	2.7	13.5	3.8	0.1
Queue Delay	0.0	0.0	0.0	0.7	0.0	0.0
Total Delay	78.7	0.1	2.7	14.2	3.8	0.1
LOS	E	A	A	B	A	A
Approach Delay	44.7			14.0	3.5	
Approach LOS	D			B	A	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 23 (16%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 13.5 Intersection LOS: B
Intersection Capacity Utilization 65.5% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	950	745	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.26	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	480	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	151	115	32	1377	847	64
RTOR Reduction (vph)	0	0	0	0	0	5
Lane Group Flow (vph)	151	115	32	1377	847	59
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	16.2	140.0	112.8	112.8	105.8	128.0
Effective Green, g (s)	16.2	134.0	112.8	112.8	105.8	128.0
Actuated g/C Ratio	0.12	0.96	0.81	0.81	0.76	0.91
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	208	1538	414	1501	1408	1447
v/s Ratio Prot	c0.08		0.00	c0.74	0.45	
v/s Ratio Perm		0.07	0.06			0.04
v/c Ratio	0.73	0.07	0.08	0.92	0.60	0.04
Uniform Delay, d1	59.8	0.1	5.7	10.1	7.7	0.5
Progression Factor	1.00	1.00	0.85	0.54	0.28	0.07
Incremental Delay, d2	10.2	0.0	0.0	6.0	1.4	0.0
Delay (s)	69.9	0.1	4.9	11.4	3.5	0.0
Level of Service	E	A	A	B	A	A
Approach Delay (s)	39.8			11.3	3.3	
Approach LOS	D			B	A	

Intersection Summary			
HCM Average Control Delay	11.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		

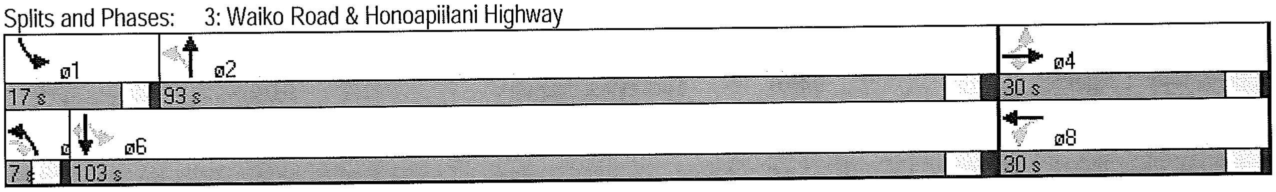
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	45	35	15	65	10	10	855	145	660	30
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	30.0	30.0	37.0	30.0	30.0	7.0	93.0	17.0	103.0	103.0
Total Split (%)	21.4%	21.4%	26.4%	21.4%	21.4%	5.0%	66.4%	12.1%	73.6%	73.6%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max
Act Effct Green (s)		25.0	32.0		25.0	92.0	87.0	106.0	99.8	99.8
Actuated g/C Ratio		0.18	0.23		0.18	0.66	0.62	0.76	0.71	0.71
v/c Ratio		0.85	0.07		0.98	0.04	0.99	1.00	0.53	0.05
Control Delay		96.1	21.4		98.1	5.1	51.6	101.4	9.3	2.7
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		96.1	21.4		98.1	5.1	51.6	101.4	9.3	2.7
LOS		F	C		F	A	D	F	A	A
Approach Delay		84.3			98.1		50.9		29.5	
Approach LOS		F			F		D		C	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 49.4 Intersection LOS: D
Intersection Capacity Utilization 90.7% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	35	15	65	10	110	10	855	125	145	660	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.92		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1871	1647		1682		1768	1813		1770	1863	1540
Flt Permitted		0.47	1.00		0.69		0.35	1.00		0.04	1.00	1.00
Satd. Flow (perm)		910	1647		1180		651	1813		82	1863	1540
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	98	41	26	75	20	153	16	950	174	220	710	56
RTOR Reduction (vph)	0	0	15	0	41	0	0	5	0	0	0	10
Lane Group Flow (vph)	0	139	11	0	207	0	16	1119	0	220	710	46
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		25.0	31.8		25.0		88.8	87.0		104.0	98.2	98.2
Effective Green, g (s)		25.0	31.8		25.0		88.8	87.0		104.0	98.2	98.2
Actuated g/C Ratio		0.18	0.23		0.18		0.63	0.62		0.74	0.70	0.70
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		163	374		211		427	1127		218	1307	1080
v/s Ratio Prot							0.00	0.62		c0.09	0.38	
v/s Ratio Perm		0.15	0.01		c0.18		0.02			c0.66		0.03
v/c Ratio		0.85	0.03		0.98		0.04	0.99		1.01	0.54	0.04
Uniform Delay, d1		55.7	42.1		57.3		9.8	26.2		52.5	10.1	6.4
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.08	0.80	0.78
Incremental Delay, d2		31.6	0.0		56.1		0.0	25.3		58.9	1.4	0.1
Delay (s)		87.3	42.1		113.3		9.8	51.5		115.9	9.4	5.1
Level of Service		F	D		F		A	D		F	A	A
Approach Delay (s)		80.2			113.3			50.9			32.9	
Approach LOS		F			F			D			C	

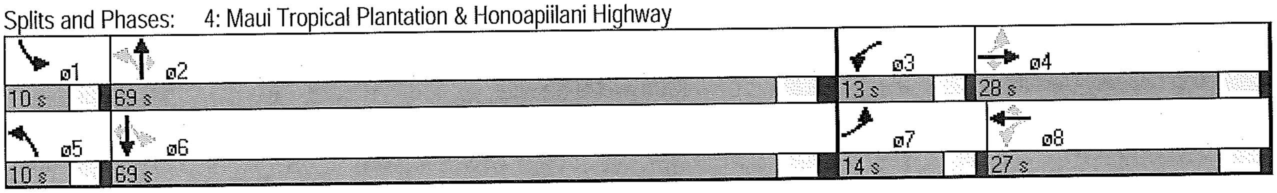
Intersection Summary			
HCM Average Control Delay	51.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	5	35	150	5	235	45	555	70	110	525	85
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	14.0	28.0	28.0	13.0	27.0	27.0	10.0	69.0	69.0	10.0	69.0	69.0
Total Split (%)	11.7%	23.3%	23.3%	10.8%	22.5%	22.5%	8.3%	57.5%	57.5%	8.3%	57.5%	57.5%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	17.0	8.9	8.9	20.0	8.3	8.3	84.9	77.0	77.0	85.8	79.0	79.0
Actuated g/C Ratio	0.14	0.07	0.07	0.17	0.07	0.07	0.71	0.64	0.64	0.72	0.66	0.66
v/c Ratio	0.53	0.04	0.25	0.66	0.04	0.73	0.09	0.50	0.07	0.24	0.46	0.09
Control Delay	51.8	48.4	18.6	57.2	49.2	19.2	5.4	14.0	5.3	6.2	12.7	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.8	48.4	18.6	57.2	49.2	19.2	5.4	14.0	5.3	6.2	12.7	2.3
LOS	D	D	B	E	D	B	A	B	A	A	B	A
Approach Delay		44.0			34.2			12.5			10.5	
Approach LOS		D			C			B			B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 18.6 Intersection LOS: B
Intersection Capacity Utilization 62.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	110	5	35	150	5	235	45	555	70	110	525	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1769	1863	1583	1770	1863	1546
Flt Permitted	0.75	1.00	1.00	0.49	1.00	1.00	0.38	1.00	1.00	0.33	1.00	1.00
Satd. Flow (perm)	1405	1863	1583	914	1863	1583	705	1863	1583	622	1863	1546
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.94	0.92
Adj. Flow (vph)	120	5	38	163	5	255	49	603	76	120	559	92
RTOR Reduction (vph)	0	0	36	0	0	233	0	0	15	0	0	34
Lane Group Flow (vph)	120	5	2	163	5	22	49	603	61	120	559	58
Confl. Peds. (#/hr)							1					1
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	16.4	6.7	6.7	23.6	10.3	10.3	79.8	75.0	75.0	82.2	76.2	76.2
Effective Green, g (s)	16.4	6.7	6.7	23.6	10.3	10.3	79.8	75.0	75.0	82.2	76.2	76.2
Actuated g/C Ratio	0.14	0.06	0.06	0.20	0.09	0.09	0.66	0.62	0.62	0.69	0.64	0.64
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	222	104	88	275	160	136	511	1164	989	483	1183	982
v/s Ratio Prot	0.04	0.00		c0.07	0.00		0.00	c0.32		c0.01	0.30	
v/s Ratio Perm	0.03		0.00	c0.05		0.01	0.06		0.04	0.16		0.04
v/c Ratio	0.54	0.05	0.02	0.59	0.03	0.16	0.10	0.52	0.06	0.25	0.47	0.06
Uniform Delay, d1	48.0	53.6	53.6	42.7	50.3	50.8	7.6	12.5	8.8	7.9	11.4	8.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.2	0.1	3.4	0.1	0.6	0.1	1.6	0.1	0.3	1.4	0.1
Delay (s)	50.6	53.8	53.7	46.1	50.4	51.4	7.7	14.1	8.9	8.2	12.8	8.4
Level of Service	D	D	D	D	D	D	A	B	A	A	B	A
Approach Delay (s)		51.5			49.4			13.1			11.5	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

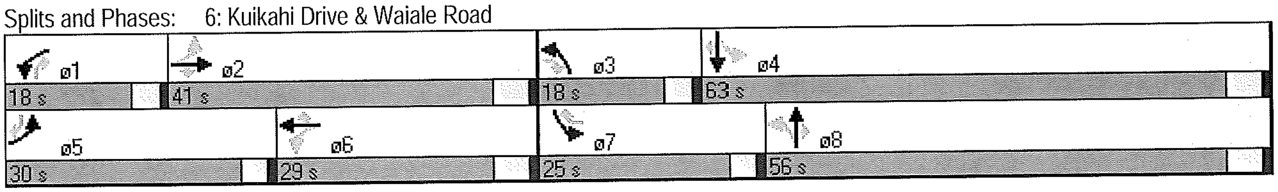
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	345	455	50	210	165	260	55	360	300	195	455	270
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	29.0		8.0	29.0		8.0	29.0		8.0	29.0	
Total Split (s)	30.0	41.0	59.0	18.0	29.0	54.0	18.0	56.0	74.0	25.0	63.0	93.0
Total Split (%)	21.4%	29.3%	42.1%	12.9%	20.7%	38.6%	12.9%	40.0%	52.9%	17.9%	45.0%	66.4%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	Min	C-Min		Min	C-Min		None	None		None	None	
Act Effct Green (s)	65.2	46.2	58.5	49.2	34.2	53.4	55.9	46.6	64.6	66.8	53.5	83.5
Actuated g/C Ratio	0.47	0.33	0.42	0.35	0.24	0.38	0.40	0.33	0.46	0.48	0.38	0.60
v/c Ratio	0.81	0.81	0.10	0.82	0.39	0.41	0.38	0.80	0.41	0.71	0.88	0.34
Control Delay	30.1	43.6	13.1	51.2	49.8	15.3	24.9	52.4	13.1	34.4	53.9	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.1	43.6	13.1	51.2	49.8	15.3	24.9	52.4	13.1	34.4	53.9	6.2
LOS	C	D	B	D	D	B	C	D	B	C	D	A
Approach Delay		35.6			36.1			35.9			36.6	
Approach LOS		D			D			D			D	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 100 (71%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 36.0 Intersection LOS: D
Intersection Capacity Utilization 84.0% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 6: Kuikahi Drive & Waiale Road



HCM Signalized Intersection Capacity Analysis
6: Kuikahi Drive & Waiale Road

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	345	455	50	210	165	260	55	360	300	195	455	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1766	1863	1538	1769	1863	1538	1770	1863	1538	1770	1863	1538
Flt Permitted	0.46	1.00	1.00	0.22	1.00	1.00	0.12	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)	861	1863	1538	408	1863	1538	220	1863	1538	291	1863	1538
Peak-hour factor, PHF	0.75	0.92	0.78	0.92	0.92	0.92	0.81	0.73	0.92	0.92	0.73	0.79
Adj. Flow (vph)	460	495	64	228	179	283	68	493	326	212	623	342
RTOR Reduction (vph)	0	0	16	0	0	101	0	0	84	0	0	75
Lane Group Flow (vph)	460	495	48	228	179	182	68	493	242	212	623	267
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	64.1	46.1	59.4	48.1	34.1	54.4	54.9	46.6	65.6	65.9	53.6	84.6
Effective Green, g (s)	64.1	46.1	59.4	48.1	34.1	54.4	54.9	46.6	65.6	65.9	53.6	84.6
Actuated g/C Ratio	0.46	0.33	0.42	0.34	0.24	0.39	0.39	0.33	0.47	0.47	0.38	0.60
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0		4.0	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)	562	613	653	276	454	598	178	620	721	299	713	929
v/s Ratio Prot	c0.15	0.27		0.08	0.10		0.02	0.26		c0.08	c0.33	
v/s Ratio Perm	c0.22		0.03	0.20		0.12	0.13		0.16	0.26		0.17
v/c Ratio	0.82	0.81	0.07	0.83	0.39	0.30	0.38	0.80	0.33	0.71	0.87	0.29
Uniform Delay, d1	28.8	42.9	24.0	36.3	44.3	29.7	31.3	42.4	23.4	27.8	40.1	13.3
Progression Factor	0.75	0.82	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.2	6.3	0.0	17.9	2.6	0.3	1.4	7.0	0.3	7.5	11.5	0.2
Delay (s)	26.9	41.6	18.0	54.2	46.9	30.0	32.7	49.3	23.7	35.2	51.6	13.4
Level of Service	C	D	B	D	D	C	C	D	C	D	D	B
Approach Delay (s)		33.5			42.4			38.7			37.5	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	37.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Volume (veh/h)	10	310	10	125	60	265	10	455	85	445	355	115
Peak Hour Factor	0.59	0.77	0.92	0.92	0.70	0.79	0.92	0.92	0.92	0.75	0.92	0.81
Hourly flow rate (vph)	17	403	11	136	86	335	11	495	92	593	386	142
Approach Volume (veh/h)		430			557			598			1121	
Crossing Volume (veh/h)		1115			522			1013			232	
High Capacity (veh/h)		566			917			616			1154	
High v/c (veh/h)		0.76			0.61			0.97			0.97	
Low Capacity (veh/h)		435			740			477			952	
Low v/c (veh/h)		0.99			0.75			1.25			1.18	

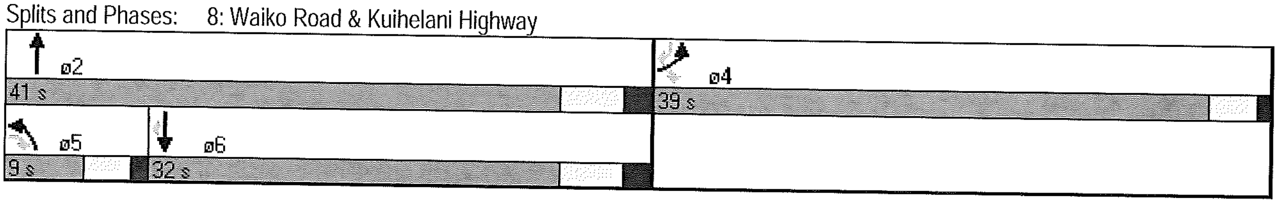
Intersection Summary			
Maximum v/c High	0.97		
Maximum v/c Low	1.25		
Intersection Capacity Utilization	137.1%	ICU Level of Service	H

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	655	305	10	510	690	395
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	16.0	24.0	
Total Split (s)	39.0	48.0	9.0	41.0	32.0	71.0
Total Split (%)	48.8%	60.0%	11.3%	51.3%	40.0%	88.8%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Max	Max	
Act Effct Green (s)	27.7	36.8	5.0	35.3	26.2	58.0
Actuated g/C Ratio	0.38	0.50	0.07	0.48	0.36	0.79
v/c Ratio	0.69	0.75	0.26	0.33	0.62	0.39
Control Delay	21.8	19.6	40.6	13.5	23.2	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.8	19.6	40.6	13.5	23.2	1.0
LOS	C	B	D	B	C	A
Approach Delay	20.9			14.9	14.2	
Approach LOS	C			B	B	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 73.1
Natural Cycle: 60
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 17.3 Intersection LOS: B
Intersection Capacity Utilization 46.3% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	655	305	10	510	690	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	897	610	32	560	784	534
RTOR Reduction (vph)	0	21	0	0	0	95
Lane Group Flow (vph)	897	589	32	560	784	439
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	27.7	36.7	5.0	35.3	26.3	60.0
Effective Green, g (s)	27.7	36.7	5.0	35.3	26.3	60.0
Actuated g/C Ratio	0.38	0.50	0.07	0.48	0.36	0.82
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	1303	796	121	1711	1275	1301
v/s Ratio Prot	0.26		0.02	0.16	c0.22	
v/s Ratio Perm		c0.37				0.28
v/c Ratio	0.69	0.74	0.26	0.33	0.61	0.34
Uniform Delay, d1	19.0	14.4	32.3	11.6	19.2	1.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.2	3.3	0.4	0.5	2.2	0.1
Delay (s)	20.2	17.6	32.7	12.1	21.4	1.7
Level of Service	C	B	C	B	C	A
Approach Delay (s)	19.2			13.2	13.4	
Approach LOS	B			B	B	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	155	65	30	380	390	75
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	168	71	33	413	424	82
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	902	424	505			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	902	424	505			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	44	89	97			
cM capacity (veh/h)	299	630	1059			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	239	33	413	424	82
Volume Left	168	33	0	0	0
Volume Right	71	0	0	0	82
cSH	354	1059	1700	1700	1700
Volume to Capacity	0.68	0.03	0.24	0.25	0.05
Queue Length 95th (ft)	118	2	0	0	0
Control Delay (s)	34.0	8.5	0.0	0.0	0.0
Lane LOS	D	A			
Approach Delay (s)	34.0	0.6		0.0	
Approach LOS	D				

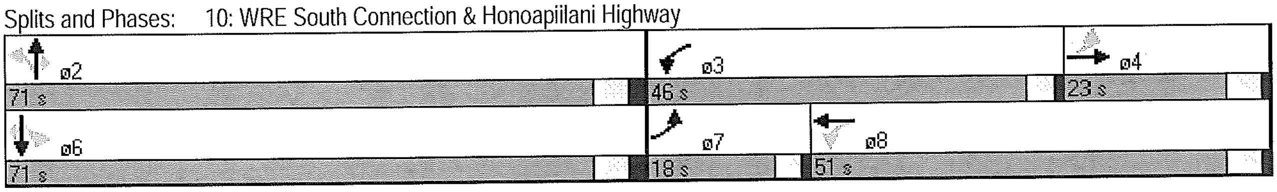
Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	45	30	435	20	30	590	385	10	665	20
Turn Type	pm+pt		pm+pt		Perm		Perm	Perm		Perm
Protected Phases	7	4	3	8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	7	4	3	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	23.0	8.0	23.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	18.0	23.0	46.0	51.0	71.0	71.0	71.0	71.0	71.0	71.0
Total Split (%)	12.9%	16.4%	32.9%	36.4%	50.7%	50.7%	50.7%	50.7%	50.7%	50.7%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag						
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	C-Min	C-Min	C-Min	C-Min	C-Min	C-Min
Act Effct Green (s)	26.1	9.5	48.7	27.4	76.9	76.9	76.9	76.9	76.9	76.9
Actuated g/C Ratio	0.19	0.07	0.35	0.20	0.55	0.55	0.55	0.55	0.55	0.55
v/c Ratio	0.16	0.62	0.89	0.08	0.16	0.63	0.42	0.04	0.71	0.03
Control Delay	31.1	41.4	59.6	31.5	20.3	26.3	7.5	17.6	29.3	12.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	41.4	59.6	31.5	20.3	26.3	7.5	17.6	29.3	12.8
LOS	C	D	E	C	C	C	A	B	C	B
Approach Delay		38.2		58.1		18.9			28.7	
Approach LOS		D		E		B			C	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 30.9 Intersection LOS: C
Intersection Capacity Utilization 74.9% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 10: WRE South Connection & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	30	70	435	20	5	30	590	385	10	665	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.90		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1668		1770	1811		1770	1863	1583	1770	1863	1583
Flt Permitted	0.74	1.00		0.31	1.00		0.21	1.00	1.00	0.26	1.00	1.00
Satd. Flow (perm)	1378	1668		577	1811		382	1863	1583	489	1863	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)	49	33	76	473	22	5	33	641	418	11	723	22
RTOR Reduction (vph)	0	63	0	0	4	0	0	0	127	0	0	3
Lane Group Flow (vph)	49	46	0	473	23	0	33	641	291	11	723	19
Turn Type	pm+pt			pm+pt			Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	25.5	9.5		52.2	32.2		76.8	76.8	76.8	76.8	76.8	76.8
Effective Green, g (s)	25.5	9.5		52.2	32.2		76.8	76.8	76.8	76.8	76.8	76.8
Actuated g/C Ratio	0.18	0.07		0.37	0.23		0.55	0.55	0.55	0.55	0.55	0.55
Clearance Time (s)	4.0	5.0		4.0	5.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	296	113		545	417		210	1022	868	268	1022	868
v/s Ratio Prot	0.02	0.03		c0.24	0.01			0.34			c0.39	
v/s Ratio Perm	0.01			c0.08			0.09		0.18	0.02		0.01
v/c Ratio	0.17	0.40		0.87	0.06		0.16	0.63	0.33	0.04	0.71	0.02
Uniform Delay, d1	48.2	62.5		37.9	42.0		15.6	21.7	17.5	14.6	23.3	14.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	2.4		13.7	0.1		1.6	2.9	1.0	0.3	4.1	0.0
Delay (s)	48.4	64.9		51.6	42.1		17.2	24.7	18.5	14.9	27.4	14.5
Level of Service	D	E		D	D		B	C	B	B	C	B
Approach Delay (s)		59.8			51.1			22.1			26.9	
Approach LOS		E			D			C			C	

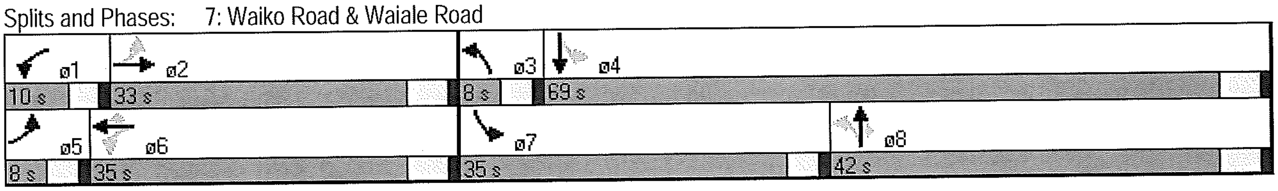
Intersection Summary			
HCM Average Control Delay	31.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	10	310	125	60	265	10	455	85	445	355
Turn Type	pm+pt		pm+pt		Perm	pm+pt		Perm	pm+pt	
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	8.0	26.0	26.0	8.0	26.0	26.0	8.0	26.0
Total Split (s)	8.0	33.0	10.0	35.0	35.0	8.0	42.0	42.0	35.0	69.0
Total Split (%)	6.7%	27.5%	8.3%	29.2%	29.2%	6.7%	35.0%	35.0%	29.2%	57.5%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 111.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



HCM Signalized Intersection Capacity Analysis
7: Waiko Road & Waiale Road

2/3/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	310	10	125	60	265	10	455	85	445	355	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1854		1770	1863	1583	1770	1863	1583	1770	1794	
Flt Permitted	0.71	1.00		0.19	1.00	1.00	0.48	1.00	1.00	0.12	1.00	
Satd. Flow (perm)	1331	1854		361	1863	1583	885	1863	1583	225	1794	
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)	11	337	11	136	65	288	11	495	92	484	386	125
RTOR Reduction (vph)	0	1	0	0	0	207	0	0	17	0	9	0
Lane Group Flow (vph)	11	347	0	136	65	81	11	495	75	484	502	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	28.4	27.7		37.8	33.1	33.1	36.7	36.0	36.0	69.9	65.2	
Effective Green, g (s)	28.4	27.7		37.8	33.1	33.1	36.7	36.0	36.0	69.9	65.2	
Actuated g/C Ratio	0.24	0.24		0.32	0.28	0.28	0.31	0.31	0.31	0.59	0.55	
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	324	436		189	524	445	281	570	484	526	994	
v/s Ratio Prot	0.00	c0.19		c0.04	0.03		0.00	0.27		c0.23	0.28	
v/s Ratio Perm	0.01			0.19		0.05	0.01		0.05	c0.31		
v/c Ratio	0.03	0.80		0.72	0.12	0.18	0.04	0.87	0.16	0.92	0.50	
Uniform Delay, d1	34.1	42.3		32.8	31.5	32.0	28.0	38.6	29.8	32.1	16.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	9.7		12.3	0.1	0.2	0.1	13.2	0.2	21.5	0.4	
Delay (s)	34.1	52.1		45.1	31.6	32.2	28.1	51.8	29.9	53.6	16.7	
Level of Service	C	D		D	C	C	C	D	C	D	B	
Approach Delay (s)		51.5			35.7			48.0			34.6	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	40.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	117.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	87.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

```
****************************************************************************
*                                                                          *
*  15:1:10                 08-557 waiale-waiko   alt 1 PM              14  *
*                                                                          *
****************************************************************************
*                                                   *                      *
* E     (m)     4.60   4.60   4.60   4.60           * TIME PERIOD    min      90  *
* L'    (m)    10.00  10.00  10.00  10.00           * TIME SLICE     min      15  *
* V     (m)     3.70   3.70   3.70   3.70           * RESULTS PERIOD min  15 75  *
* RAD   (m)    20.00  20.00  20.00  20.00           * TIME COST     $/hr  15.00  *
* PHI   (d)    30.00  30.00  30.00  30.00           * FLOW PERIOD    min  15 75  *
* DIA   (m)    37.00  37.00  37.00  37.00           * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP         0      0      0      0           * FLOW PEAK am/op/pm     PM  *
*                                                   *                      *
****************************************************************************
  LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *                *         *
*wb waiko  *1.05*  255  120  315  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*sb waiale *1.05*   95  405  235  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*eb waiko  *1.05*   30  225   15  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*nb waiale *1.05*  125  495   10  0          *1.00*75*0.75 1.125 0.75*15 45 75 *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
*          *    *                            *    *  *                *         *
****************************************************************************
*                                                       *                  *
* FLOW         veh      690     735     270     630     *                  *
* CAPACITY     veh      843     886     594     868     * AVDEL s    23.6  *
* AVE DELAY   mins     0.49    0.48    0.19    0.27     * L  O  S       C  *
* MAX DELAY   mins     0.93    0.91    0.29    0.45     * VEH HRS    15.3  *
* AVE QUEUE    veh        6       6       1       3     * COST  $   229.1  *
* MAX QUEUE    veh       10      11       1       4     *                  *
*                                                       *                  *
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AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

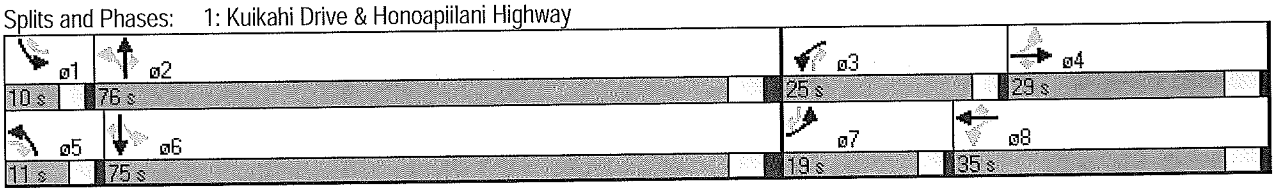
- Year 2030 with Alternative 1 PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	40	100	55	265	185	145	100	635	340	100	755	65
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	24.0		7.0	24.0	
Total Split (s)	19.0	29.0	40.0	25.0	35.0	45.0	11.0	76.0	101.0	10.0	75.0	94.0
Total Split (%)	13.6%	20.7%	28.6%	17.9%	25.0%	32.1%	7.9%	54.3%	72.1%	7.1%	53.6%	67.1%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	
Act Effct Green (s)	24.7	16.2	27.2	41.2	28.7	38.7	87.8	78.8	102.8	85.8	77.8	89.3
Actuated g/C Ratio	0.18	0.12	0.19	0.29	0.20	0.28	0.63	0.56	0.73	0.61	0.56	0.64
v/c Ratio	0.21	0.73	0.17	0.84	0.57	0.33	0.98	0.83	0.36	0.79	0.96	0.07
Control Delay	36.9	78.2	10.9	58.9	52.2	8.0	80.1	32.6	3.3	40.6	50.3	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.9	78.2	10.9	58.9	52.2	8.0	80.1	32.6	3.3	40.6	50.3	5.1
LOS	D	E	B	E	D	A	F	C	A	D	D	A
Approach Delay		55.3			42.6			28.2			46.3	
Approach LOS		E			D			C			D	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 25 (18%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 39.1 | Intersection LOS: D
Intersection Capacity Utilization 81.1% | ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	40	100	55	265	185	145	100	635	340	100	755	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.62	1.00	1.00	0.29	1.00	1.00	0.05	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	1187	1909	1623	546	1863	1583	95	1863	1583	224	1863	1583
Peak-hour factor, PHF	0.79	0.62	0.88	0.94	0.85	0.75	0.71	0.73	0.76	0.62	0.76	0.88
Adj. Flow (vph)	51	161	62	282	218	193	141	870	447	161	993	74
RTOR Reduction (vph)	0	0	50	0	0	138	0	0	85	0	0	16
Lane Group Flow (vph)	51	161	12	282	218	55	141	870	362	161	993	58
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	23.7	16.2	28.2	40.2	28.7	39.7	85.8	78.8	104.8	83.8	77.8	91.3
Effective Green, g (s)	23.7	16.2	28.2	40.2	28.7	39.7	85.8	78.8	104.8	83.8	77.8	91.3
Actuated g/C Ratio	0.17	0.12	0.20	0.29	0.20	0.28	0.61	0.56	0.75	0.60	0.56	0.65
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	235	221	327	332	382	449	142	1049	1185	200	1035	1032
v/s Ratio Prot	0.01	0.08		c0.12	0.12		c0.05	0.47		0.03	0.53	
v/s Ratio Perm	0.03		0.01	c0.12		0.03	c0.56		0.23	0.45		0.04
v/c Ratio	0.22	0.73	0.04	0.85	0.57	0.12	0.99	0.83	0.31	0.81	0.96	0.06
Uniform Delay, d1	49.7	59.8	45.0	42.9	50.1	37.2	43.3	25.1	5.7	24.5	29.6	8.8
Progression Factor	1.00	1.00	1.00	0.93	0.94	1.38	0.95	1.06	1.64	1.00	1.00	1.00
Incremental Delay, d2	0.2	9.7	0.0	16.5	1.2	0.0	52.2	4.1	0.0	19.5	19.8	0.0
Delay (s)	49.9	69.5	45.0	56.1	48.1	51.6	93.5	30.6	9.4	44.0	49.4	8.8
Level of Service	D	E	D	E	D	D	F	C	A	D	D	A
Approach Delay (s)		60.3			52.3			30.2			46.2	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM Average Control Delay	42.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		

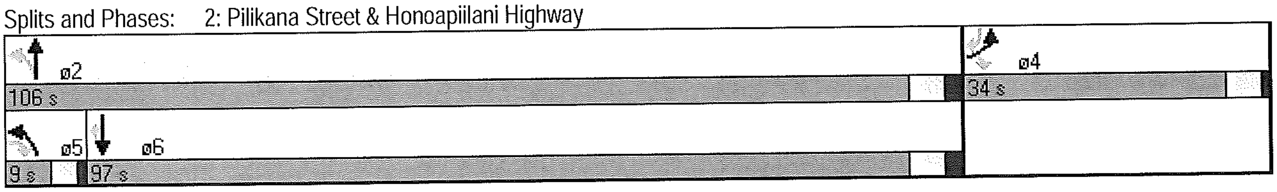
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Volume (vph)	50	40	80	955	950	115
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5	2			6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	34.0	43.0	9.0	106.0	97.0	131.0
Total Split (%)	24.3%	30.7%	6.4%	75.7%	69.3%	93.6%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	
Act Effct Green (s)	9.7	18.6	121.3	119.3	110.4	125.1
Actuated g/C Ratio	0.07	0.13	0.87	0.85	0.79	0.89
v/c Ratio	0.53	0.23	0.26	0.87	0.74	0.09
Control Delay	77.6	13.9	3.1	11.9	6.6	0.1
Queue Delay	0.0	0.0	0.0	0.4	0.0	0.0
Total Delay	77.6	13.9	3.1	12.3	6.6	0.1
LOS	E	B	A	B	A	A
Approach Delay	46.7			11.8	5.9	
Approach LOS	D			B	A	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 136 (97%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 10.8 Intersection LOS: B
Intersection Capacity Utilization 71.9% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Volume (vph)	50	40	80	955	950	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.18	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	327	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	66	62	86	1384	1080	134
RTOR Reduction (vph)	0	53	0	0	0	13
Lane Group Flow (vph)	66	9	86	1384	1080	121
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5	2			6 4
Actuated Green, G (s)	9.7	19.6	119.3	119.3	110.4	126.1
Effective Green, g (s)	9.7	19.6	119.3	119.3	110.4	126.1
Actuated g/C Ratio	0.07	0.14	0.85	0.85	0.79	0.90
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	124	225	329	1588	1469	1426
v/s Ratio Prot	c0.04		0.01	c0.74	0.58	
v/s Ratio Perm		0.01	0.21			0.08
v/c Ratio	0.53	0.04	0.26	0.87	0.74	0.08
Uniform Delay, d1	63.0	52.1	9.3	5.9	7.4	0.7
Progression Factor	1.00	1.00	1.23	0.94	0.61	0.66
Incremental Delay, d2	2.2	0.0	0.1	4.5	1.4	0.0
Delay (s)	65.1	52.1	11.6	10.1	6.0	0.5
Level of Service	E	D	B	B	A	A
Approach Delay (s)	58.8			10.2	5.3	
Approach LOS	E			B	A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

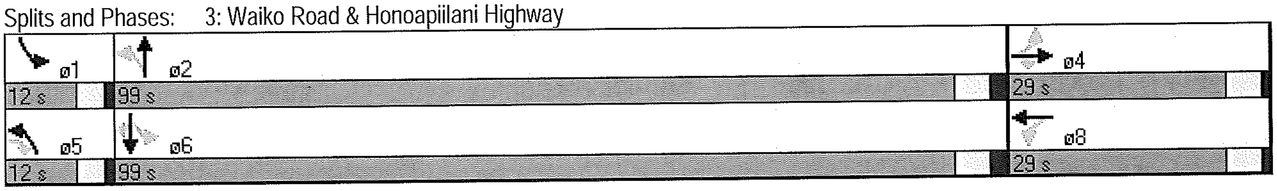
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	15	25	20	25	45	15	915	75	900	40
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	29.0	29.0	41.0	29.0	29.0	12.0	99.0	12.0	99.0	99.0
Total Split (%)	20.7%	20.7%	29.3%	20.7%	20.7%	8.6%	70.7%	8.6%	70.7%	70.7%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max
Act Effct Green (s)		24.0	32.8		24.0	100.2	93.4	106.2	97.9	97.9
Actuated g/C Ratio		0.17	0.23		0.17	0.72	0.67	0.76	0.70	0.70
v/c Ratio		0.50	0.10		0.99	0.06	0.96	0.80	0.75	0.05
Control Delay		64.0	12.4		98.5	3.1	42.4	70.4	6.9	2.1
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.1	0.0
Total Delay		64.0	12.4		98.5	3.1	42.4	70.4	7.0	2.1
LOS		E	B		F	A	D	E	A	A
Approach Delay		47.4			98.5		41.8		13.3	
Approach LOS		D			F		D		B	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 36.6 Intersection LOS: D
Intersection Capacity Utilization 91.4% ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	25	20	25	45	155	15	915	145	75	900	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Frt		1.00	0.85		0.92		1.00	0.97		1.00	1.00	0.85
Flt Protected		0.98	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1903	1647		1713		1770	1807		1770	1863	1540
Flt Permitted		0.51	1.00		0.96		0.17	1.00		0.04	1.00	1.00
Satd. Flow (perm)		981	1647		1649		319	1807		77	1863	1540
Peak-hour factor, PHF	0.50	0.46	0.50	0.75	0.43	0.89	0.88	0.95	0.72	0.63	0.92	0.71
Adj. Flow (vph)	30	54	40	33	105	174	17	963	201	119	978	56
RTOR Reduction (vph)	0	0	31	0	32	0	0	5	0	0	0	7
Lane Group Flow (vph)	0	84	9	0	280	0	17	1159	0	119	978	49
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		24.0	32.9		24.0		97.3	93.4		104.7	97.1	97.1
Effective Green, g (s)		24.0	32.9		24.0		97.3	93.4		104.7	97.1	97.1
Actuated g/C Ratio		0.17	0.23		0.17		0.69	0.67		0.75	0.69	0.69
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		168	387		283		262	1206		149	1292	1068
v/s Ratio Prot							0.00	c0.64		c0.04	0.53	
v/s Ratio Perm		0.09	0.01		c0.17		0.04			0.55		0.03
v/c Ratio		0.50	0.02		0.99		0.06	0.96		0.80	0.76	0.05
Uniform Delay, d1		52.6	41.2		57.9		12.9	21.6		44.9	13.8	6.8
Progression Factor		1.00	1.00		1.00		0.65	1.18		1.58	0.28	0.43
Incremental Delay, d2		0.9	0.0		49.7		0.0	16.7		17.5	3.0	0.1
Delay (s)		53.4	41.2		107.5		8.4	42.1		88.5	6.8	3.0
Level of Service		D	D		F		A	D		F	A	A
Approach Delay (s)		49.5			107.5			41.6			15.0	
Approach LOS		D			F			D			B	

Intersection Summary			
HCM Average Control Delay	38.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	91.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
4: Maui Tropical Plantation & Honoapiilani Highway

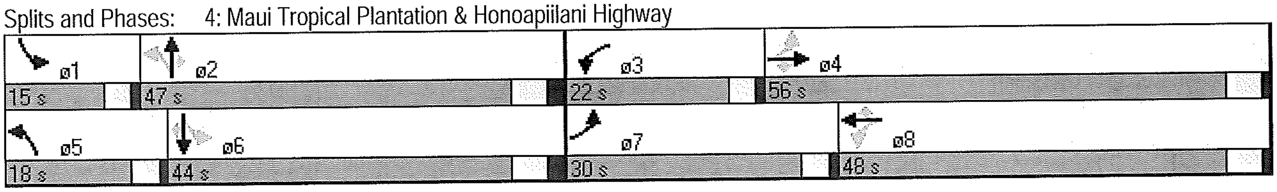
1/21/2010

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	185	5	75	155	5	250	135	620	205	210	450	240
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	23.0	23.0	8.0	23.0	23.0	8.0	24.0	24.0	8.0	24.0	24.0
Total Split (s)	30.0	56.0	56.0	22.0	48.0	48.0	18.0	47.0	47.0	15.0	44.0	44.0
Total Split (%)	21.4%	40.0%	40.0%	15.7%	34.3%	34.3%	12.9%	33.6%	33.6%	10.7%	31.4%	31.4%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	32.2	12.4	12.4	25.7	8.7	8.7	93.2	81.6	81.6	95.8	82.9	82.9
Actuated g/C Ratio	0.23	0.09	0.09	0.18	0.06	0.06	0.67	0.58	0.58	0.68	0.59	0.59
v/c Ratio	0.60	0.03	0.38	0.56	0.04	0.77	0.26	0.57	0.23	0.48	0.44	0.26
Control Delay	51.7	52.8	15.5	48.3	55.0	19.9	2.6	4.8	1.0	7.0	14.3	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.7	52.8	15.5	48.3	55.0	19.9	2.6	4.8	1.0	7.0	14.3	6.1
LOS	D	D	B	D	D	B	A	A	A	A	B	A
Approach Delay		41.4			31.0			3.7			10.4	
Approach LOS		D			C			A			B	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 109 (78%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 14.6 Intersection LOS: B
Intersection Capacity Utilization 73.7% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
4: Maui Tropical Plantation & Honoapiilani Highway

1/21/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	185	5	75	155	5	250	135	620	205	210	450	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1769	1863	1583	1770	1863	1546
Flt Permitted	0.53	1.00	1.00	0.75	1.00	1.00	0.40	1.00	1.00	0.30	1.00	1.00
Satd. Flow (perm)	986	1863	1583	1405	1863	1583	748	1863	1583	550	1863	1546
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	1.00	0.92	0.92	0.92	0.92
Adj. Flow (vph)	201	5	82	168	5	272	147	620	223	228	489	261
RTOR Reduction (vph)	0	0	75	0	0	255	0	0	27	0	0	69
Lane Group Flow (vph)	201	5	7	168	5	17	147	620	196	228	489	192
Confl. Peds. (#/hr)							1					1
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	32.1	12.4	12.4	24.7	8.7	8.7	91.3	81.6	81.6	93.9	82.9	82.9
Effective Green, g (s)	32.1	12.4	12.4	24.7	8.7	8.7	91.3	81.6	81.6	93.9	82.9	82.9
Actuated g/C Ratio	0.23	0.09	0.09	0.18	0.06	0.06	0.65	0.58	0.58	0.67	0.59	0.59
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	336	165	140	290	116	98	559	1086	923	465	1103	915
v/s Ratio Prot	c0.08	0.00		0.07	0.00		0.02	c0.33		c0.04	0.26	
v/s Ratio Perm	c0.05		0.00	0.04		0.01	0.15		0.12	0.29		0.12
v/c Ratio	0.60	0.03	0.05	0.58	0.04	0.17	0.26	0.57	0.21	0.49	0.44	0.21
Uniform Delay, d1	47.0	58.3	58.4	52.5	61.7	62.2	10.1	18.3	13.9	12.1	15.8	13.3
Progression Factor	1.00	1.00	1.00	0.94	0.94	0.77	0.25	0.18	0.07	0.52	0.73	0.90
Incremental Delay, d2	2.9	0.1	0.2	2.8	0.2	0.8	0.1	1.1	0.3	0.5	0.9	0.3
Delay (s)	49.8	58.4	58.6	52.3	58.0	49.1	2.6	4.4	1.2	6.9	12.4	12.3
Level of Service	D	E	E	D	E	D	A	A	A	A	B	B
Approach Delay (s)		52.5			50.4			3.4			11.1	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

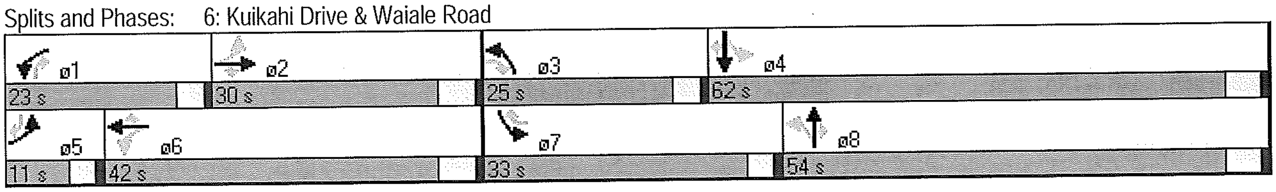
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	190	335	60	265	170	545	50	345	370	410	475	385
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	29.0		8.0	29.0		8.0	29.0		8.0	29.0	
Total Split (s)	11.0	30.0	55.0	23.0	42.0	75.0	25.0	54.0	77.0	33.0	62.0	73.0
Total Split (%)	7.9%	21.4%	39.3%	16.4%	30.0%	53.6%	17.9%	38.6%	55.0%	23.6%	44.3%	52.1%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	Min	C-Min		Min	C-Min		None	None		None	None	
Act Effct Green (s)	45.5	37.5	49.3	61.5	49.5	81.3	46.6	37.7	60.7	70.5	57.7	68.7
Actuated g/C Ratio	0.32	0.27	0.35	0.44	0.35	0.58	0.33	0.27	0.43	0.50	0.41	0.49
v/c Ratio	0.56	0.73	0.14	0.79	0.28	0.59	0.31	0.77	0.55	0.98	0.84	0.49
Control Delay	32.0	47.8	13.3	46.1	36.7	14.3	22.3	57.2	23.5	67.9	46.7	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	47.8	13.3	46.1	36.7	14.3	22.3	57.2	23.5	67.9	46.7	15.0
LOS	C	D	B	D	D	B	C	E	C	E	D	B
Approach Delay		38.2			26.8			38.8			44.3	
Approach LOS		D			C			D			D	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 29 (21%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 37.6 Intersection LOS: D
Intersection Capacity Utilization 90.7% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 6: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	190	335	60	265	170	545	50	345	370	410	475	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1762	1863	1538	1770	1863	1538	1769	1863	1538	1770	1863	1538
Flt Permitted	0.64	1.00	1.00	0.22	1.00	1.00	0.19	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	1189	1863	1538	403	1863	1538	355	1863	1538	347	1863	1538
Peak-hour factor, PHF	0.82	0.92	0.73	0.92	0.92	0.92	0.82	0.89	0.92	0.92	0.74	0.93
Adj. Flow (vph)	232	364	82	288	185	592	61	388	402	446	642	414
RTOR Reduction (vph)	0	0	29	0	0	101	0	0	57	0	0	81
Lane Group Flow (vph)	232	364	53	288	185	491	61	388	345	446	642	333
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	44.5	37.5	50.3	60.5	49.5	82.3	45.5	37.7	61.7	69.5	57.7	69.7
Effective Green, g (s)	44.5	37.5	50.3	60.5	49.5	82.3	45.5	37.7	61.7	69.5	57.7	69.7
Actuated g/C Ratio	0.32	0.27	0.36	0.43	0.35	0.59	0.32	0.27	0.44	0.50	0.41	0.50
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0		4.0	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)	407	499	553	360	659	904	194	502	678	455	768	766
v/s Ratio Prot	0.03	0.20		c0.11	0.10		0.02	0.21		c0.19	0.34	
v/s Ratio Perm	0.15		0.03	c0.24		0.32	0.08		0.22	c0.29		0.22
v/c Ratio	0.57	0.73	0.10	0.80	0.28	0.54	0.31	0.77	0.51	0.98	0.84	0.43
Uniform Delay, d1	38.3	46.6	29.8	30.1	32.5	17.5	34.7	47.2	28.2	34.6	36.9	22.5
Progression Factor	0.76	0.79	0.72	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	8.2	0.1	12.0	1.1	0.7	0.9	7.3	0.6	36.9	7.9	0.4
Delay (s)	30.7	45.1	21.4	42.1	33.5	18.1	35.6	54.5	28.8	71.5	44.8	22.9
Level of Service	C	D	C	D	C	B	D	D	C	E	D	C
Approach Delay (s)		37.3			27.3			41.0			46.7	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	38.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Volume (veh/h)	15	225	30	315	120	255	10	495	125	235	405	95
Peak Hour Factor	0.59	0.77	0.92	0.92	0.70	0.79	0.92	0.92	0.92	0.75	0.92	0.81
Hourly flow rate (vph)	25	292	33	342	171	323	11	538	136	313	440	117
Approach Volume (veh/h)		350			837			685			871	
Crossing Volume (veh/h)		1096			574			631			525	
High Capacity (veh/h)		575			879			840			915	
High v/c (veh/h)		0.61			0.95			0.81			0.95	
Low Capacity (veh/h)		442			707			672			738	
Low v/c (veh/h)		0.79			1.18			1.02			1.18	

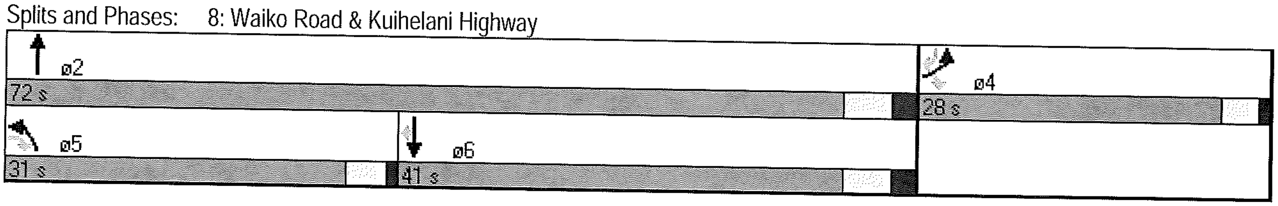
Intersection Summary			
Maximum v/c High	0.95		
Maximum v/c Low	1.18		
Intersection Capacity Utilization	141.5%	ICU Level of Service	H

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	450	105	145	960	855	600
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	16.0	24.0	
Total Split (s)	28.0	59.0	31.0	72.0	41.0	69.0
Total Split (%)	28.0%	59.0%	31.0%	72.0%	41.0%	69.0%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	19.8	37.2	13.4	51.6	34.1	57.9
Actuated g/C Ratio	0.24	0.46	0.16	0.63	0.42	0.71
v/c Ratio	0.74	0.24	0.66	0.47	0.66	0.55
Control Delay	35.1	12.0	44.4	8.9	22.9	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.1	12.0	44.4	8.9	22.9	3.8
LOS	D	B	D	A	C	A
Approach Delay	30.0			14.4	15.0	
Approach LOS	C			B	B	

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 81.5
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 18.0 Intersection LOS: B
Intersection Capacity Utilization 56.2% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	450	105	145	960	855	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.60	0.75	0.91	0.88	0.88
Adj. Flow (vph)	616	175	193	1055	972	682
RTOR Reduction (vph)	0	14	0	0	0	114
Lane Group Flow (vph)	616	161	193	1055	972	568
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	19.7	37.1	13.4	51.6	34.2	59.9
Effective Green, g (s)	19.7	37.1	13.4	51.6	34.2	59.9
Actuated g/C Ratio	0.24	0.46	0.16	0.63	0.42	0.74
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	832	722	292	2246	1489	1166
v/s Ratio Prot	c0.18		c0.11	0.30	c0.27	
v/s Ratio Perm		0.10				0.36
v/c Ratio	0.74	0.22	0.66	0.47	0.65	0.49
Uniform Delay, d1	28.4	13.4	31.8	7.7	18.8	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.1	0.1	4.3	0.3	1.4	0.7
Delay (s)	31.6	13.4	36.1	8.1	20.2	5.1
Level of Service	C	B	D	A	C	A
Approach Delay (s)	27.6			12.4	14.0	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	16.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	81.3	Sum of lost time (s)	14.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	165	70	90	525	385	330
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	179	76	98	571	418	359
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1185	418	777			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1185	418	777			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	3	88	88			
cM capacity (veh/h)	185	635	839			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	255	98	571	418	359
Volume Left	179	98	0	0	0
Volume Right	76	0	0	0	359
cSH	234	839	1700	1700	1700
Volume to Capacity	1.09	0.12	0.34	0.25	0.21
Queue Length 95th (ft)	281	10	0	0	0
Control Delay (s)	130.5	9.9	0.0	0.0	0.0
Lane LOS	F	A			
Approach Delay (s)	130.5	1.4		0.0	
Approach LOS	F				

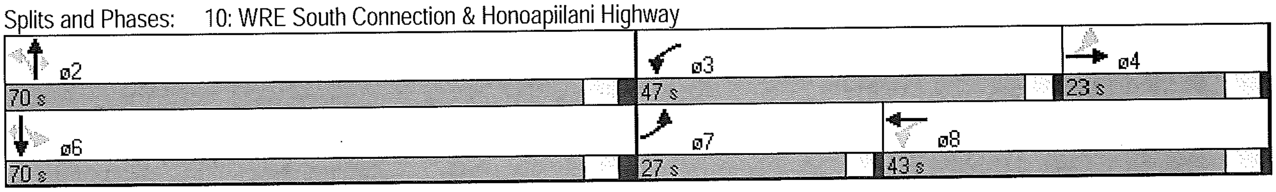
Intersection Summary			
Average Delay	20.2		
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	75	45	405	50	30	855	570	10	630	50
Turn Type	pm+pt		pm+pt		Perm		Perm	Perm		Perm
Protected Phases	7	4	3	8		2			6	
Permitted Phases	4		8		2		2	6		6
Detector Phase	7	4	3	8	2	2	2	6	6	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	23.0	8.0	23.0	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	27.0	23.0	47.0	43.0	70.0	70.0	70.0	70.0	70.0	70.0
Total Split (%)	19.3%	16.4%	33.6%	30.7%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag						
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	29.2	13.2	51.8	34.7	75.9	75.9	75.9	75.9	75.9	75.9
Actuated g/C Ratio	0.21	0.09	0.37	0.25	0.54	0.54	0.54	0.54	0.54	0.54
v/c Ratio	0.25	0.76	0.88	0.13	0.15	0.92	0.63	0.20	0.68	0.06
Control Delay	31.0	56.1	57.4	34.0	21.5	45.5	15.6	38.2	28.1	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.0	56.1	57.4	34.0	21.5	45.5	15.6	38.2	28.1	15.7
LOS	C	E	E	C	C	D	B	D	C	B
Approach Delay		47.9		54.6		33.3			27.4	
Approach LOS		D		D		C			C	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 57 (41%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 36.5 Intersection LOS: D
Intersection Capacity Utilization 89.1% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 10: WRE South Connection & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	45	110	405	50	5	30	855	570	10	630	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.89		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1664		1770	1839		1770	1863	1583	1770	1863	1583
Flt Permitted	0.72	1.00		0.22	1.00		0.22	1.00	1.00	0.05	1.00	1.00
Satd. Flow (perm)	1338	1664		412	1839		413	1863	1583	99	1863	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)	82	49	120	440	54	5	33	929	620	11	685	54
RTOR Reduction (vph)	0	65	0	0	2	0	0	0	132	0	0	9
Lane Group Flow (vph)	82	104	0	440	57	0	33	929	488	11	685	45
Turn Type	pm+pt			pm+pt			Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	30.6	14.1		54.0	33.5		75.0	75.0	75.0	75.0	75.0	75.0
Effective Green, g (s)	30.6	14.1		54.0	33.5		75.0	75.0	75.0	75.0	75.0	75.0
Actuated g/C Ratio	0.22	0.10		0.39	0.24		0.54	0.54	0.54	0.54	0.54	0.54
Clearance Time (s)	4.0	5.0		4.0	5.0		6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	343	168		507	440		221	998	848	53	998	848
v/s Ratio Prot	0.03	0.06		c0.22	0.03			c0.50			0.37	
v/s Ratio Perm	0.02			c0.11			0.08		0.31	0.11		0.03
v/c Ratio	0.24	0.62		0.87	0.13		0.15	0.93	0.58	0.21	0.69	0.05
Uniform Delay, d1	44.8	60.4		36.9	41.8		16.4	30.1	21.8	17.0	23.9	15.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.22	0.96	1.21
Incremental Delay, d2	0.4	6.9		14.5	0.1		1.4	16.0	2.8	8.0	3.6	0.1
Delay (s)	45.2	67.3		51.5	41.9		17.8	46.1	24.6	28.7	26.5	18.9
Level of Service	D	E		D	D		B	D	C	C	C	B
Approach Delay (s)		60.1			50.3			37.1			26.0	
Approach LOS		E			D			D			C	

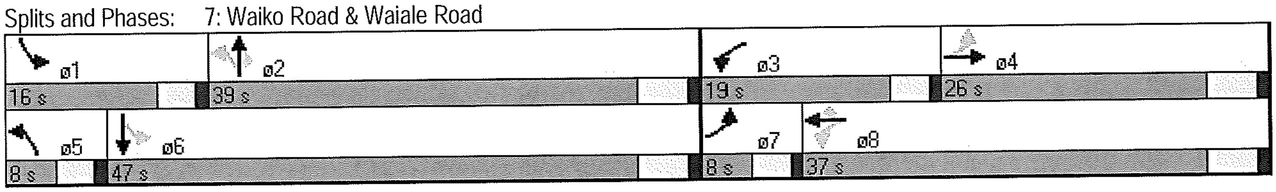
Intersection Summary			
HCM Average Control Delay	38.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	15	225	315	120	255	10	495	125	235	405
Turn Type	pm+pt		pm+pt		Perm	pm+pt		Perm	pm+pt	
Protected Phases	7	4	3	8		5	2		1	6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	8.0	26.0	26.0	8.0	26.0	26.0	8.0	26.0
Total Split (s)	8.0	26.0	19.0	37.0	37.0	8.0	39.0	39.0	16.0	47.0
Total Split (%)	8.0%	26.0%	19.0%	37.0%	37.0%	8.0%	39.0%	39.0%	16.0%	47.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 91.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	225	30	315	120	255	10	495	125	235	405	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1827		1770	1863	1583	1770	1863	1583	1770	1810	
Flt Permitted	0.67	1.00		0.30	1.00	1.00	0.37	1.00	1.00	0.14	1.00	
Satd. Flow (perm)	1255	1827		551	1863	1583	681	1863	1583	258	1810	
Peak-hour factor, PHF	0.92	1.00	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	225	33	342	130	277	11	538	136	255	440	103
RTOR Reduction (vph)	0	6	0	0	0	184	0	0	27	0	8	0
Lane Group Flow (vph)	16	252	0	342	130	93	11	538	109	255	535	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	21.1	19.6		38.1	32.6	32.6	34.0	33.3	33.3	48.9	44.2	
Effective Green, g (s)	21.1	19.6		38.1	32.6	32.6	34.0	33.3	33.3	48.9	44.2	
Actuated g/C Ratio	0.22	0.20		0.39	0.34	0.34	0.35	0.34	0.34	0.50	0.46	
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	281	369		399	626	532	247	640	543	311	825	
v/s Ratio Prot	0.00	0.14		c0.13	0.07		0.00	0.29		c0.10	0.30	
v/s Ratio Perm	0.01			c0.21		0.06	0.02		0.07	c0.32		
v/c Ratio	0.06	0.68		0.86	0.21	0.17	0.04	0.84	0.20	0.82	0.65	
Uniform Delay, d1	30.0	35.8		23.2	23.0	22.7	20.8	29.4	22.5	18.9	20.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	5.2		16.4	0.2	0.2	0.1	9.7	0.2	15.4	1.8	
Delay (s)	30.1	41.0		39.6	23.1	22.9	20.9	39.1	22.6	34.3	22.2	
Level of Service	C	D		D	C	C	C	D	C	C	C	
Approach Delay (s)		40.4			30.6			35.6			26.1	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM Average Control Delay	31.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	97.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

```
*****************************************************************
*                                                               *
*   9:2:10              08-557 waiale-waiko   alt 1 AM      15  *
*                                                               *
*****************************************************************
*                                        *                      *
* E     (m)    4.60   4.60   4.60   4.60  * TIME PERIOD    min    90  *
* L'    (m)   10.00  10.00  10.00  10.00  * TIME SLICE     min    15  *
* V     (m)    3.70   3.70   3.70   3.70  * RESULTS PERIOD min 15 75  *
* RAD   (m)   20.00  20.00  20.00  20.00  * TIME COST     $/hr 15.00  *
* PHI   (d)   30.00  30.00  30.00  30.00  * FLOW PERIOD    min 15 75  *
* DIA   (m)   37.00  37.00  37.00  37.00  * FLOW TYPE  pcu/veh   VEH  *
* GRAD SEP        0      0      0      0  * FLOW PEAK am/op/pm    AM  *
*                                        *                      *
*****************************************************************
 LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*         *    *                           *    *  *               *         *
*wb waiko  *1.05*  225   60  125  0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*sb waiale *1.05*  115  355  445  0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*eb waiko  *1.05*   10  310   10  0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*nb waiale *1.05*   85  455   10  0        *1.00*75*0.75 1.125 0.75*15 45 75 *
*         *    *                           *    *  *               *         *
*         *    *                           *    *  *               *         *
*         *    *                           *    *  *               *         *
*****************************************************************
*                                                  *            *
* FLOW         veh     410    915    330    550    *            *
* CAPACITY     veh     869   1029    611    702    * AVDEL s  27.4 *
* AVE DELAY   mins    0.13   0.67   0.22   0.48    * L O S       D *
* MAX DELAY   mins    0.18   1.35   0.34   0.91    * VEH HRS  16.8 *
* AVE QUEUE    veh       1     11      1      5    * COST $  251.4 *
* MAX QUEUE    veh       1     20      2      8    *            *
*                                                  *            *
*****************************************************************
```

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2030 with Alternative 2 AM

Timings
1: Kuikahi Drive & Honoapiilani Highway

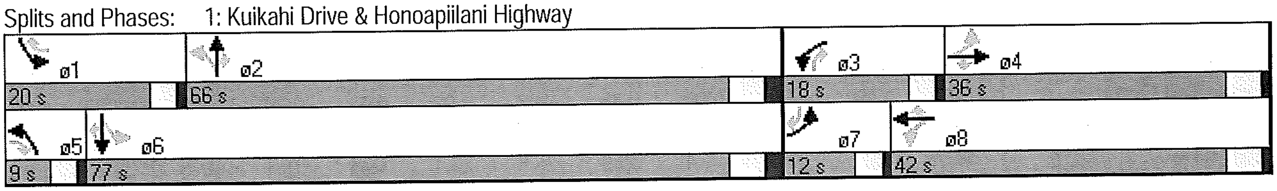
2/8/2010

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	260	110	200	75	225	50	690	430	155	495	25
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	24.0		7.0	24.0	
Total Split (s)	12.0	36.0	45.0	18.0	42.0	62.0	9.0	66.0	84.0	20.0	77.0	89.0
Total Split (%)	8.6%	25.7%	32.1%	12.9%	30.0%	44.3%	6.4%	47.1%	60.0%	14.3%	55.0%	63.6%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 65 (46%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	105	260	110	200	75	225	50	690	430	155	495	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.70	1.00	1.00	0.11	1.00	1.00	0.26	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	1336	1909	1623	213	1863	1583	491	1863	1583	116	1863	1583
Peak-hour factor, PHF	0.79	0.62	0.88	0.94	0.85	0.75	0.71	0.92	0.76	0.62	0.76	0.88
Adj. Flow (vph)	133	419	125	213	88	300	70	750	566	250	651	28
RTOR Reduction (vph)	0	0	69	0	0	91	0	0	60	0	0	9
Lane Group Flow (vph)	133	419	56	213	88	209	70	750	506	250	651	19
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	38.9	31.0	41.0	49.0	37.1	58.1	65.0	60.0	80.0	80.0	71.0	84.9
Effective Green, g (s)	38.9	31.0	41.0	49.0	37.1	58.1	65.0	60.0	80.0	80.0	71.0	84.9
Actuated g/C Ratio	0.28	0.22	0.29	0.35	0.27	0.42	0.46	0.43	0.57	0.57	0.51	0.61
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	398	423	475	230	494	657	274	798	905	255	945	960
v/s Ratio Prot	0.02	0.22		c0.09	0.05		0.01	0.40		c0.11	0.35	
v/s Ratio Perm	0.07		0.03	c0.23		0.13	0.11		0.32	c0.45		0.01
v/c Ratio	0.33	0.99	0.12	0.93	0.18	0.32	0.26	0.94	0.56	0.98	0.69	0.02
Uniform Delay, d1	39.4	54.4	36.3	37.5	39.7	27.6	22.8	38.3	18.9	46.4	26.1	11.0
Progression Factor	1.00	1.00	1.00	0.90	0.85	0.93	1.02	0.93	0.79	1.00	1.00	1.00
Incremental Delay, d2	0.2	41.1	0.0	37.7	0.1	0.1	0.1	11.7	0.2	50.6	4.1	0.0
Delay (s)	39.6	95.4	36.3	71.4	33.8	25.8	23.4	47.4	15.1	97.0	30.2	11.0
Level of Service	D	F	D	E	C	C	C	D	B	F	C	B
Approach Delay (s)		73.5			43.1			33.0			47.6	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM Average Control Delay	46.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

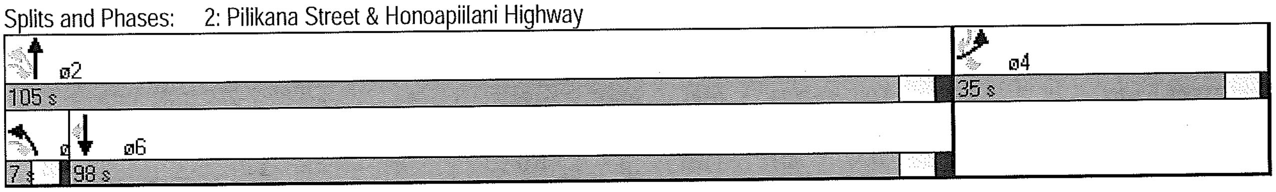
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Volume (vph)	115	75	30	950	745	55
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Detector Phase	4	4 5 2	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	35.0	147.0	7.0	105.0	98.0	133.0
Total Split (%)	25.0%	105.0%	5.0%	75.0%	70.0%	95.0%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 5 (4%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	75	30	950	745	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.26	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	480	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	151	115	32	1377	847	64
RTOR Reduction (vph)	0	0	0	0	0	5
Lane Group Flow (vph)	151	115	32	1377	847	59
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5 2	2			6 4
Actuated Green, G (s)	16.2	140.0	112.8	112.8	105.8	128.0
Effective Green, g (s)	16.2	134.0	112.8	112.8	105.8	128.0
Actuated g/C Ratio	0.12	0.96	0.81	0.81	0.76	0.91
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	208	1538	414	1501	1408	1447
v/s Ratio Prot	c0.08		0.00	c0.74	0.45	
v/s Ratio Perm		0.07	0.06			0.04
v/c Ratio	0.73	0.07	0.08	0.92	0.60	0.04
Uniform Delay, d1	59.8	0.1	5.7	10.1	7.7	0.5
Progression Factor	1.00	1.00	0.72	0.50	0.30	0.00
Incremental Delay, d2	10.2	0.0	0.0	6.8	1.4	0.0
Delay (s)	69.9	0.1	4.1	11.9	3.7	0.0
Level of Service	E	A	A	B	A	A
Approach Delay (s)	39.8			11.7	3.4	
Approach LOS	D			B	A	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		

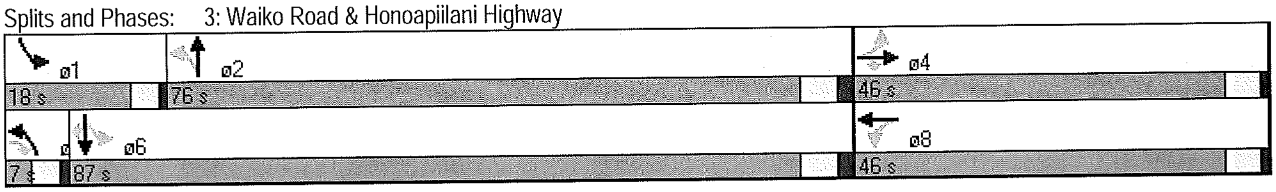
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	45	35	15	65	10	10	855	145	660	30
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	46.0	46.0	53.0	46.0	46.0	7.0	76.0	18.0	87.0	87.0
Total Split (%)	32.9%	32.9%	37.9%	32.9%	32.9%	5.0%	54.3%	12.9%	62.1%	62.1%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
3: Waiko Road & Honoapiilani Highway

2/8/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱		✥		↰	↑↱		↰	↑	↱
Volume (vph)	45	35	15	65	10	110	10	855	125	145	660	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Frt		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.92		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1871	1647		1682		1768	1813		1770	1863	1540
Flt Permitted		0.46	1.00		0.68		0.36	1.00		0.04	1.00	1.00
Satd. Flow (perm)		886	1647		1160		665	1813		82	1863	1540
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	98	41	26	75	20	153	16	950	174	220	710	56
RTOR Reduction (vph)	0	0	17	0	49	0	0	3	0	0	0	7
Lane Group Flow (vph)	0	139	9	0	199	0	16	1121	0	220	710	49
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		23.8	30.6		23.8		89.1	87.3		105.2	99.4	99.4
Effective Green, g (s)		23.8	30.6		23.8		89.1	87.3		105.2	99.4	99.4
Actuated g/C Ratio		0.17	0.22		0.17		0.64	0.62		0.75	0.71	0.71
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		151	360		197		437	1131		229	1323	1093
v/s Ratio Prot							0.00	c0.62		c0.10	0.38	
v/s Ratio Perm		0.16	0.01		c0.17		0.02			0.63		0.03
v/c Ratio		0.92	0.02		1.01		0.04	0.99		0.96	0.54	0.04
Uniform Delay, d1		57.2	43.0		58.1		9.6	26.0		52.0	9.5	6.1
Progression Factor		1.00	1.00		1.00		0.85	0.70		0.90	0.90	1.06
Incremental Delay, d2		49.5	0.0		66.8		0.0	22.9		44.0	1.3	0.1
Delay (s)		106.7	43.0		124.9		8.2	41.0		91.1	9.9	6.5
Level of Service		F	D		F		A	D		F	A	A
Approach Delay (s)		96.7			124.9			40.5			27.8	
Approach LOS		F			F			D			C	

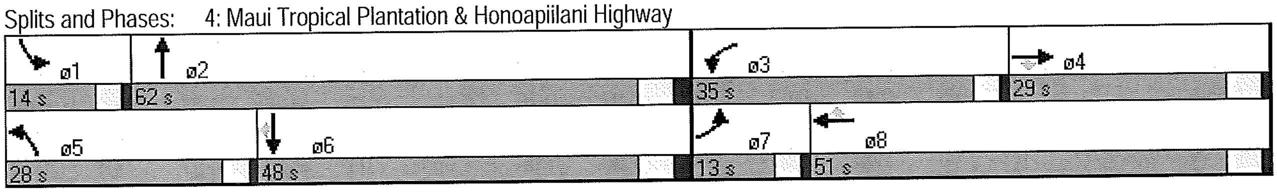
Intersection Summary			
HCM Average Control Delay	47.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	35	35	585	25	240	45	555	455	120	525	85
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	24.0	24.0	8.0	23.0	23.0	8.0	24.0		8.0	24.0	24.0
Total Split (s)	13.0	29.0	29.0	35.0	51.0	51.0	28.0	62.0	0.0	14.0	48.0	48.0
Total Split (%)	9.3%	20.7%	20.7%	25.0%	36.4%	36.4%	20.0%	44.3%	0.0%	10.0%	34.3%	34.3%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	4.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	C-Max

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 8 (6%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
4: Maui Tropical Plantation & Honoapiilani Highway 2/8/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	35	35	585	25	240	45	555	455	120	525	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	4.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	3433	1863	1583	1770	1863	1583	1770	1863	1546
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	3433	1863	1583	1770	1863	1583	1770	1863	1546
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)	120	38	38	636	27	261	49	603	495	130	571	92
RTOR Reduction (vph)	0	0	36	0	0	210	0	0	0	0	0	24
Lane Group Flow (vph)	120	38	2	636	27	51	49	603	495	130	571	68
Confl. Peds. (#/hr)							1					1
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	9.0	7.2	7.2	29.3	27.5	27.5	8.1	74.5	140.0	10.0	76.4	76.4
Effective Green, g (s)	9.0	7.2	7.2	29.3	27.5	27.5	8.1	74.5	140.0	10.0	76.4	76.4
Actuated g/C Ratio	0.06	0.05	0.05	0.21	0.20	0.20	0.06	0.53	1.00	0.07	0.55	0.55
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	114	96	81	718	366	311	102	991	1583	126	1017	844
v/s Ratio Prot	c0.07	0.02		c0.19	0.01		0.03	c0.32		c0.07	0.31	
v/s Ratio Perm			0.00			0.03			c0.31			0.04
v/c Ratio	1.05	0.40	0.02	0.89	0.07	0.16	0.48	0.61	0.31	1.03	0.56	0.08
Uniform Delay, d1	65.5	64.3	63.1	53.7	45.9	46.7	63.9	22.7	0.0	65.0	20.8	15.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.04	1.28
Incremental Delay, d2	99.1	2.7	0.1	12.6	0.1	0.3	3.5	2.8	0.5	83.1	1.9	0.2
Delay (s)	164.6	67.0	63.2	66.3	46.0	47.0	67.4	25.4	0.5	139.5	23.7	19.5
Level of Service	F	E	E	E	D	D	E	C	A	F	C	B
Approach Delay (s)		126.0			60.3			16.5			42.2	
Approach LOS		F			E			B			D	

Intersection Summary			
HCM Average Control Delay	43.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		

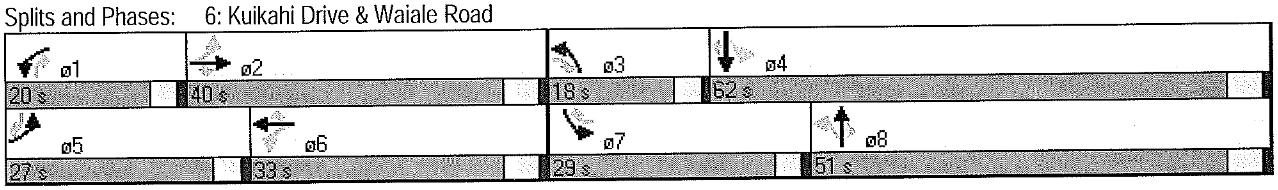
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	345	455	50	210	165	260	55	360	300	195	455	270
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	1.0		4.0	4.0	
Minimum Split (s)	8.0	29.0		8.0	29.0		8.0	29.0		8.0	29.0	
Total Split (s)	27.0	40.0	58.0	20.0	33.0	62.0	18.0	51.0	71.0	29.0	62.0	89.0
Total Split (%)	19.3%	28.6%	41.4%	14.3%	23.6%	44.3%	12.9%	36.4%	50.7%	20.7%	44.3%	63.6%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Min		None	C-Min		None	None		None	None	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 88 (63%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	345	455	50	210	165	260	55	360	300	195	455	270
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1765	1863	1538	1769	1863	1538	1770	1863	1538	1770	1863	1538
Flt Permitted	0.49	1.00	1.00	0.18	1.00	1.00	0.11	1.00	1.00	0.15	1.00	1.00
Satd. Flow (perm)	903	1863	1538	342	1863	1538	204	1863	1538	272	1863	1538
Peak-hour factor, PHF	0.75	0.92	0.78	0.92	0.92	0.92	0.81	0.73	0.92	0.92	0.73	0.79
Adj. Flow (vph)	460	495	64	228	179	283	68	493	326	212	623	342
RTOR Reduction (vph)	0	0	16	0	0	83	0	0	96	0	0	134
Lane Group Flow (vph)	460	495	48	228	179	200	68	493	230	212	623	208
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	64.8	45.3	58.7	53.3	37.8	58.4	54.0	45.6	66.1	65.2	52.8	80.8
Effective Green, g (s)	64.8	45.3	58.7	53.3	37.8	58.4	54.0	45.6	66.1	65.2	52.8	80.8
Actuated g/C Ratio	0.46	0.32	0.42	0.38	0.27	0.42	0.39	0.33	0.47	0.47	0.38	0.58
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0		4.0	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)	560	603	645	288	503	642	173	607	726	294	703	888
v/s Ratio Prot	c0.14	0.27		0.09	0.10		0.02	0.26		c0.08	c0.33	
v/s Ratio Perm	c0.25		0.03	0.21		0.13	0.13		0.15	0.26		0.13
v/c Ratio	0.82	0.82	0.07	0.79	0.36	0.31	0.39	0.81	0.32	0.72	0.89	0.23
Uniform Delay, d1	29.2	43.6	24.4	33.4	41.3	27.3	32.0	43.3	22.9	28.3	40.8	14.5
Progression Factor	0.72	0.81	0.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.5	7.1	0.0	13.8	2.0	0.3	1.5	8.1	0.3	8.4	12.9	0.1
Delay (s)	26.6	42.2	16.0	47.2	43.2	27.6	33.4	51.4	23.2	36.7	53.7	14.6
Level of Service	C	D	B	D	D	C	C	D	C	D	D	B
Approach Delay (s)		33.5			38.1			39.7			39.3	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	37.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Volume (veh/h)	10	310	10	125	60	265	10	455	85	445	355	115
Peak Hour Factor	0.59	0.77	0.92	0.92	0.70	0.79	0.92	0.92	0.92	0.75	0.92	0.81
Hourly flow rate (vph)	17	403	11	136	86	335	11	495	92	593	386	142
Approach Volume (veh/h)		430			557			598			1121	
Crossing Volume (veh/h)		1115			522			1013			232	
High Capacity (veh/h)		566			917			616			1154	
High v/c (veh/h)		0.76			0.61			0.97			0.97	
Low Capacity (veh/h)		435			740			477			952	
Low v/c (veh/h)		0.99			0.75			1.25			1.18	

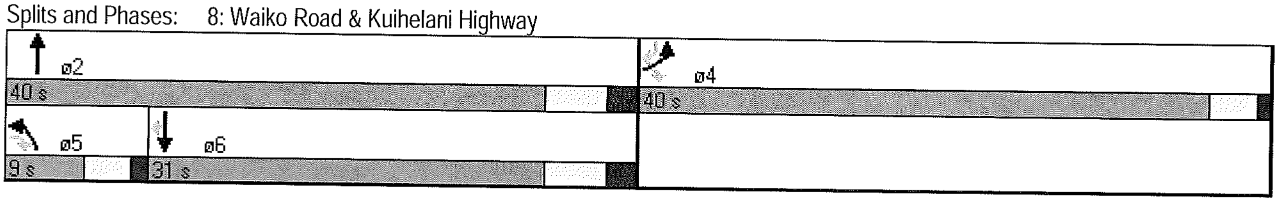
Intersection Summary			
Maximum v/c High	0.97		
Maximum v/c Low	1.25		
Intersection Capacity Utilization	137.1%	ICU Level of Service	H

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	655	305	10	510	690	395
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	16.0	24.0	
Total Split (s)	40.0	49.0	9.0	40.0	31.0	71.0
Total Split (%)	50.0%	61.3%	11.3%	50.0%	38.8%	88.8%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Max	Max	

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 72.3
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	655	305	10	510	690	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	897	610	32	560	784	534
RTOR Reduction (vph)	0	18	0	0	0	97
Lane Group Flow (vph)	897	592	32	560	784	437
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	27.9	37.0	5.1	34.4	25.3	59.2
Effective Green, g (s)	27.9	37.0	5.1	34.4	25.3	59.2
Actuated g/C Ratio	0.39	0.51	0.07	0.48	0.35	0.82
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	1325	810	125	1684	1238	1296
v/s Ratio Prot	0.26		0.02	0.16	c0.22	
v/s Ratio Perm		c0.37				0.28
v/c Ratio	0.68	0.73	0.26	0.33	0.63	0.34
Uniform Delay, d1	18.5	13.8	31.8	11.8	19.6	1.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	2.9	0.4	0.5	2.5	0.1
Delay (s)	19.5	16.7	32.2	12.3	22.1	1.7
Level of Service	B	B	C	B	C	A
Approach Delay (s)	18.4			13.4	13.8	
Approach LOS	B			B	B	

Intersection Summary			
HCM Average Control Delay	15.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	72.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

7: Waiko Road & Waiale Road

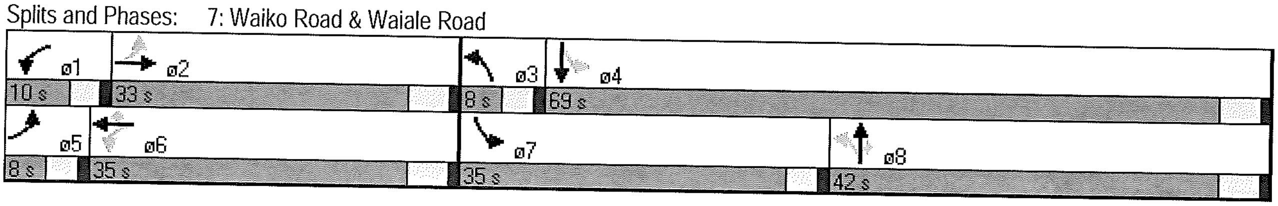
2/3/2010

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	10	310	125	60	265	10	455	85	445	355
Turn Type	pm+pt		pm+pt		Perm	pm+pt		Perm	pm+pt	
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	8.0	26.0	26.0	8.0	26.0	26.0	8.0	26.0
Total Split (s)	8.0	33.0	10.0	35.0	35.0	8.0	42.0	42.0	35.0	69.0
Total Split (%)	6.7%	27.5%	8.3%	29.2%	29.2%	6.7%	35.0%	35.0%	29.2%	57.5%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 111.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑	↱	↰	↑↱	
Volume (vph)	10	310	10	125	60	265	10	455	85	445	355	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1854		1770	1863	1583	1770	1863	1583	1770	1794	
Flt Permitted	0.71	1.00		0.19	1.00	1.00	0.48	1.00	1.00	0.12	1.00	
Satd. Flow (perm)	1331	1854		361	1863	1583	885	1863	1583	225	1794	
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)	11	337	11	136	65	288	11	495	92	484	386	125
RTOR Reduction (vph)	0	1	0	0	0	207	0	0	17	0	9	0
Lane Group Flow (vph)	11	347	0	136	65	81	11	495	75	484	502	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	28.4	27.7		37.8	33.1	33.1	36.7	36.0	36.0	69.9	65.2	
Effective Green, g (s)	28.4	27.7		37.8	33.1	33.1	36.7	36.0	36.0	69.9	65.2	
Actuated g/C Ratio	0.24	0.24		0.32	0.28	0.28	0.31	0.31	0.31	0.59	0.55	
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	324	436		189	524	445	281	570	484	526	994	
v/s Ratio Prot	0.00	c0.19		c0.04	0.03		0.00	0.27		c0.23	0.28	
v/s Ratio Perm	0.01			0.19		0.05	0.01		0.05	c0.31		
v/c Ratio	0.03	0.80		0.72	0.12	0.18	0.04	0.87	0.16	0.92	0.50	
Uniform Delay, d1	34.1	42.3		32.8	31.5	32.0	28.0	38.6	29.8	32.1	16.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	9.7		12.3	0.1	0.2	0.1	13.2	0.2	21.5	0.4	
Delay (s)	34.1	52.1		45.1	31.6	32.2	28.1	51.8	29.9	53.6	16.7	
Level of Service	C	D		D	C	C	C	D	C	D	B	
Approach Delay (s)		51.5			35.7			48.0			34.6	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	40.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	117.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	87.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

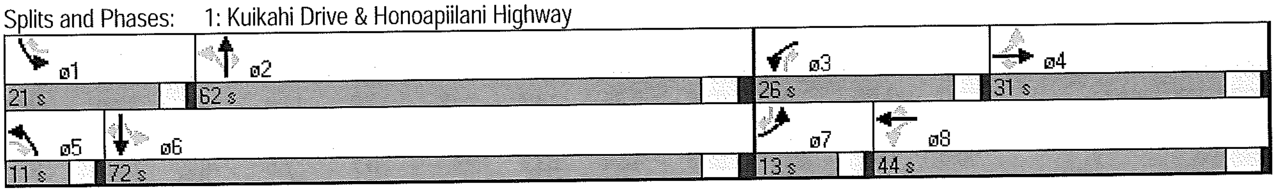
- Year 2030 with Alternative 2 PM

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	100	55	265	185	145	100	635	340	100	755	65
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Detector Phase	7	4	4 5	3	8	8 1	5	2	2 3	1	6	6 7
Switch Phase												
Minimum Initial (s)	6.0	6.0		6.0	6.0		3.0	10.0		3.0	10.0	
Minimum Split (s)	10.0	23.0		10.0	23.0		7.0	24.0		7.0	24.0	
Total Split (s)	13.0	31.0	42.0	26.0	44.0	65.0	11.0	62.0	88.0	21.0	72.0	85.0
Total Split (%)	9.3%	22.1%	30.0%	18.6%	31.4%	46.4%	7.9%	44.3%	62.9%	15.0%	51.4%	60.7%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 1: Kuikahi Drive & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	100	55	265	185	145	100	635	340	100	755	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-5%			0%			0%			0%	
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1814	1909	1623	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.62	1.00	1.00	0.29	1.00	1.00	0.06	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	1187	1909	1623	546	1863	1583	103	1863	1583	355	1863	1583
Peak-hour factor, PHF	0.79	0.62	0.88	0.94	0.85	0.75	0.71	0.92	0.76	0.62	0.76	0.88
Adj. Flow (vph)	51	161	62	282	218	193	141	690	447	161	993	74
RTOR Reduction (vph)	0	0	50	0	0	129	0	0	107	0	0	14
Lane Group Flow (vph)	51	161	12	282	218	64	141	690	340	161	993	60
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4 5	8		8 1	2		2 3	6		6 7
Actuated Green, G (s)	23.6	16.2	28.2	40.8	29.4	46.4	79.2	72.2	98.8	88.2	77.2	90.6
Effective Green, g (s)	23.6	16.2	28.2	40.8	29.4	46.4	79.2	72.2	98.8	88.2	77.2	90.6
Actuated g/C Ratio	0.17	0.12	0.20	0.29	0.21	0.33	0.57	0.52	0.71	0.63	0.55	0.65
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	2.0	2.0		2.0	2.0		2.0	5.0		2.0	5.0	
Lane Grp Cap (vph)	233	221	327	339	391	525	142	961	1117	345	1027	1024
v/s Ratio Prot	0.01	0.08		c0.12	0.12		c0.05	0.37		0.04	c0.53	
v/s Ratio Perm	0.03		0.01	c0.12		0.04	0.51		0.22	0.25		0.04
v/c Ratio	0.22	0.73	0.04	0.83	0.56	0.12	0.99	0.72	0.30	0.47	0.97	0.06
Uniform Delay, d1	49.8	59.8	45.0	42.4	49.5	32.6	41.1	26.1	7.7	17.9	30.2	9.1
Progression Factor	1.00	1.00	1.00	0.96	0.96	1.94	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	9.7	0.0	14.6	0.9	0.0	73.0	4.6	0.1	0.4	21.2	0.0
Delay (s)	50.0	69.5	45.0	55.2	48.4	63.3	114.1	30.7	7.8	18.2	51.3	9.1
Level of Service	D	E	D	E	D	E	F	C	A	B	D	A
Approach Delay (s)		60.3			55.3			31.9			44.4	
Approach LOS		E			E			C			D	

Intersection Summary			
HCM Average Control Delay	43.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		

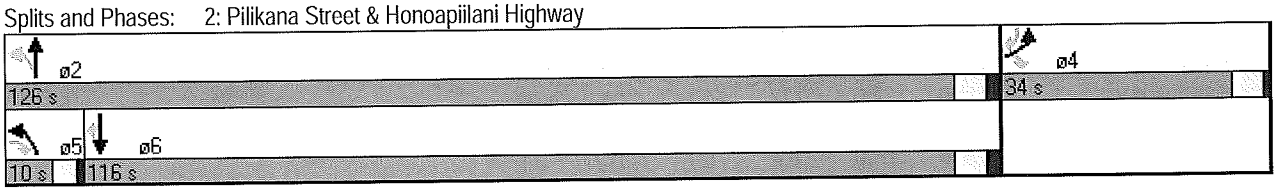
c Critical Lane Group

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	955	950	115
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5	2			6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	11.0		7.0	16.0	16.0	
Total Split (s)	34.0	44.0	10.0	126.0	116.0	150.0
Total Split (%)	21.3%	27.5%	6.3%	78.8%	72.5%	93.8%
Yellow Time (s)	4.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	C-Max	C-Max	

Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 160
Offset: 150 (94%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated

Splits and Phases: 2: Pilikana Street & Honoapiilani Highway



HCM Signalized Intersection Capacity Analysis
2: Pilikana Street & Honoapiilani Highway

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	50	40	80	955	950	115
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	-3%			0%	0%	
Total Lost time (s)	5.0	5.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1796	1607	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.19	1.00	1.00	1.00
Satd. Flow (perm)	1796	1607	348	1863	1863	1583
Peak-hour factor, PHF	0.76	0.65	0.93	0.69	0.88	0.86
Adj. Flow (vph)	66	62	86	1384	1080	134
RTOR Reduction (vph)	0	54	0	0	0	12
Lane Group Flow (vph)	66	8	86	1384	1080	122
Turn Type		custom	pm+pt			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5	2			6 4
Actuated Green, G (s)	10.3	20.7	138.7	138.7	129.3	145.6
Effective Green, g (s)	10.3	20.7	138.7	138.7	129.3	145.6
Actuated g/C Ratio	0.06	0.13	0.87	0.87	0.81	0.91
Clearance Time (s)	5.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	116	208	350	1615	1506	1441
v/s Ratio Prot	c0.04		0.01	c0.74	0.58	
v/s Ratio Perm		0.00	0.20			0.08
v/c Ratio	0.57	0.04	0.25	0.86	0.72	0.08
Uniform Delay, d1	72.7	60.9	8.8	5.5	7.0	0.7
Progression Factor	1.00	1.00	0.72	0.51	1.00	1.00
Incremental Delay, d2	3.8	0.0	0.1	3.3	3.0	0.0
Delay (s)	76.5	61.0	6.4	6.1	10.0	0.7
Level of Service	E	E	A	A	A	A
Approach Delay (s)	69.0			6.1	8.9	
Approach LOS	E			A	A	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	160.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

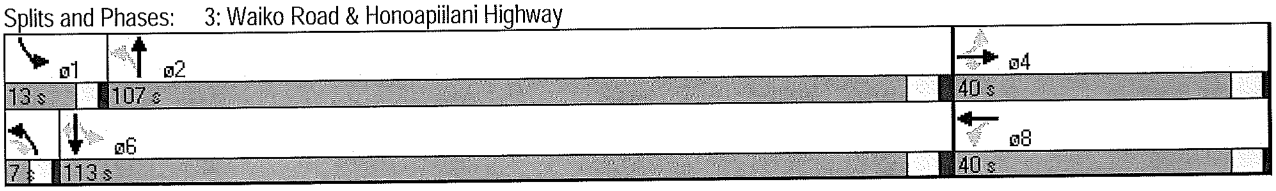
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	15	25	20	25	45	15	915	75	900	40
Turn Type	Perm		custom	Perm		pm+pt		pm+pt		Perm
Protected Phases		4			8	5	2	1	6	
Permitted Phases	4		4 5	8		2		6		6
Detector Phase	4	4	4 5	8	8	5	2	1	6	6
Switch Phase										
Minimum Initial (s)	6.0	6.0		6.0	6.0	3.0	10.0	3.0	10.0	10.0
Minimum Split (s)	23.0	23.0		23.0	23.0	7.0	24.0	7.0	24.0	24.0
Total Split (s)	40.0	40.0	47.0	40.0	40.0	7.0	107.0	13.0	113.0	113.0
Total Split (%)	25.0%	25.0%	29.4%	25.0%	25.0%	4.4%	66.9%	8.1%	70.6%	70.6%
Yellow Time (s)	4.0	4.0		4.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	4.0	6.0	4.0	6.0	6.0
Lead/Lag						Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?										
Recall Mode	None	None		None	None	None	C-Max	None	C-Max	C-Max

Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 160
Offset: 132 (83%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 3: Waiko Road & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	25	20	25	45	155	15	915	145	75	900	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-8%			0%			0%			0%	
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.97
Frt		1.00	0.85		0.91		1.00	0.98		1.00	1.00	0.85
Flt Protected		0.97	1.00		1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1887	1647		1694		1770	1809		1770	1863	1538
Flt Permitted		0.44	1.00		0.97		0.18	1.00		0.04	1.00	1.00
Satd. Flow (perm)		861	1647		1648		336	1809		68	1863	1538
Peak-hour factor, PHF	0.46	0.85	0.58	0.87	0.50	0.72	0.62	0.90	0.72	0.66	0.93	0.54
Adj. Flow (vph)	33	29	34	29	90	215	24	1017	201	114	968	74
RTOR Reduction (vph)	0	0	26	0	42	0	0	4	0	0	0	8
Lane Group Flow (vph)	0	62	8	0	292	0	24	1214	0	114	968	66
Confl. Peds. (#/hr)							2		1	1		2
Turn Type	Perm		custom	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4 5	8			2			6		6
Actuated Green, G (s)		31.0	38.4		31.0		108.0	105.6		118.0	111.6	111.6
Effective Green, g (s)		31.0	38.4		31.0		108.0	105.6		118.0	111.6	111.6
Actuated g/C Ratio		0.19	0.24		0.19		0.68	0.66		0.74	0.70	0.70
Clearance Time (s)		5.0			5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		2.0			2.0		2.0	5.0		2.0	5.0	5.0
Lane Grp Cap (vph)		167	395		319		248	1194		140	1299	1073
v/s Ratio Prot							0.00	c0.67		c0.04	0.52	
v/s Ratio Perm		0.07	0.00		c0.18		0.06			0.56		0.04
v/c Ratio		0.37	0.02		0.92		0.10	1.02		0.81	0.75	0.06
Uniform Delay, d1		56.0	46.4		63.2		15.0	27.2		55.4	15.2	7.6
Progression Factor		1.00	1.00		1.00		0.43	0.37		1.15	0.76	1.05
Incremental Delay, d2		0.5	0.0		29.1		0.0	26.3		21.4	2.9	0.1
Delay (s)		56.5	46.4		92.3		6.5	36.3		85.0	14.4	8.1
Level of Service		E	D		F		A	D		F	B	A
Approach Delay (s)		53.0			92.3			35.7			21.0	
Approach LOS		D			F			D			C	

Intersection Summary			
HCM Average Control Delay	37.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	160.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	91.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
4: Maui Tropical Plantation & Honoapiilani Highway

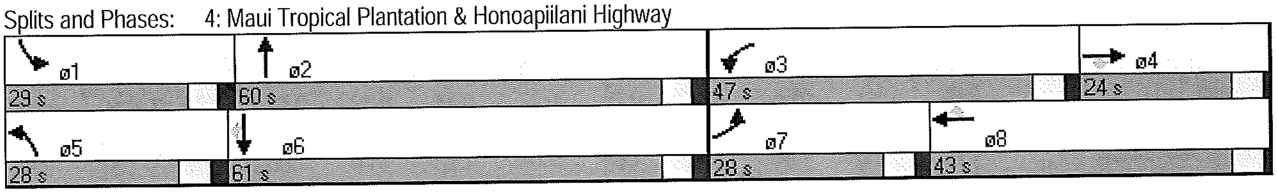
2/8/2010

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	185	50	75	560	55	255	135	620	775	220	450	240
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Detector Phase	7	4	4	3	8	8	5	2		1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0		10.0	24.0	24.0
Total Split (s)	28.0	24.0	24.0	47.0	43.0	43.0	28.0	60.0	0.0	29.0	61.0	61.0
Total Split (%)	17.5%	15.0%	15.0%	29.4%	26.9%	26.9%	17.5%	37.5%	0.0%	18.1%	38.1%	38.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	1.0	2.0	1.0	1.0	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	5.0	5.0	6.0	5.0	5.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	C-Max

Intersection Summary

Cycle Length: 160
Actuated Cycle Length: 160
Offset: 115 (72%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated

Splits and Phases: 4: Maui Tropical Plantation & Honoapiilani Highway



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	185	50	75	560	55	255	135	620	775	220	450	240
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	5.0	5.0	6.0	5.0	5.0	6.0	6.0	4.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	3433	1863	1583	1770	1863	1583	1770	1863	1545
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	3433	1863	1583	1770	1863	1583	1770	1863	1545
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)	201	54	82	609	60	277	147	674	842	239	489	261
RTOR Reduction (vph)	0	0	77	0	0	237	0	0	0	0	0	87
Lane Group Flow (vph)	201	54	5	609	60	40	147	674	842	239	489	174
Confl. Peds. (#/hr)							1					1
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	20.8	10.0	10.0	33.8	23.0	23.0	17.9	70.3	160.0	22.9	75.3	75.3
Effective Green, g (s)	20.8	10.0	10.0	33.8	23.0	23.0	17.9	70.3	160.0	22.9	75.3	75.3
Actuated g/C Ratio	0.13	0.06	0.06	0.21	0.14	0.14	0.11	0.44	1.00	0.14	0.47	0.47
Clearance Time (s)	6.0	5.0	5.0	6.0	5.0	5.0	6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	230	116	99	725	268	228	198	819	1583	253	877	727
v/s Ratio Prot	0.11	0.03		c0.18	0.03		0.08	c0.36		c0.14	0.26	
v/s Ratio Perm			0.00			0.03			c0.53			0.11
v/c Ratio	0.87	0.47	0.05	0.84	0.22	0.17	0.74	0.82	0.53	0.94	0.56	0.24
Uniform Delay, d1	68.3	72.4	70.5	60.5	60.6	60.2	68.8	39.4	0.0	67.9	30.4	25.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	1.51	2.35
Incremental Delay, d2	28.6	2.9	0.2	8.5	0.4	0.4	13.9	9.2	1.3	32.3	1.7	0.5
Delay (s)	96.9	75.4	70.8	69.0	61.0	60.5	82.8	48.5	1.3	83.7	47.6	59.9
Level of Service	F	E	E	E	E	E	F	D	A	F	D	E
Approach Delay (s)		87.1			66.0			27.6			59.6	
Approach LOS		F			E			C			E	

Intersection Summary			
HCM Average Control Delay	50.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	160.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	190	335	60	265	170	545	50	345	370	410	475	385
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Detector Phase	5	2	2 3	1	6	6 7	3	8	8 1	7	4	4 5
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	29.0		8.0	29.0		8.0	29.0		8.0	29.0	
Total Split (s)	12.0	30.0	54.0	26.0	44.0	76.0	24.0	52.0	78.0	32.0	60.0	72.0
Total Split (%)	8.6%	21.4%	38.6%	18.6%	31.4%	54.3%	17.1%	37.1%	55.7%	22.9%	42.9%	51.4%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	C-Min		None	C-Min		None	None		None	None	

Intersection Summary

Cycle Length: 140

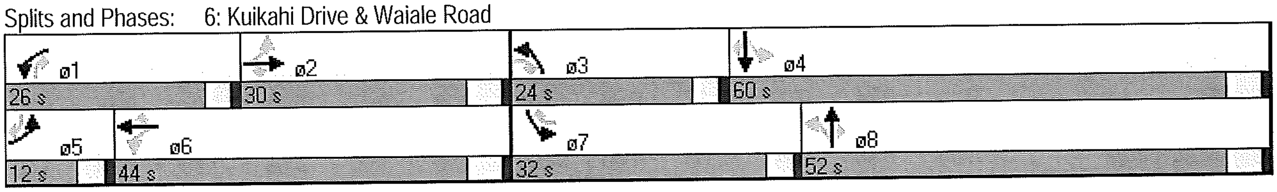
Actuated Cycle Length: 140

Offset: 12 (9%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Splits and Phases: 6: Kuikahi Drive & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Volume (vph)	190	335	60	265	170	545	50	345	370	410	475	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1762	1863	1538	1770	1863	1538	1767	1863	1538	1770	1863	1538
Flt Permitted	0.64	1.00	1.00	0.21	1.00	1.00	0.37	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	1189	1863	1538	393	1863	1538	690	1863	1538	358	1863	1538
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)	207	364	65	288	185	592	54	375	402	446	516	418
RTOR Reduction (vph)	0	0	23	0	0	102	0	0	55	0	0	180
Lane Group Flow (vph)	207	364	42	288	185	490	54	375	347	446	516	238
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Turn Type	pm+pt		custom	pm+pt		custom	pm+pt		custom	pm+pt		custom
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2 3	6		6 7	8		8 1	4		4 5
Actuated Green, G (s)	45.0	37.0	49.6	61.3	49.3	82.3	44.3	36.7	62.0	68.7	57.1	70.1
Effective Green, g (s)	45.0	37.0	49.6	61.3	49.3	82.3	44.3	36.7	62.0	68.7	57.1	70.1
Actuated g/C Ratio	0.32	0.26	0.35	0.44	0.35	0.59	0.32	0.26	0.44	0.49	0.41	0.50
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0		4.0	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)	415	492	545	372	656	904	277	488	681	458	760	770
v/s Ratio Prot	0.03	0.20		c0.11	0.10		0.01	0.20		c0.19	0.28	
v/s Ratio Perm	0.13		0.03	c0.23		0.32	0.05		0.23	c0.28		0.15
v/c Ratio	0.50	0.74	0.08	0.77	0.28	0.54	0.19	0.77	0.51	0.97	0.68	0.31
Uniform Delay, d1	36.9	47.1	30.0	29.6	32.6	17.4	34.0	47.7	28.1	34.0	33.9	20.6
Progression Factor	0.80	0.86	0.74	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	9.0	0.1	9.7	1.1	0.7	0.3	7.1	0.6	35.0	2.4	0.2
Delay (s)	30.2	49.7	22.1	39.2	33.7	18.1	34.3	54.9	28.7	69.1	36.4	20.9
Level of Service	C	D	C	D	C	B	C	D	C	E	D	C
Approach Delay (s)		40.5			26.5			40.9			42.2	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	37.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Right Turn Channelized												
Volume (veh/h)	15	225	30	315	120	255	10	495	125	235	405	95
Peak Hour Factor	0.59	0.77	0.92	0.92	0.70	0.79	0.92	0.92	0.92	0.75	0.92	0.81
Hourly flow rate (vph)	25	292	33	342	171	323	11	538	136	313	440	117
Approach Volume (veh/h)		350			837			685			871	
Crossing Volume (veh/h)		1096			574			631			525	
High Capacity (veh/h)		575			879			840			915	
High v/c (veh/h)		0.61			0.95			0.81			0.95	
Low Capacity (veh/h)		442			707			672			738	
Low v/c (veh/h)		0.79			1.18			1.02			1.18	

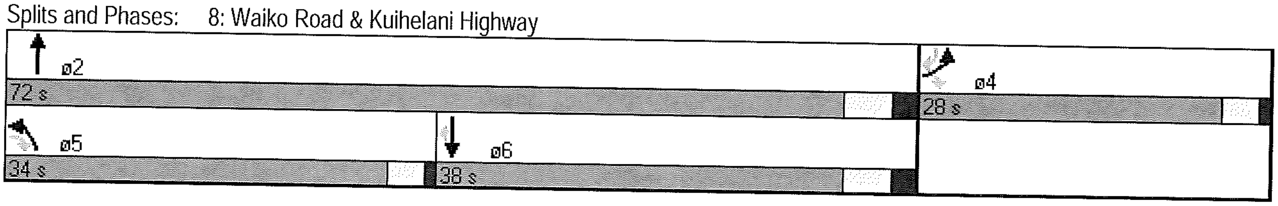
Intersection Summary			
Maximum v/c High	0.95		
Maximum v/c Low	1.18		
Intersection Capacity Utilization	141.5%	ICU Level of Service	H

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	450	105	145	960	855	600
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Detector Phase	4	4 5	5	2	6	6 4
Switch Phase						
Minimum Initial (s)	6.0		3.0	10.0	10.0	
Minimum Split (s)	28.0		7.0	16.0	24.0	
Total Split (s)	28.0	62.0	34.0	72.0	38.0	66.0
Total Split (%)	28.0%	62.0%	34.0%	72.0%	38.0%	66.0%
Yellow Time (s)	3.0		3.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?						
Recall Mode	None		None	Min	Min	

Intersection Summary

Cycle Length: 100
Actual Cycle Length: 95.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 8: Waiko Road & Kuihelani Highway



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	450	105	145	960	855	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	6.0	6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	1770	3539	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	1770	3539	3539	1583
Peak-hour factor, PHF	0.73	0.50	0.31	0.91	0.88	0.74
Adj. Flow (vph)	616	210	468	1055	972	811
RTOR Reduction (vph)	0	8	0	0	0	52
Lane Group Flow (vph)	616	202	468	1055	972	759
Turn Type		custom	Prot			custom
Protected Phases	4		5	2	6	
Permitted Phases		4 5				6 4
Actuated Green, G (s)	21.5	52.9	27.4	63.6	32.2	59.7
Effective Green, g (s)	21.5	52.9	27.4	63.6	32.2	59.7
Actuated g/C Ratio	0.23	0.56	0.29	0.67	0.34	0.63
Clearance Time (s)	4.0		4.0	6.0	6.0	
Vehicle Extension (s)	2.0		2.0	5.0	5.0	
Lane Grp Cap (vph)	776	881	510	2367	1198	994
v/s Ratio Prot	0.18		c0.26	0.30	0.27	
v/s Ratio Perm		0.13				c0.48
v/c Ratio	0.79	0.23	0.92	0.45	0.81	0.76
Uniform Delay, d1	34.7	10.7	32.8	7.4	28.7	12.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.2	0.0	21.0	0.3	4.8	4.2
Delay (s)	40.0	10.8	53.8	7.7	33.5	16.8
Level of Service	D	B	D	A	C	B
Approach Delay (s)	32.5			21.9	25.9	
Approach LOS	C			C	C	

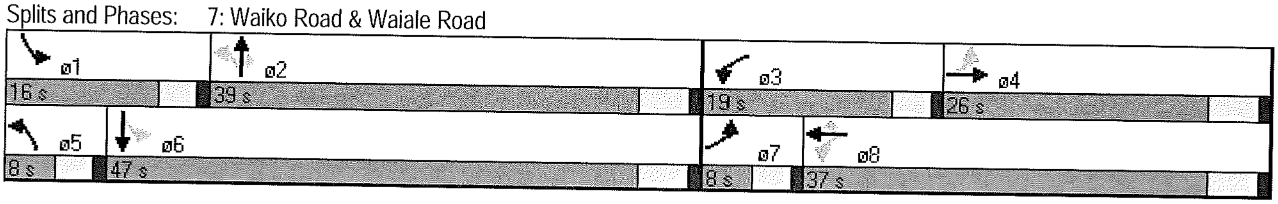
Intersection Summary			
HCM Average Control Delay	25.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	95.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Volume (vph)	15	225	315	120	255	10	495	125	235	405
Turn Type	pm+pt		pm+pt		Perm	pm+pt		Perm	pm+pt	
Protected Phases	7	4	3	8		5	2		1	6
Permitted Phases	4		8		8	2		2	6	
Detector Phase	7	4	3	8	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	8.0	26.0	26.0	8.0	26.0	26.0	8.0	26.0
Total Split (s)	8.0	26.0	19.0	37.0	37.0	8.0	39.0	39.0	16.0	47.0
Total Split (%)	8.0%	26.0%	19.0%	37.0%	37.0%	8.0%	39.0%	39.0%	16.0%	47.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	None	None	None	None

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 92.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 7: Waiko Road & Waiale Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	225	30	315	120	255	10	495	125	235	405	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1830		1770	1863	1583	1770	1863	1583	1770	1810	
Flt Permitted	0.67	1.00		0.27	1.00	1.00	0.36	1.00	1.00	0.13	1.00	
Satd. Flow (perm)	1255	1830		504	1863	1583	671	1863	1583	250	1810	
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)	16	245	33	342	130	277	11	538	136	255	440	103
RTOR Reduction (vph)	0	5	0	0	0	182	0	0	27	0	8	0
Lane Group Flow (vph)	16	273	0	342	130	95	11	538	109	255	535	0
Turn Type	pm+pt			pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	21.9	20.4		39.1	33.6	33.6	34.1	33.4	33.4	49.0	44.3	
Effective Green, g (s)	21.9	20.4		39.1	33.6	33.6	34.1	33.4	33.4	49.0	44.3	
Actuated g/C Ratio	0.22	0.21		0.40	0.34	0.34	0.35	0.34	0.34	0.50	0.45	
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	288	381		391	638	542	241	634	539	305	817	
v/s Ratio Prot	0.00	0.15		c0.13	0.07		0.00	0.29		c0.10	0.30	
v/s Ratio Perm	0.01			c0.22		0.06	0.02		0.07	c0.32		
v/c Ratio	0.06	0.72		0.87	0.20	0.18	0.05	0.85	0.20	0.84	0.65	
Uniform Delay, d1	29.9	36.2		23.3	22.8	22.6	21.3	30.0	22.9	19.9	20.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	6.3		19.0	0.2	0.2	0.1	10.3	0.2	17.7	1.9	
Delay (s)	29.9	42.5		42.3	23.0	22.7	21.4	40.3	23.1	37.6	22.8	
Level of Service	C	D		D	C	C	C	D	C	D	C	
Approach Delay (s)		41.8			31.7			36.6			27.6	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM Average Control Delay	32.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	98.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX D

SIGNAL WARRANT ANALYSIS

Appendix D: Signal Warrant Analysis

Because future projections are customarily based on peak hours only, extrapolation was used to approximate volumes for other hours.

Methodology

Peak hour warrants were projected for future conditions using the following methodology:

1. Use daily tube counts to determine hourly fluctuation of traffic.
2. Find the AM and PM hours that are second highest to the AM and PM peak hours; they shall be named AM2 and PM2.
3. Calculate the ratio between the intersection volume totals for AM2 and the AM peak hour; do the same for PM2 and the PM peak hour.
4. Apply the ratios calculated in step 3 to the AM and PM peak hour turning movement volumes, respectively.
5. Use the AM Peak, PM peak, AM2, and PM2 projections as the basis to perform a 4-hour signal warrant.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Base Year 2030 w/Mitigative Measures

Intersection: MTP Access/Road 1/Honoapiilani Highway

PEAK HOUR PROJECTIONS

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	55	860	85	160	740	100	145	5	35	210	5	390
PM	170	925	305	560	680	305	245	5	75	220	5	410
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	55	860	0	160	740	0	145	5	0	210	5	0
PM	170	925	0	560	680	0	245	5	0	220	5	0

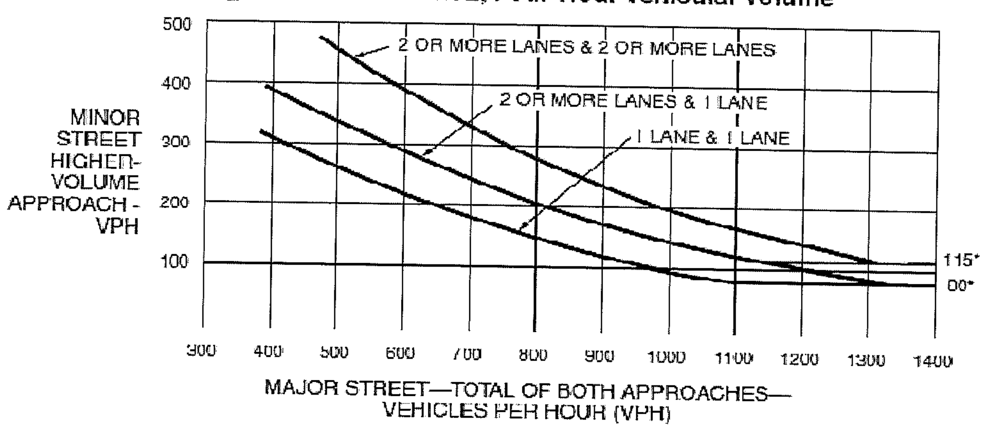
Honoapiilani

		305	680	560		
		100	740	160		
		<	v	>		
MTP	245	145	--^ ^--	390	410	
	5	5	--> <--	5	5	
	75	35	--v v--	210	220	
		<	^	>		
		55	860	85		
		170	925	305		

VOLUMES USED FOR WARRANTS

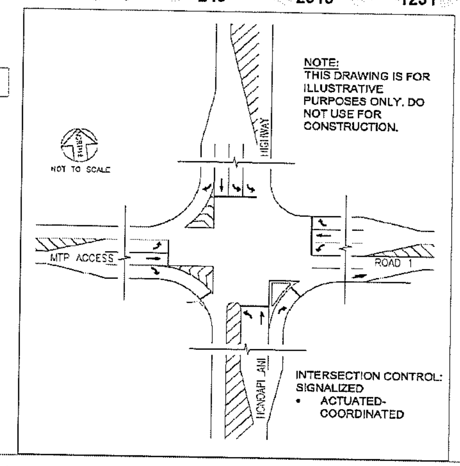
Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	53	835	0	155	718	0	141	5	0	204	5	0	209	355	888	1761
AM Peak	07:00 AM	595	492	1087	100.0%	55	860	0	160	740	0	145	5	0	210	5	0	215	1815	915	1815
PM2	02:00 PM	442	615	1056	97.1%	165	899	0	544	661	0	238	5	0	214	5	0	243	2269	1205	2269
PM Peak	03:00 PM	534	545	1079	99.3%	169	918	0	556	675	0	243	5	0	218	5	0	248	2318	1231	2318

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

1



Lane Classification: Immaterial

Justification: Volume is high enough to meet warrant irrespective of lane Classification.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Base Year 2030 w/Mitigative Measures

Intersection: East Waiko Road/Waiale Road

PEAK HOUR PROJECTIONS

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	0	0	0	565	0	115	195	310	0	0	135	295
PM	0	0	0	345	0	95	260	250	0	0	330	255
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	0	0	0	565	0	0	195	310	0	0	135	0
PM	0	0	0	345	0	0	260	250	0	0	330	0

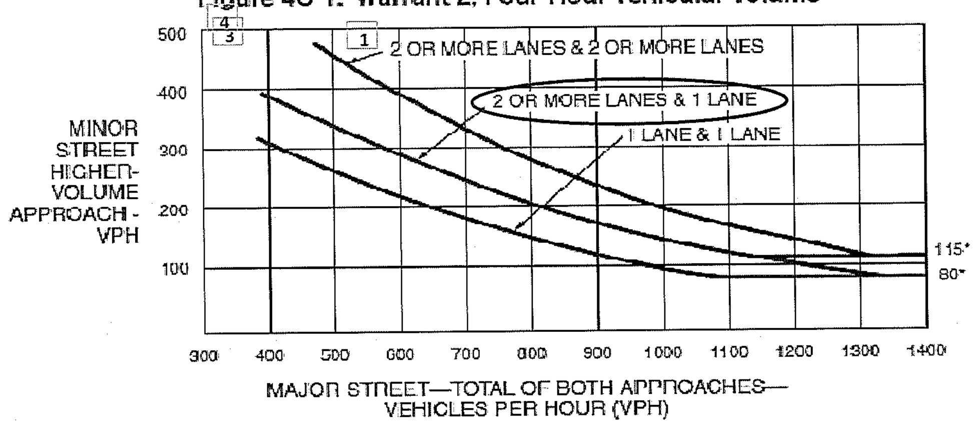
Waiale

		95	0	345		
		115	0	565		
		<	v	>		
Waiko	260	195	--^ ^--	295	255	
	250	310	--> <--	135	330	
	0	0	--v v--	0	0	
		<	^	>		
		0	0	0		
		0	0	0		

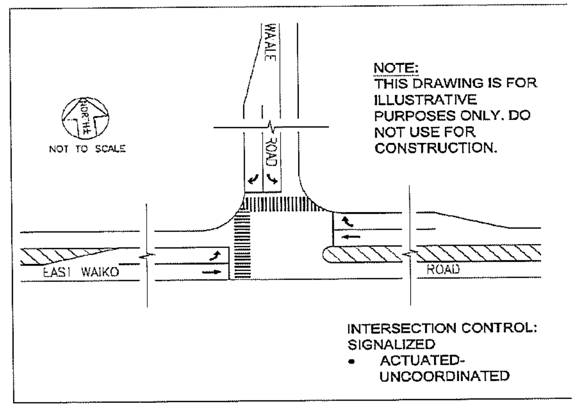
VOLUMES USED FOR WARRANTS

Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	0	0	0	548	0	0	189	301	0	0	131	0	490	621	548	548
AM Peak	07:00 AM	595	492	1087	100.0%	0	0	0	565	0	0	195	310	0	0	135	0	505	565	565	565
PM2	02:00 PM	442	615	1056	97.1%	0	0	0	335	0	0	253	243	0	0	321	0	496	335	335	335
PM Peak	03:00 PM	534	545	1079	99.3%	0	0	0	342	0	0	258	248	0	0	328	0	506	342	342	342

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.



Lane Classification: 2&1

N-S Justificaiton: RT Volume not counted. Therefore, SB could only be considered 1-lane.

E-W Justification: EB has two lanes, with equitable distribution.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Base Year 2030 w/Mitigative Measures

Intersection: East Waiko Road/Waiale Road

PEAK HOUR PROJECTIONS

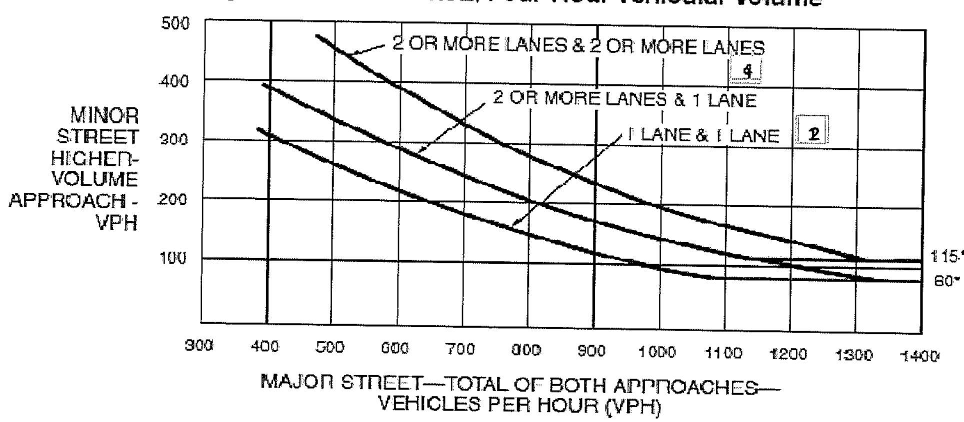
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	10	455	85	445	355	115	10	310	10	125	60	225
PM	10	495	125	235	405	95	15	225	30	315	120	255
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	10	455	0	445	355	0	10	310	0	125	60	0
PM	10	495	0	235	405	0	15	225	0	315	120	0

			Waiale		
		95	405	235	
		115	355	445	
		<	v	>	
Waiko	15	10	--^ ^--	225	255
	225	310	--> <--	60	120
	30	10	--v v--	125	315
		<	^	>	
		10	455	85	
		10	495	125	

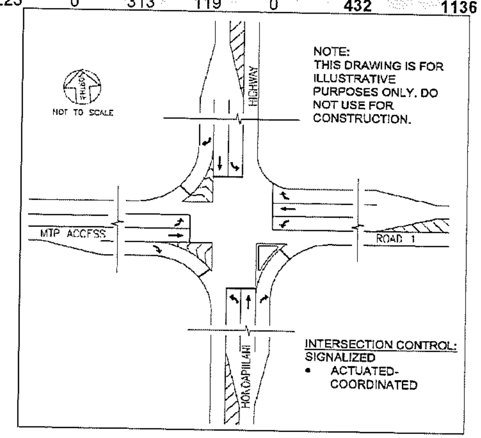
VOLUMES USED FOR WARRANTS

Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	10	442	0	432	345	0	10	301	0	121	58	0	311	490	777	1229
AM Peak	07:00 AM	595	492	1087	100.0%	10	455	0	445	355	0	10	310	0	125	60	0	320	1265	800	1265
PM2	02:00 PM	442	615	1056	97.1%	10	481	0	228	393	0	15	219	0	306	117	0	423	1112	621	1112
PM Peak	03:00 PM	534	545	1079	99.3%	10	491	0	233	402	0	15	223	0	313	119	0	432	1136	635	1136

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.



Lane Classification: Immaterial
Justification: Volume is high enough to meet warrant irrespective of lane Classification.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Alternative 1

Intersection: MTP Access/Road 1/Honoapiilani Highway

PEAK HOUR PROJECTIONS

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	45	555	70	110	525	85	110	5	35	150	5	235
PM	135	620	205	210	450	240	185	5	75	155	5	250
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	45	555	0	110	525	0	110	5	0	150	5	0
PM	135	620	0	210	450	0	185	5	0	155	5	0

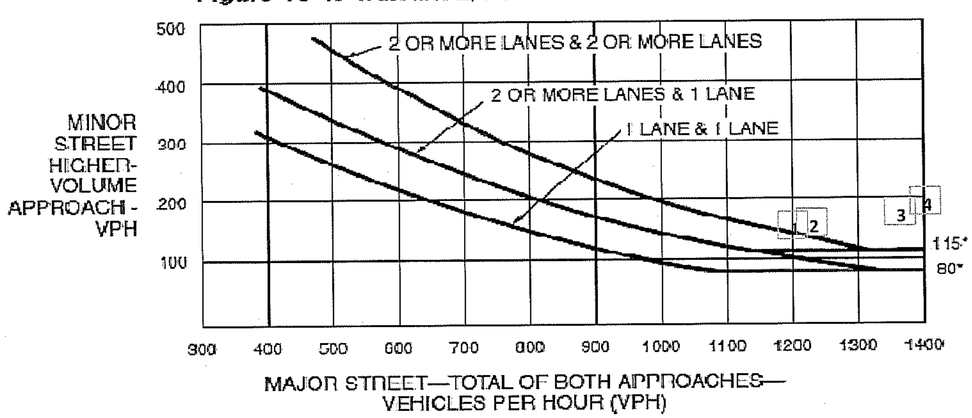
Honoapiilani

		240	450	210		
		85	525	110		
		<	v	>		
MTP	185	110	_^ ^_	235	250	
	5	5	--> <--	5	5	
	75	35	--v v--	150	155	
		<	^	>		
		45	555	70		
		135	620	205		

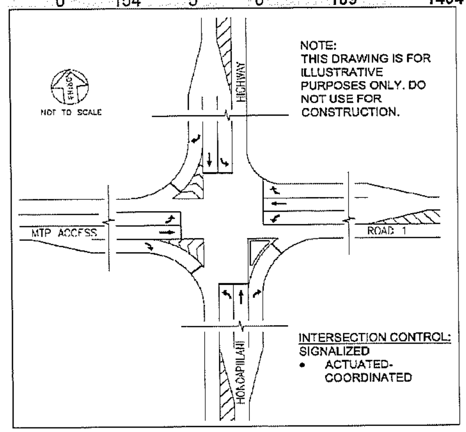
VOLUMES USED FOR WARRANTS

Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	44	539	0	107	510	0	107	5	0	146	5	0	151	263	617	1200
AM Peak	07:00 AM	595	492	1087	100.0%	45	555	0	110	525	0	110	5	0	150	5	0	155	1235	635	1235
PM2	02:00 PM	442	615	1056	97.1%	131	602	0	204	437	0	180	5	0	151	5	0	185	1374	733	1374
PM Peak	03:00 PM	534	545	1079	99.3%	134	615	0	208	447	0	184	5	0	154	5	0	189	1404	749	1404

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.



Lane Classification: Immaterial

Justification: Volume is high enough to meet warrant irrespective of lane Classification.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Alternative 1

Intersection: WRE/WCT South Access/Honoapiilani Highway

PEAK HOUR PROJECTIONS

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	30	590	385	10	665	20	45	30	70	435	20	5
PM	30	855	570	10	630	50	75	45	110	405	50	5
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	30	590	0	10	665	0	45	30	0	435	20	0
PM	30	855	0	10	630	0	75	45	0	405	50	0

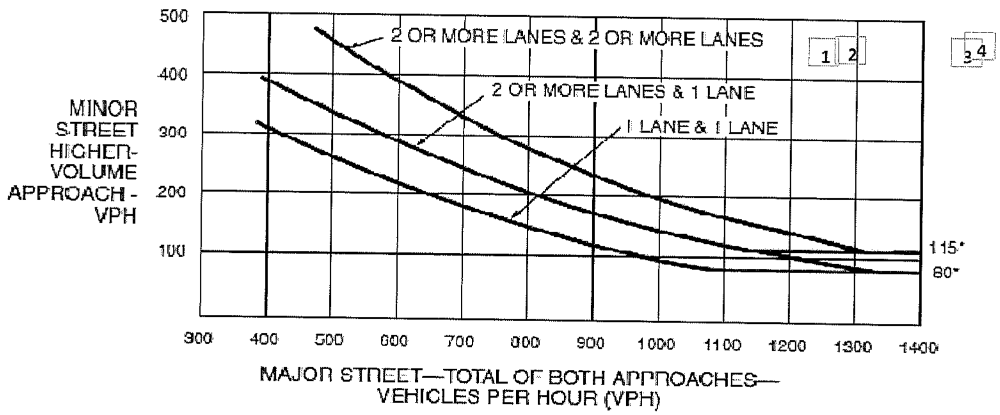
Honoapiilani

		50	630	10		
		20	665	10		
		<	v	>		
WCT	75	45	--^ ^--	5		5
	45	30	--> <--	20		50
	110	70	--v v--	435		405
		<	^	>		
		30	590	385		
		30	855	570		

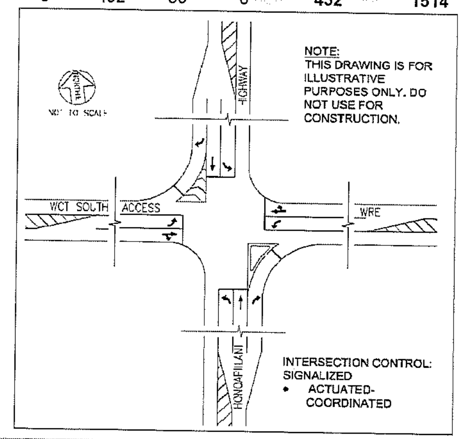
VOLUMES USED FOR WARRANTS

Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	29	573	0	10	645	0	44	29	0	422	19	0	441	514	655	1257
AM Peak	07:00 AM	595	492	1087	100.0%	30	590	0	10	665	0	45	30	0	435	20	0	455	1295	675	1295
PM2	02:00 PM	442	615	1056	97.1%	29	831	0	10	612	0	73	44	0	393	49	0	442	1482	860	1482
PM Peak	03:00 PM	534	545	1079	99.3%	30	849	0	10	625	0	74	45	0	402	50	0	452	1514	879	1514

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.



Lane Classification: Immaterial

Justification: Volume is high enough to meet warrant irrespective of lane Classification.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

MUTCD 2009 4-Hour Warrant Analysis

2/11/2010

Scenario: Alternative 2

Intersection: MTP Access/Road 1/Honoapiilani Highway

PEAK HOUR PROJECTIONS

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	45	555	455	120	525	85	110	35	35	585	25	240
PM	135	620	775	220	450	240	185	50	75	560	55	255
On/Off	on	on	off	on	on	off	on	on	off	on	on	off
PCT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
AM	45	555	0	120	525	0	110	35	0	585	25	0
PM	135	620	0	220	450	0	185	50	0	560	55	0

Honoapiilani

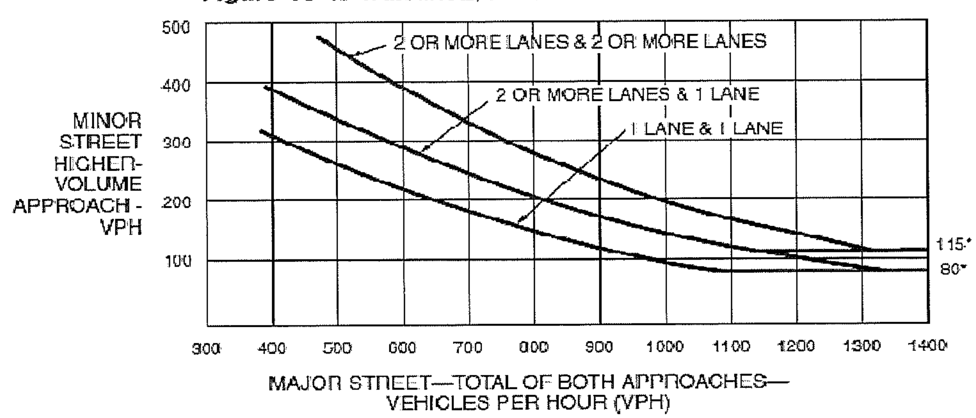
	0	240	450	220		0
	0	85	525	120		0
	0	<	v	>		0
	185	110	--^ ^--	240	255	
MTP	50	35	--> <--	25	55	
	75	35	--v v--	585	560	
	0	<	^	>		0
	0	45	555	455		0
	0	135	620	775		0

VOLUMES USED FOR WARRANTS

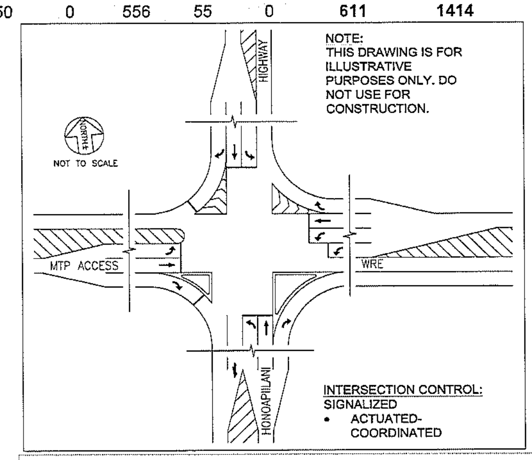
Title	Hour Start	SB	NB	Total	Factor	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	E-W High Volume	E-W Combined Volume	N-S High Volume	N-S Combined Volume
AM2	06:00 AM	512	544	1055	97.1%	44	539	0	116	510	0	107	34	0	568	24	0	592	733	626	1209
AM Peak	07:00 AM	595	492	1087	100.0%	45	555	0	120	525	0	110	35	0	585	25	0	610	1245	645	1245
PM2	02:00 PM	442	615	1056	97.1%	131	602	0	214	437	0	180	49	0	544	53	0	597	1384	733	1384
PM Peak	03:00 PM	534	545	1079	99.3%	134	615	0	218	447	0	184	50	0	556	55	0	611	1414	749	1414

1 2 3 4

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.



Lane Classification: Immaterial

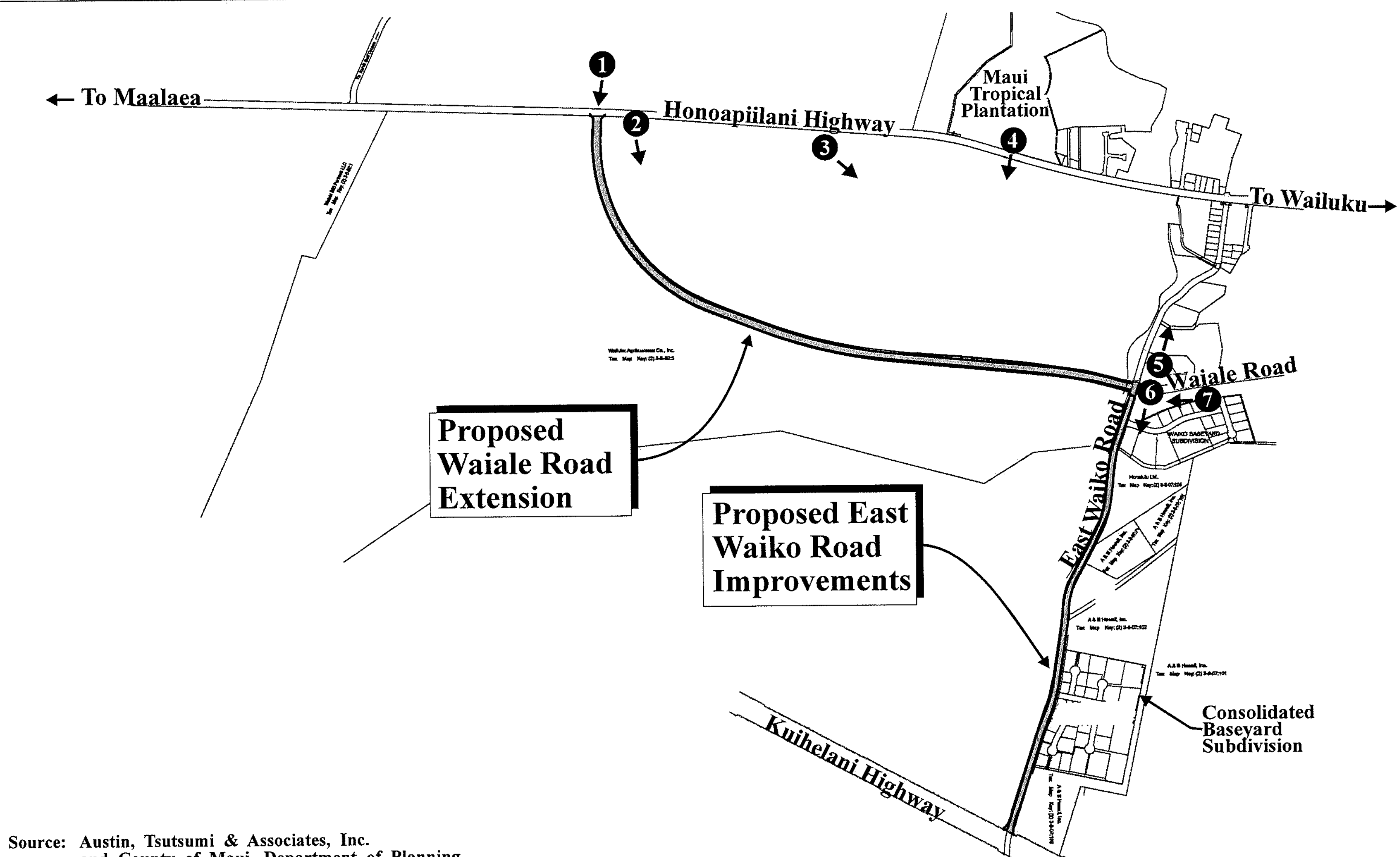
Justification: Volume is high enough to meet warrant irrespective of lane Classification.

Conclusion: 4-Hour Warrant will most likely be met*

*Since the result is based upon data extrapoation, the result cannot be verified.

APPENDIX B.

Project Area Photographs



Source: Austin, Tsutsumi & Associates, Inc. and County of Maui, Department of Planning

Proposed Waiale Road Extension and East Waiko Road Improvement
Photographic Reference Map

NOT TO SCALE

Prepared for: County of Maui, Dept. of Public Works

MUNEKIYO & HIRAGA, INC.

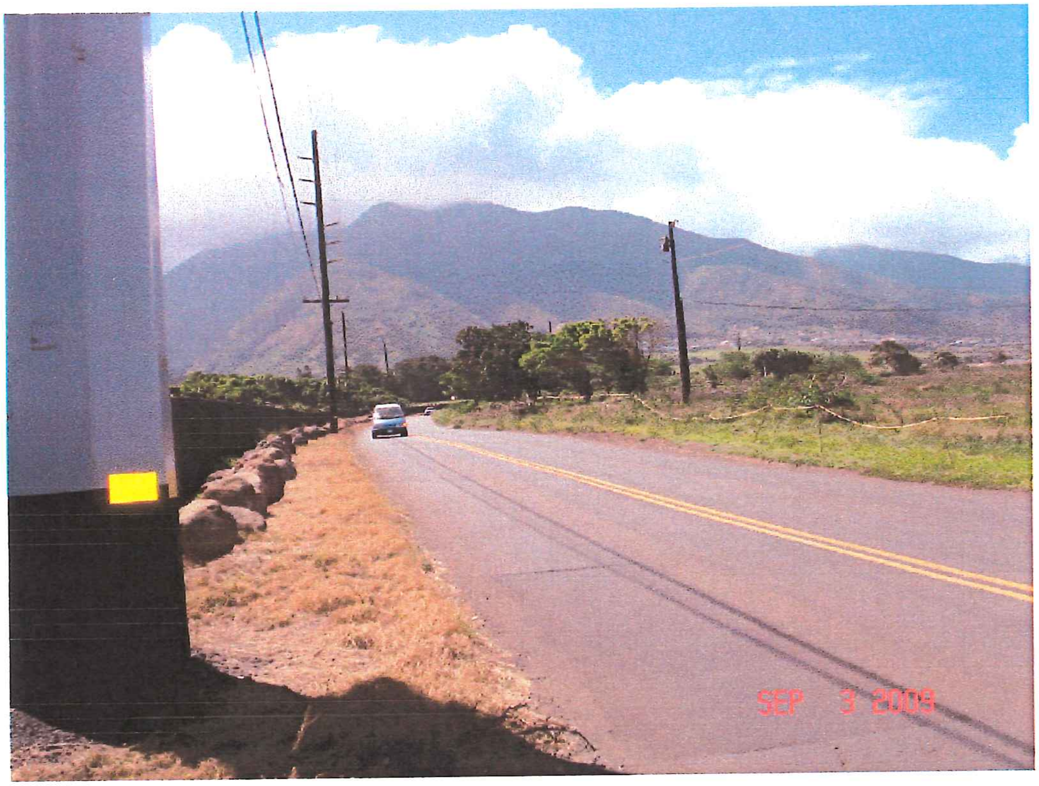
COM\DPW Waiale\DraftEA\photoref

Photograph No. 1
Mauka of Honoapiilani Highway Intersection at
Old Quarry Road Looking East

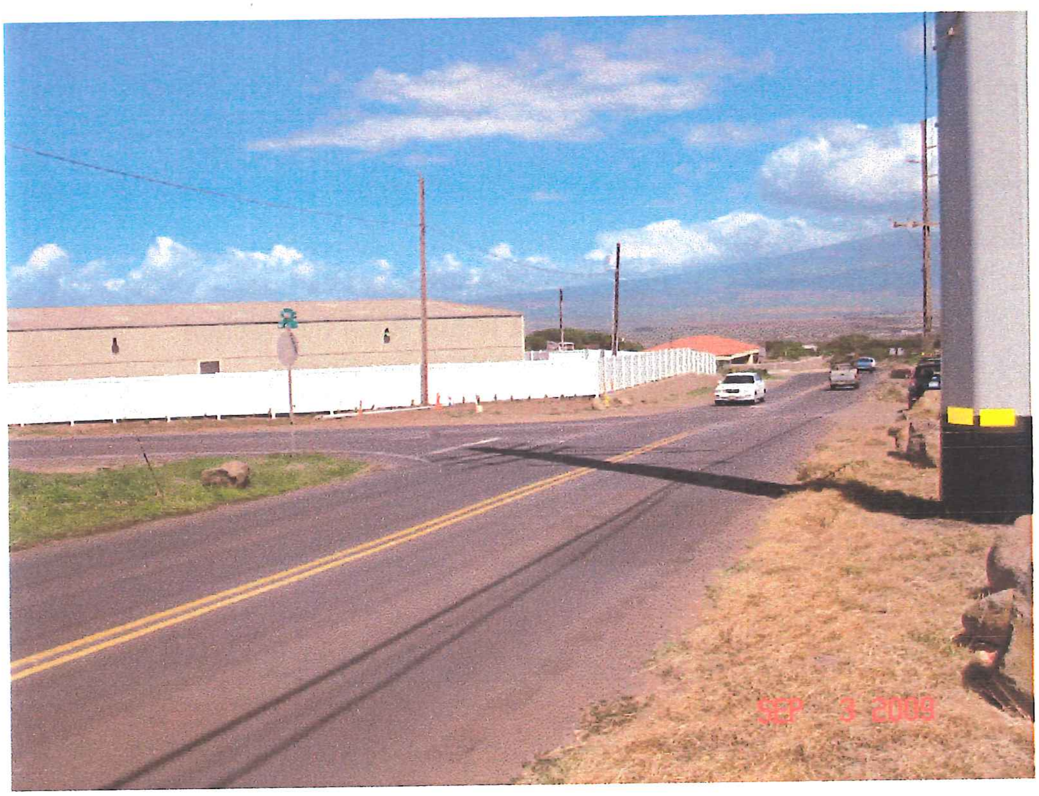
Photograph No. 2
Makai of Honoapiilani Highway Just North of
Old Quarry Road Intersection Looking East

Photograph No. 3
Makai of Honoapiilani Highway Midway Between Old Quarry Road
and Maui Tropical Plantation Intersection Looking Northeast

Photograph No. 4
Mauka of Honoapiilani Highway at Maui Tropical Plantation
Intersection Looking East



Photograph No. 5
Near the Intersection of Waiale Road and
East Waiko Road Looking West



Photograph No. 6
At the Intersection of Waiale Road and
East Waiko Road Looking East

Photograph No. 7
At the Waiale Road and East Waiko Road Intersection
Looking South Towards Waikapu Stream

APPENDIX C.

Preliminary Engineering and Drainage Report

PRELIMINARY ENGINEERING AND DRAINAGE REPORT FOR WAIALE ROAD EXTENSION & EAST WAIKO ROAD IMPROVEMENT

WAIKAPU, WAILUKU, MAUI
TMK: (2) 3-5-002:014, 018, & 888
(2) 3-5-027: 021
(2) 3-6-002:003
(2) 3-8-005: 999

April 2010

Prepared for:

County of Maui, Public Works Division

Austin Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
1871 Wili Pa Loop, Suite A
Wailuku, Maui, Hawaii 96793
Telephone: (808) 244-8044
Fax: (808) 242-9163
Honolulu • Wailuku • Hilo, Hawaii

PRELIMINARY ENGINEERING
FOR
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENT

WAIKAPU, WAILUKU, MAUI

TMK: (2) 3-5-002: 014, 018, & 888

(2) 3-5-027: 021

(2) 3-6-002: 003

(2) 3-8-005: 999

Prepared for

County of Maui, Department of Public Works

D. TRANG NGUYEN
LICENSED PROFESSIONAL ENGINEER
No. 10724-C
HAWAII U.S.A.

Prepared by

Austin Tsutsumi & Associates, Inc.

Civil Engineers • Surveyors

Honolulu • Wailuku • Hilo, Hawaii

April 2010

TABLE OF CONTENTS

PRELIMINARY ENGINEERING
FOR
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENT

TMK: (2) 3-5-002:014, 018, 888, (2) 3-5-027:021, (2) 3-6-002:003, (2) 3-8-005:999

I. INTRODUCTION

The County of Maui, Department of Public Works (DPW) proposes to extend Waiale Road from its current terminus at East Waiko Road southward to Honoapiilani Highway. In addition, DPW proposes to upgrade the existing East Waiko Road which involves improving the pavement section, re-striping and providing drainage improvements.

The purpose of this report is to provide an overview of the preliminary civil engineering design of the Waiale Road Extension and East Waiko Road Improvement project. This report evaluates the existing site conditions and defines requirements for proposed grading and drainage.

II. PROPOSED PROJECT

A. LOCATION

The Waiale Road Extension and East Waiko Road Improvement project is located in Waikapu, Wailuku, Maui with TMK Nos. (2) 3-5-002:014, 018, & 888, (2) 3-5-027:021, (2) 3-6-002:003 and (2) 3-8-005:999. The Waiale Road Extension portion of the project is located near Honoapiilani Highway to the east, and southerly of East Waiko Road, with vacant agricultural land surrounding the proposed alignment. The East Waiko Road portion of the project is bordered by various light industrial developments to the north, Kuihelani Highway to the east, and vacant agricultural land to the south. The project right-of-way areas are approximately 16.00 acres for Waiale Road and 6.26 acres for East Waiko Road. Refer to Exhibit 1 for the Location Map.

B. PROJECT

The project consists of two parts: the construction of 8,600 lineal-feet of a two-lane bypass road that will be an extension of the existing Waiale Road, and improvements on 4,600 lineal-feet of the existing East Waiko Road. The scope of work includes the design of the proposed roadway improvements and related drainage system. Refer to Exhibits 2A and 2B for the Site Plan of each roadway.

III. EXISTING CONDITIONS

A. TOPOGRAPHY AND SOIL CONDITIONS

The ground surface of the Waiale Road Extension site is currently covered with sugar cane with some intermediate paved and dirt cane haul roads. The roadway lot slopes in an easterly direction. Onsite elevations range from 260 to 360 feet mean sea level (MSL).

The soil types found in the proposed Waiale Road Extension area include Iao Clay (IcB), Pulehu Silt Loam (PpA), Pulehu Cobbly Silt Loam (PrB), and Pulehu Cobbly Clay Loam (PtB, PtA). Iao Clay is a dark brown clay found on well drained alluvial fans. It has moderately slow permeability, medium runoff, an erosion hazard of slight to moderate, and a Hydrologic Soil Group (HSG) rating of "B". Pulehu series soils are dark brown silt clays and are also found on well drained alluvial fans. Pulehu soils have moderate permeability, slow runoff, an erosion hazard of no more than slight, and a HSG rating of "B".

The soil types found in the East Waiko Road area include Jaucas Sand (JaC) and Puuone Sand (PZUE). Jaucas Sand is a brown, single grain sand. Permeability is rapid, runoff is very slow to slow, the erosion hazard is slight, and the HSG rating is "A". Exposed Jaucas Sand soils can be susceptible to severe erosion where the vegetation has been removed. Puuone Sand is found on the low uplands of Maui and consists of approximately 20 inches of sand over a strongly cemented sand layer. Permeability is rapid above the cemented layer, runoff is slow, and the hazard of wind erosion is slight to moderate. The HSG for Puuone Sand is "C".

Soil classifications and descriptions are taken from the United States Department of Agriculture (USDA) Soil Conservation Service's (SCS) publication, Soil Survey of the Islands of Kauai, Oahu, Molokai, Maui, and Lanai.

B. CLIMATE AND RAINFALL

Waikapu's climate is generally cool and sunny throughout the year with summer high temperatures ranging from 70-80 degrees. Waikapu has a climate typical of areas in the Hawaiian Islands, where strong trade winds prevail. These trade winds occur mainly throughout the dry seasonal months of May through September. Rainy seasonal months of October through April produce strong wind conditions varying from trades from the northeast to southerly winds known as "Kona storms". Average annual rainfall in Waikapu averages from 20 to 30 inches.

C. INFRASTRUCTURE

1. Drainage

The Waiale Road Extension project area is currently sugarcane land. Stormwater runs off in a west to east direction as non-concentrated sheet flow, eventually draining into the Waikapu Stream. The project site currently generates a 50-year, 1-hour peak runoff of 17 cfs. Offsite area mauka of the project site and makai of Honoapiilani Highway also drains in a similar manner. Offsite Drainage Area O-1 generates a 100-year, 24-hour runoff rate of 354 cfs and Offsite Drainage Area O-2 generates a 50-year, 1-hour runoff rate of 63 cfs. Note that 100-year, 24-hour runoff rates are required to be used for design of drainage areas larger than 100 acres. Refer to Exhibit 4 for the Existing Drainage Map.

The proposed road alignment crosses the Waikapu Stream, which has a large offsite contributing watershed area (Refer to Exhibit 6). The Federal Emergency Management Agency (FEMA) has studied this stream, mapping the 100-year floodplain area. Additionally there is a USGS stream gauge located approximately 500 feet makai of Honoapiilani Highway. Unfortunately this gauge has only been in service since 2002, so an accurate estimate of the 100-year, 24-hour flow rate cannot be made from the historical gauge data. The highest flow rate measured at the gauge was 1,400 cfs in 2004.

The remaining offsite area mauka of Honoapiilani Highway does not reach the project area as it is intercepted by the Waihee irrigation ditch and also the Honoapiilani Highway drainage system. The Honoapiilani Highway drainage system flows south toward Maalaea.

Existing East Waiko Road slopes continuously at approximately 3 percent grade toward Kuihelani Highway. Paved swales convey runoff along the road alignment and eventually are collected by a storm drain and ditch system at Kuihelani Highway that flows in a northerly direction. Existing 50-year, 1-hour East Waiko Road runoff is estimated to be 21 cfs.

Refer to Appendix A for Preliminary Hydrology Calculations.

2. Roadway

The proposed Waiale Road Extension area currently is undeveloped with sugarcane fields. There is one partially paved cane haul road that intersects proposed Waiale Road Extension alignment.

East Waiko Road is an existing roadway that is approximately 20 feet wide with paved swales along the edges. The existing Right-of-Way is 60 feet wide.

D. FLOOD ZONE

The Waikapu Stream contains a Zone AE 100-year (1-percent annual chance) floodway area with base flood elevations determined. Outside of the floodway area is Zone X, which is defined as areas outside the 1-percent annual chance floodplain, areas of 1-percent annual chance sheet flow flooding where average depths are less than 1 foot, or areas protected by levees. Flood zone classification is based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) numbers 150003 0393E and 150003 0394E, effective September 25, 2009. Refer to Exhibit 7 for the Flood Zone Map.

The proposed Waikapu Stream crossing will need to safely pass the 100-year stream flow. Various County, State, and Federal permits will be required as part of construction document review process; and thus, impact on the floodway area will be minimized as best as possible during the design phase.

IV. PROPOSED IMPROVEMENT

A. GRADING PLAN

The proposed Waiale Road Extension will require both excavation and embankment for the construction of the new roadway, with an estimated net volume of approximately 48,600 cubic yards (CY) of fill to be imported. The road cross-section consists of a 36-foot wide crowned asphalt concrete (AC) travel way and 6-foot AC drainage swales on each side. Road slopes will be generally between 0 to 5 percent after improvements, with a maximum of 2:1 slopes along the embankment. Refer to Exhibit 3A for the Waiale Road Extension Preliminary Grading and Drainage Plan.

The improvements to East Waiko Road consist of road widening from the existing 20-ft width to 36-foot width of AC pavement and re-construction of paved drainage swales. The existing roadway grade will be maintained, requiring an estimated net cut volume of approximately 6,900 CY to be exported. As mentioned previously, the road slopes continuously at approximately 3 percent grade towards Kuihelani Highway. Refer to Exhibit 3B for the East Waiko Road Preliminary Grading and Drainage Plan.

Severe erosion hazards are not expected during construction due to the mild topography and location of the project site, however special care should be taken on East Waiko Road due to the loose sandy soils. Best Management erosion control practices will be incorporated during the construction to minimize soil loss. Periodic water spraying of the disturbed soil will be implemented to help prevent airborne dirt particles from reaching adjacent properties. An 8-inch thick ingress/egress gravel access will be constructed near the entrance of the project site. The gravel will minimize the tracking of the on-site soils by construction vehicles onto Honoapiilani Highway and East Waiko Road. A process water basin will be implemented during construction to contain process water such as chlorinated water and wash water from cleaning concrete trucks and construction equipment during mass grading. Non-hazardous process water will be retained within the basin and allowed to percolate into the ground.

An application for a National Pollution Discharge Elimination System (NPDES) permit will be submitted to the State Department of Health prior to construction for review and approval.

B. DRAINAGE PLAN

The Rational Method was used to determine the stormwater runoff quantities for drainage areas less than 100 acres, based on a 50-year, 1-hour storm. The NRCS TR-20 Method was used to determine stormwater runoff quantities for drainage areas greater than 100 acres, based on a 100-year, 24-hour storm.

Roadway runoff will be collected in the paved roadside swales. During the design phase, the swale spread will be analyzed to locate drainage inlets for the roadway storm drain system. Waiale Road Extension runoff will be conveyed to the low point at elevation 260 where it will be released into the cane fields. From this point, runoff flows through roughly 3,000 feet of cane field land before reaching Waikapu Stream. The agricultural area acts as a buffer and provides significant filtering opportunity before final discharge. East Waiko Road runoff will flow toward Kuihelani Highway where it will outlet into the existing Highway drainage system. Both proposed drainage outlets will have consistent design with the existing drainage pattern.

The Waiale Road Extension area is expected to generate a 50-year, 1-hour runoff of 61 cfs while the improved East Waiko Road will generate 30 cfs. Prior to draining off site, retention of the increase in stormwater runoff from paved roadway surface will be provided by an open-air detention basin or underground retention system. Various methods of stormwater retention will be studied further during the design phase.

The proposed Waiale Road Extension crossing of Waikapu Stream will need to accommodate the large amount of runoff from the Waikapu Stream watershed. As part of Waiale Road Extension, a bridge or arch-culvert will be constructed at the Waikapu Stream crossing; although the layout and type will be determined later during the design phase of the project. The project will seek to avoid impact in the main stream channel to the maximum extent practicable.

Offsite runoff from cane field areas will be intercepted by ditches placed just mauka of the roadway and collected runoff will pass under the roadway through culverts. A double 60-inch culvert is proposed for offsite Drainage Area O-1 and a 42-inch culvert is proposed for offsite Drainage Area O-2 as shown on Exhibit 5 Proposed Drainage Map. No development will occur in offsite areas and thus, there will be no change in flow rates under proposed conditions.

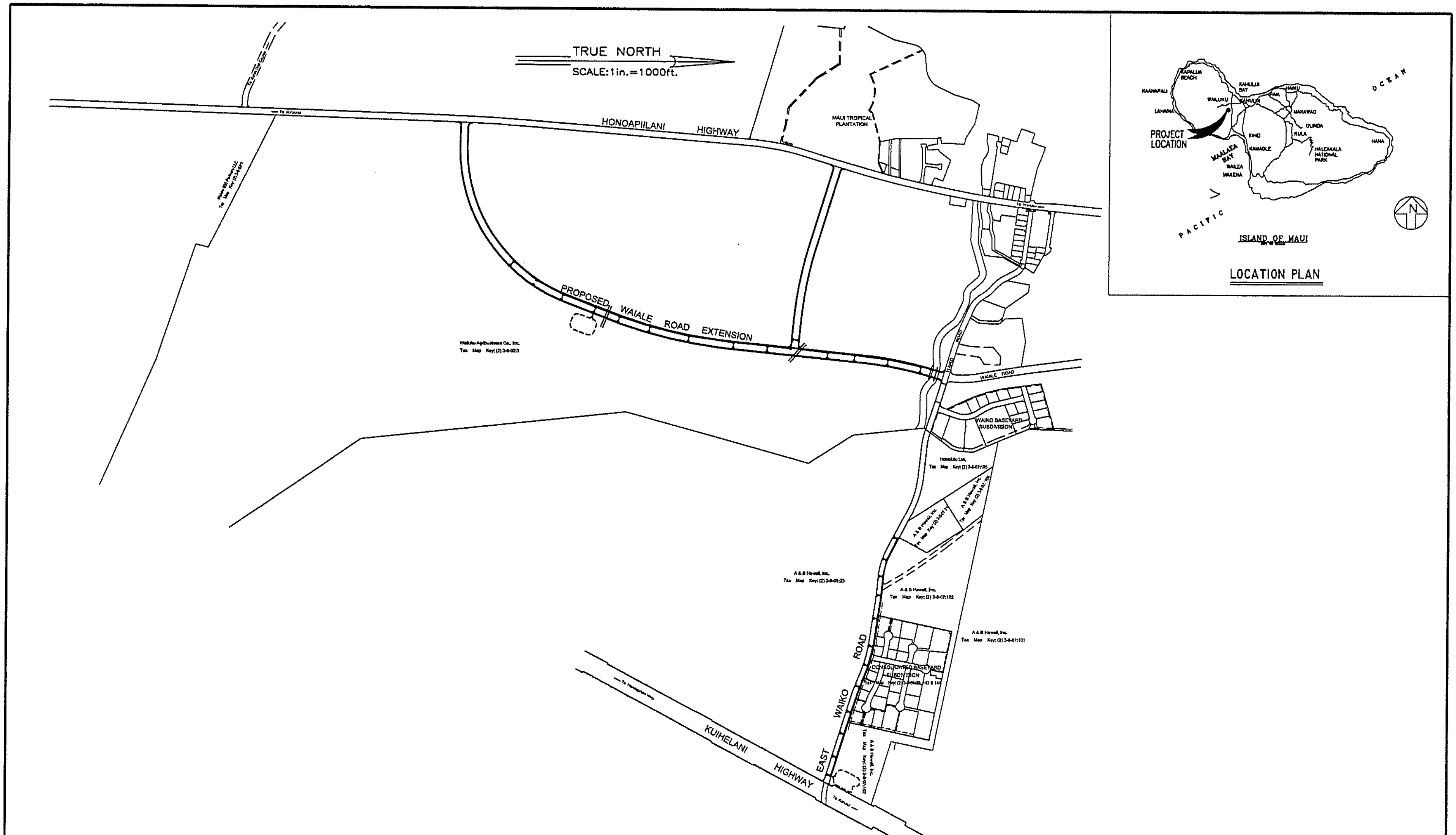
Refer to Appendix A for hydrology calculations and Exhibit 5 for the Proposed Drainage Map.

V. CONCLUSION

The proposed grading and drainage design for this project will attempt to remain consistent with the existing conditions. Waiale Road Extension with bridge crossing at Waikapu Stream will be designed so that impact on the stream channel is minimized. Widening improvement of East Waiko Road will retain the existing current drainage pattern. Off-site runoff from cane field will be allowed to pass through the proposed roadway, while retention of stormwater runoff increase from paved roadway surface will be provided by either above-ground or underground retention system. Soil loss will be minimized during the construction period by implementing appropriate erosion control measures. All drainage improvements will conform to the Maui County Standards. Thus, the project will not impose any significant adverse effects from stormwater runoff to adjacent and downstream areas.

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

EXHIBITS

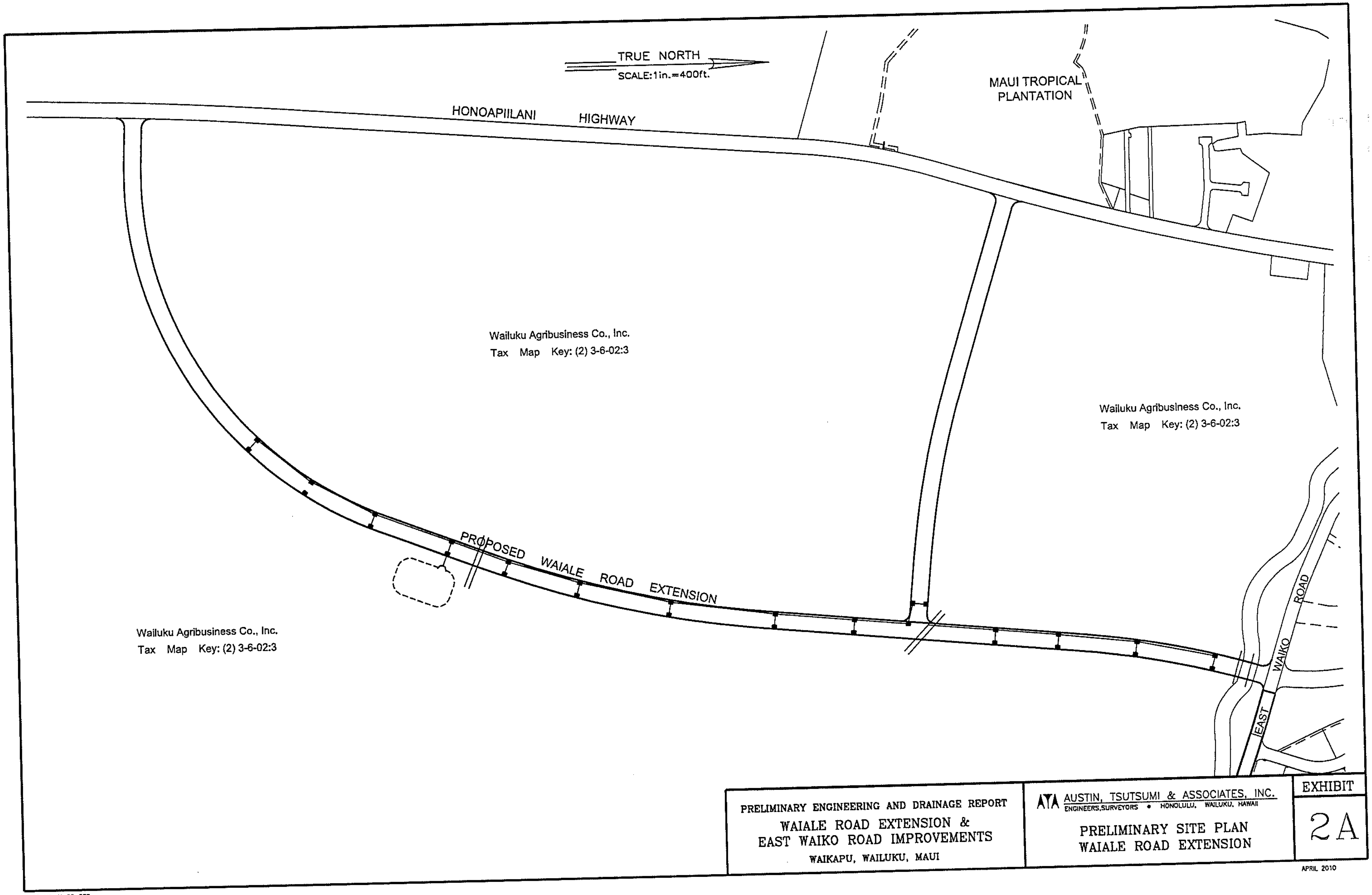


VICINITY MAP
SCALE: 1" = 1000'

PRELIMINARY ENGINEERING AND DRAINAGE REPORT WAIALE ROAD EXTENSION & EAST WAIKO ROAD IMPROVEMENTS WAIKAPU, WAILUKU, MAUI	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII PROJECT LOCATION AND VICINITY MAP	EXHIBIT 1

JOB NO. M-08-557
Z:\2008\08-557\REPORT\PER\EXH1-LOCATION & VICINITY MAP.DWG

APRIL 2010



PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII

PRELIMINARY SITE PLAN
WAIALE ROAD EXTENSION

EXHIBIT
2A

APRIL 2010

JOB NO. M-08-557
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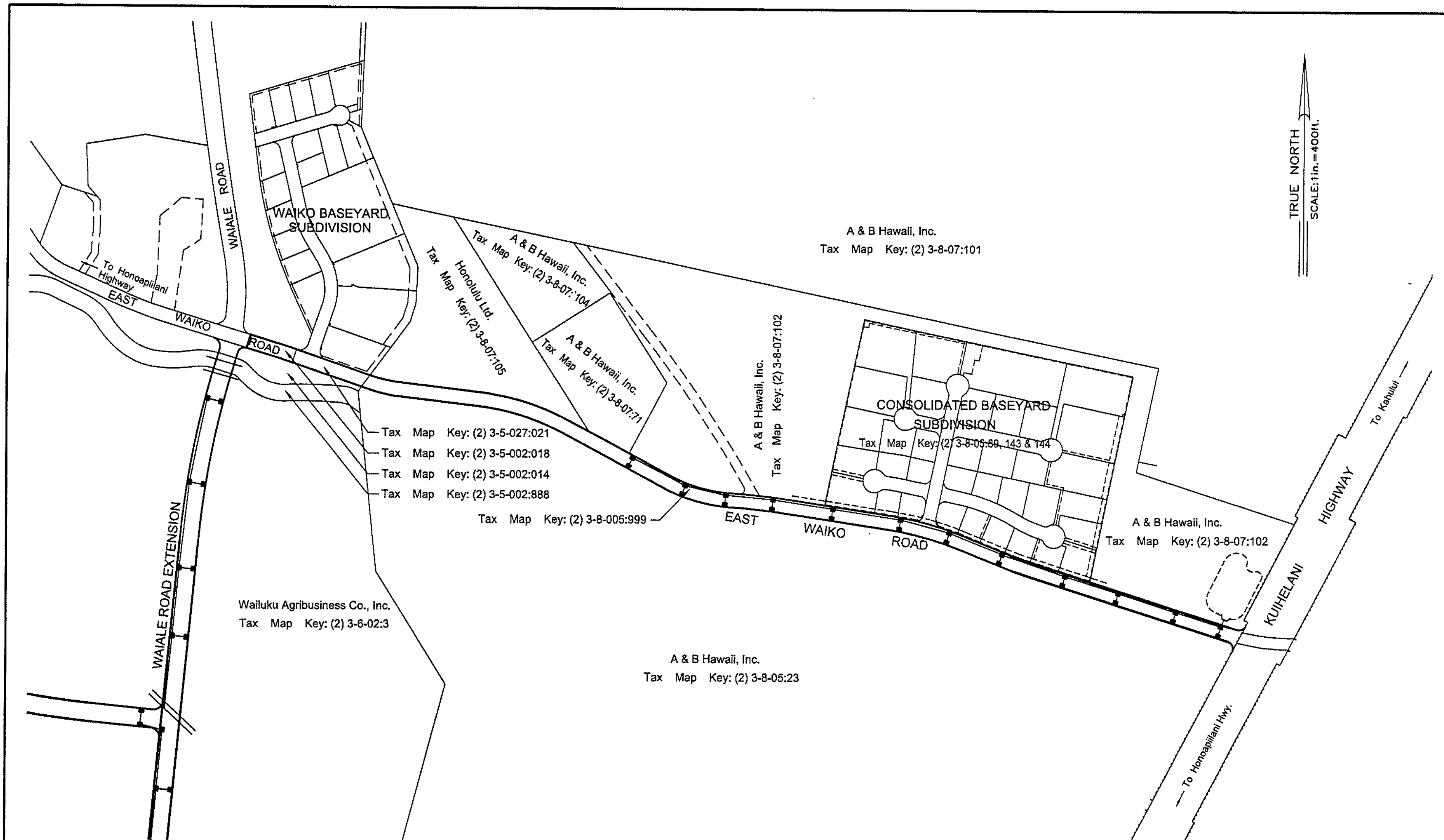

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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PRELIMINARY SITE PLAN
EAST WAIKO ROAD

EXHIBIT
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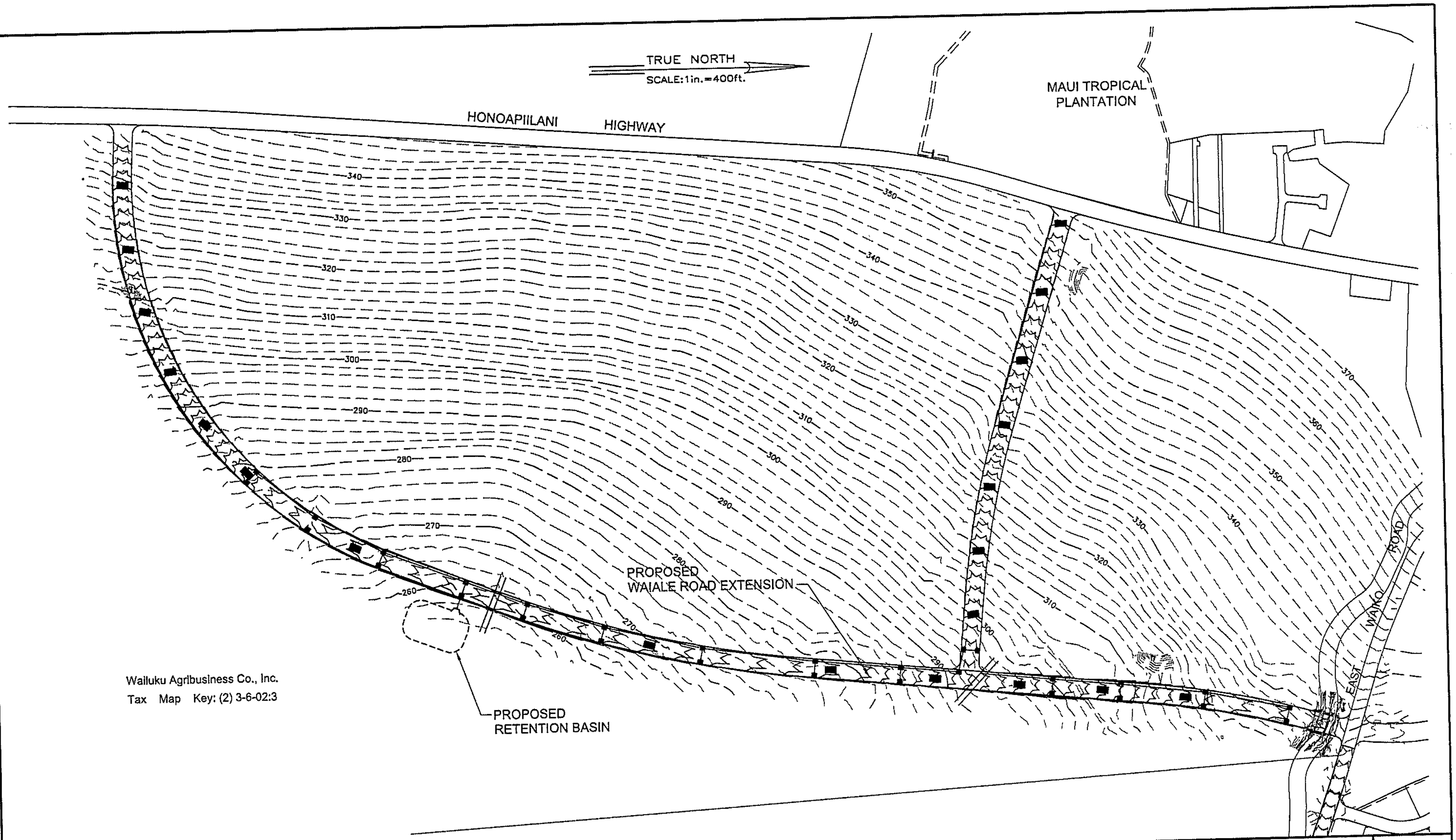

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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PRELIMINARY GRADING & DRAINAGE PLAN
WAIALE ROAD EXTENSION

EXHIBIT
3A

APRIL 2010

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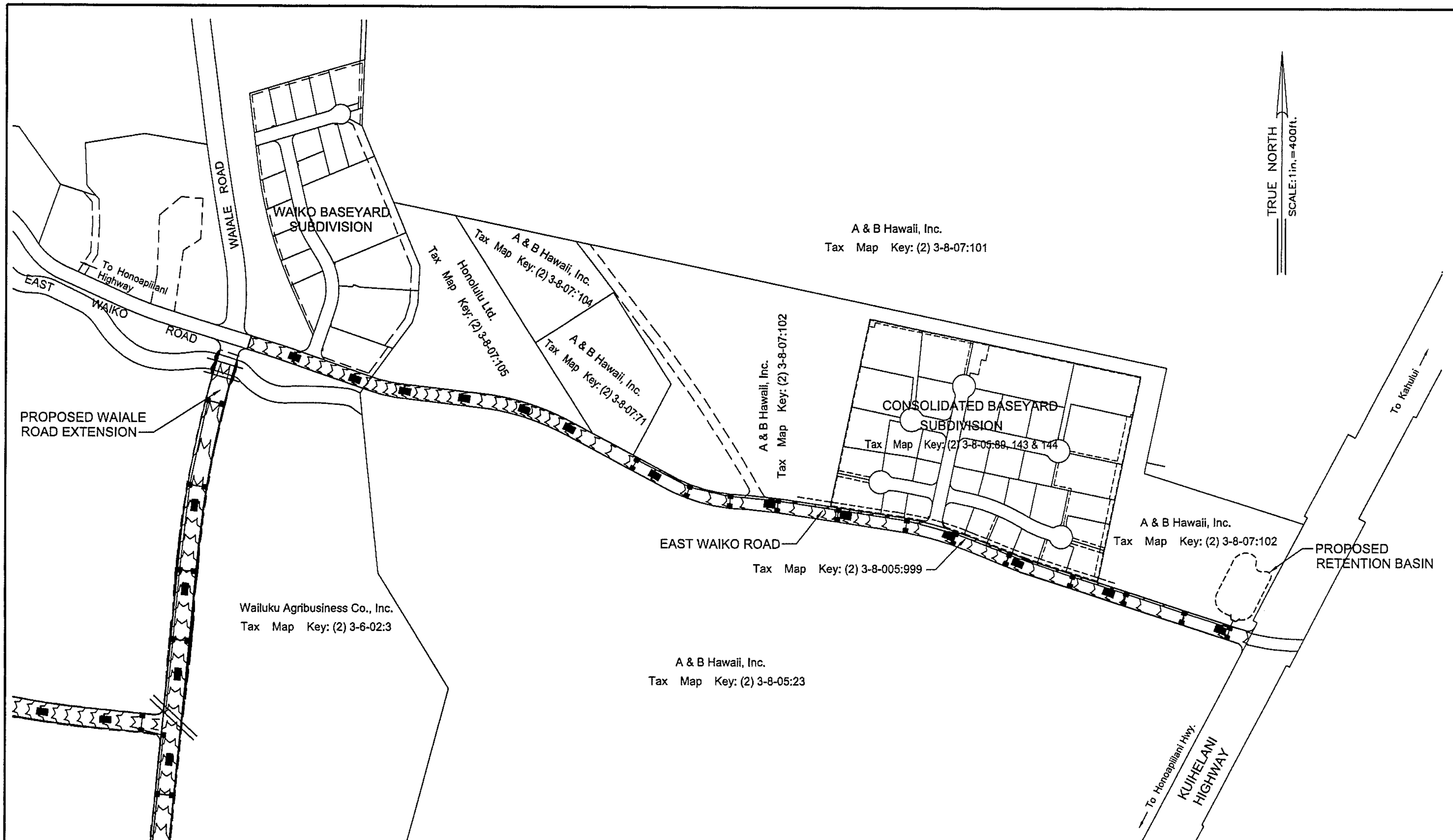

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII

PRELIMINARY GRADING & DRAINAGE PLAN
EAST WAIKO ROAD

EXHIBIT
3B

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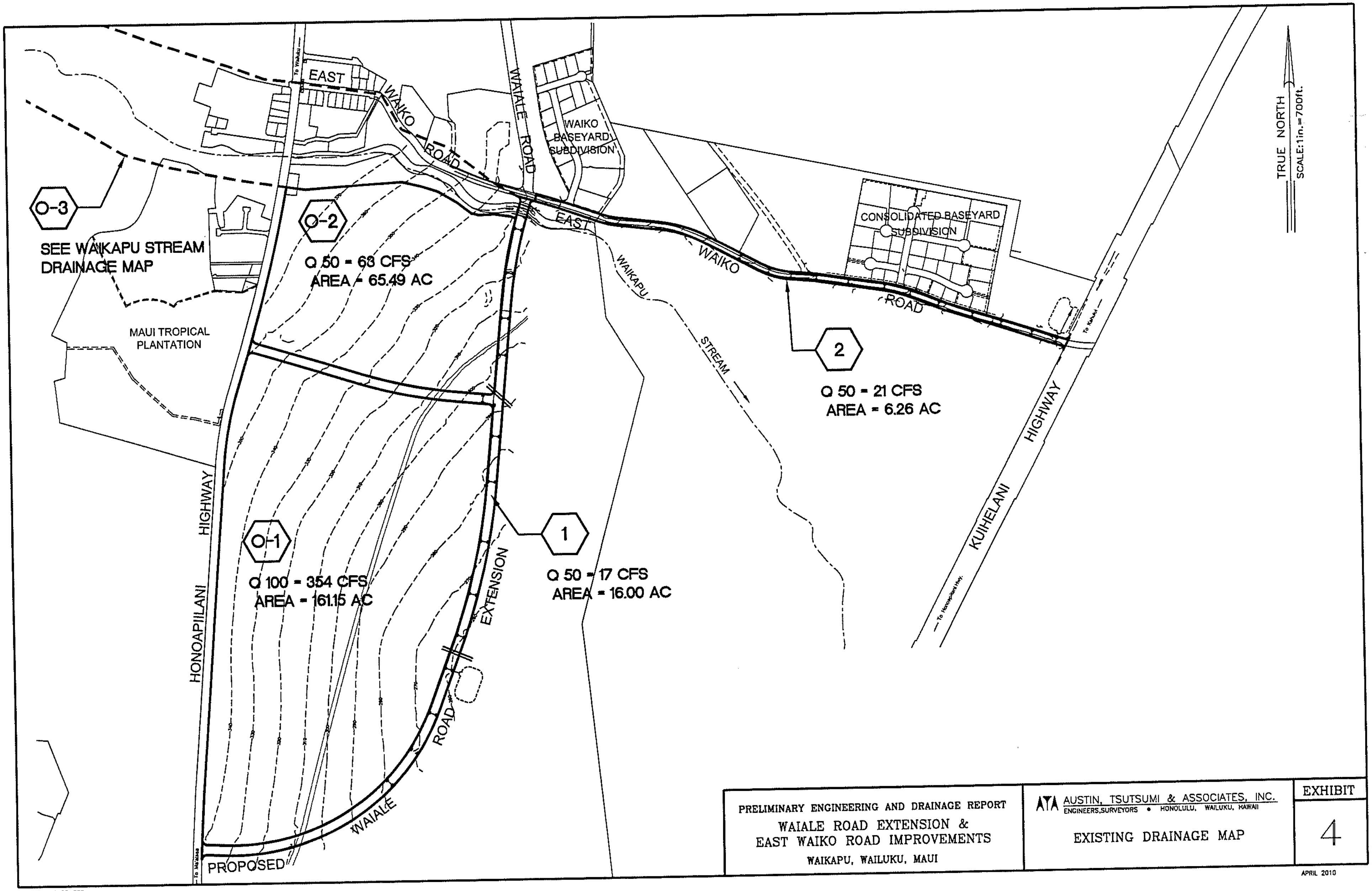

PRELIMINARY ENGINEERING AND DRAINAGE REPORT WAIALE ROAD EXTENSION & EAST WAIKO ROAD IMPROVEMENTS WAIKAPU, WAILUKU, MAUI	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU, WAILUKU, HAWAII EXISTING DRAINAGE MAP	EXHIBIT 4

APRIL 2010

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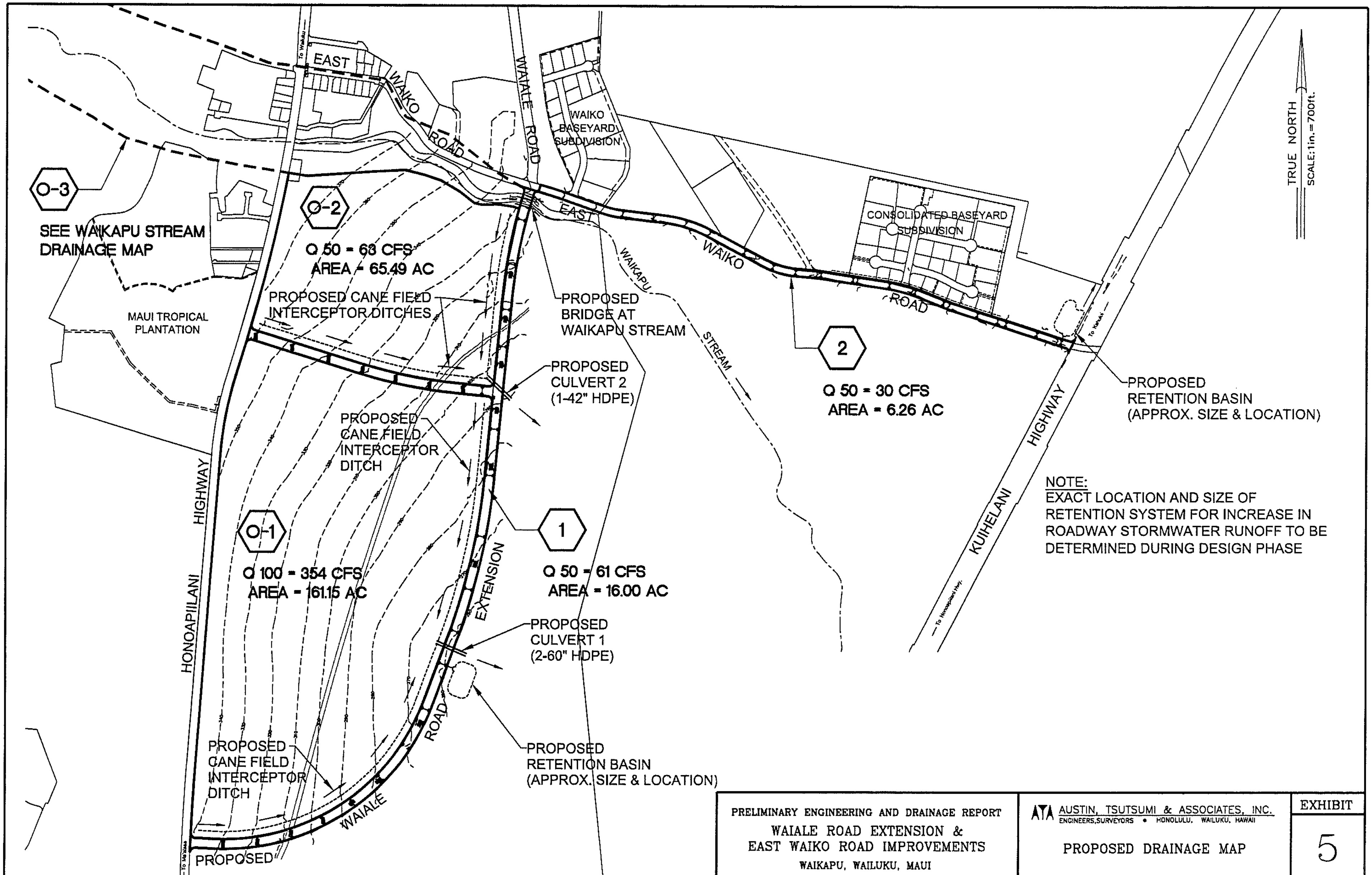

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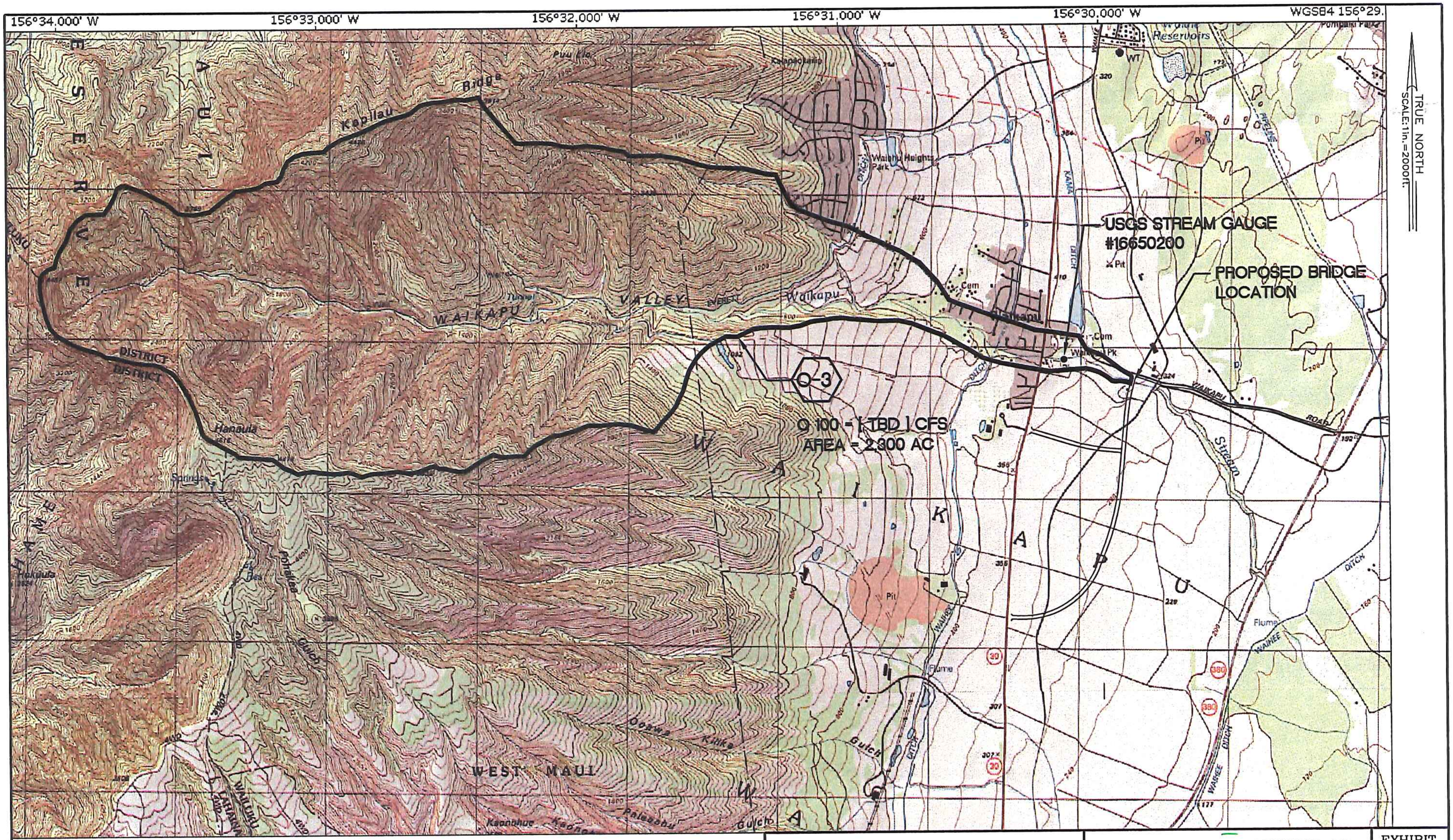

PRELIMINARY ENGINEERING AND DRAINAGE REPORT
WAIALE ROAD EXTENSION &
EAST WAIKO ROAD IMPROVEMENTS
WAIKAPU, WAILUKU, MAUI

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WAIKAPU STREAM DRAINAGE MAP

EXHIBIT
6

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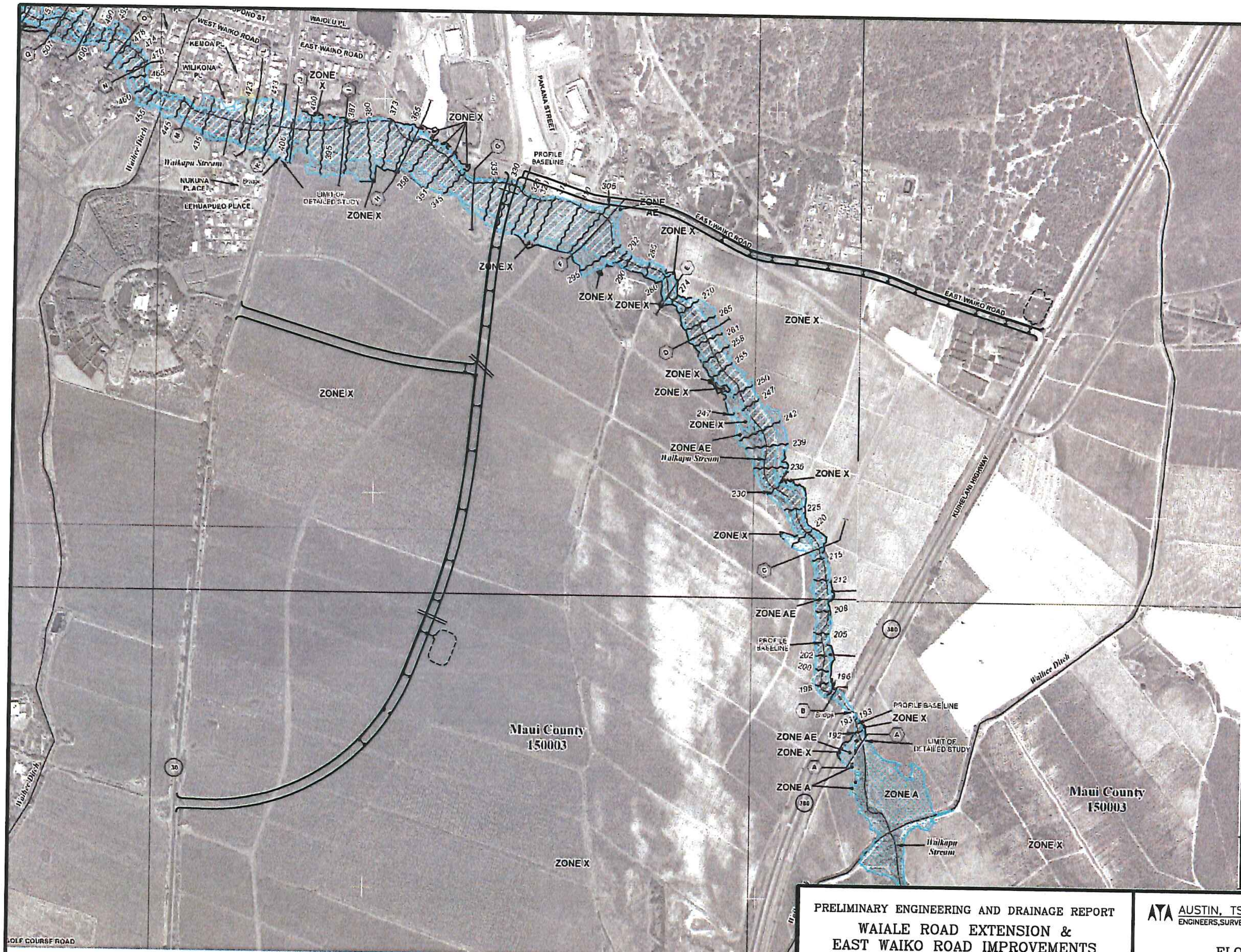

pd Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 800'

400 0 800 1600 FEET

METER

NFIP

PANEL 0393E PANEL 0394E

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MAUI COUNTY, HAWAII

PANEL 393 OF 825

PANEL 394 OF 825

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MAUI COUNTY	150003	0393	E
MAUI COUNTY	150003	0394	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
1500030393E
1500030394E

MAP REVISED
SEPTEMBER 25, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

PRELIMINARY ENGINEERING AND DRAINAGE REPORT

WAIALE ROAD EXTENSION & EAST WAIKO ROAD IMPROVEMENTS

WAIKAPU, WAILUKU, MAUI

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS ● HONOLULU, WAILUKU, HAWAII

FLOOD ZONE MAP

EXHIBIT

7

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APRIL 2010

APPENDIX A

DRAINAGE STUDY
Project: WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS
Preliminary Hydrology Calculations
Summary of Procedures

References:

1. "Rules for the Design of Storm Drainage Facilities in the County of Maui", County of Maui, Department of Public Works and Waste Management.
2. "Urban Hydrology for Small Watersheds", U.S. Dept. of Agriculture, Soil Conservation Service, Engineering Division, Technical Release 55 (TR-55), June 1986.
3. "HydroCAD Stormwater Modeling System, Owner's Manual", HydroCAD Software Solutions, LLC, Version 8, 2006.

Procedures:

The Rational Method is used to determine stormwater runoff for drainage areas less than 100 acres, based on the 50-year, 1-hour storm. For areas larger than 100 acres, the HydroCAD program is used to perform the NRCS TR-20 Method based on a 100-year, 24-hour storm. TR-55 procedures are used in the time of concentration calculations for the large 100-acre plus drainage areas.

Pre-development Runoff:

1. Refer to Appendix A for hydrology calculations.
2. Refer to Exhibit 4 for Existing Drainage Map and Exhibit 6 for Waikapu Stream Drainage Map.
3. The FEMA flood study report for Waikapu Stream will be obtained prior to the design phase of the project. The report is expected to contain the 100-year flow rate for the Waikapu Stream watershed, which is shown as Drainage Area O-3 in this report. The FEMA flow rate for Drainage Area O-3 will be used in the design of the stream crossing.

Pre-development Runoff (continued):

Drainage Area O-1: Q = 354.34 cfs (100-Yr, 24-Hr)

Drainage Area O-2: Q = 63.37 cfs (50-Yr, 1-Hr)

Drainage Area O-3: Q = *TBD* (100-Yr, 24-Hr)

Drainage Area 1: Q = 16.93 cfs (50-Yr, 1-Hr)

Drainage Area 2: Q = 20.67 cfs (50-Yr, 1-Hr)

Post-development Runoff:

1. Refer to Appendix A for hydrology calculations.
2. Refer to Exhibit 5 for Proposed Drainage Map.
3. There is no change in runoff for offsite areas.

   Drainage Area 1: Q = 61.21 cfs (50-Yr, 1-Hr)

   Drainage Area 2: Q = 30.01 cfs (50-Yr, 1-Hr)

APPENDIX D.

Biological and Water Quality Surveys of Waikapu Stream

AECOS No. 1196

Biological and water quality surveys of Waikapū Stream for the Wai'ale Road extension near Waikapū, Maui.

Prepared by:

AECOS Inc.
45-939 Kamehameha Hwy, Suite 104
Kāne'ohe, Hawai'i 96744-3221

December 1, 2009

Biological and water quality surveys of Waikapū Stream for the Wai'ale Road extension near Waikapū, Maui.

December 1, 2009 | ***Final Report*** | *AECOS* No. 1196

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Introduction

In August 2009, *AECOS*, Inc. biologists conducted water quality and aquatic biota surveys along Waikapū Stream in central Maui (Fig. 1). The County of Maui, Department of Public Works is planning to extend Wai'ale Road at East Waiko Road to Hono'api'ilani Highway.[1] *AECOS*, Inc. was contracted to ascertain aquatic resources and assess water quality within the proposed project vicinity. This report details findings of those surveys.

Improvements for both Wai'ale Road and East Waiko Road will consist of: a two-lane roadway with paved shoulders and swales; a drainage system; pavement striping and markings; signage; and relocation of existing utilities as needed. Right-of-ways ranging from 60 to 80 ft (18 to 24 m) will be required throughout most of the project. A bridge crossing will also be required over Waikapū Stream for the proposed Wai'ale Road extension. Project improvements will include (County of Maui, 2008):

- extending Wai'ale Road to the Old Quarry Road intersection;
- improving East Waiko Road from Wai'ale Road to Kuihelani Highway.

Waikapū Stream originates in the west Maui mountains, at an elevation of approximately 3300 ft (1006 m). The stream flows west for approximately 4.5

[1] This document prepared for Munekiyo & Hiraga Associates, Inc will be incorporated into the Environmental Assessment (EA) for the Wai'ale Road Extension Project and become part of the public record.

mi (7.2 km) through Waikapū valley, reaching the central plain of the Maui isthmus before flowing southeast for 4.1 mi (6.6 km) and emptying into Kealia Pond, most of which is in the Keālia National Wildlife Refuge. The pond is located between Mā'alaea and Kīhei along Maui's southern coast. The stream is intersected throughout its course by at least four ditches (Everett, Upper Waihee, Lower Waihee, and Upper Maalaea Road) diverting water for agricultural use in central Maui.

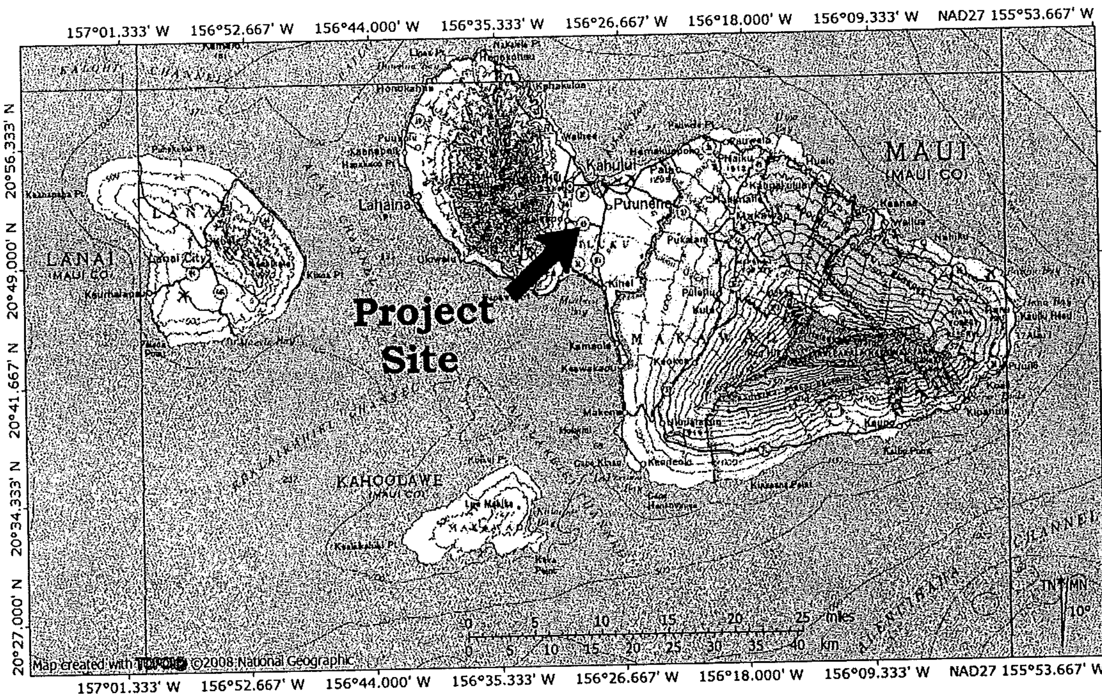

Figure 1. General location of the project site near Waikapū, Maui.

Near the project site, the stream bed consists primarily of basalt bedrock, covered with boulders and gravel. Deeper pools contain layers of silt and sand on the bottom. Stream banks are 12-15 ft (3 to 4 m) in height and vegetated with java plum (*Syzygium cumini*), koa haole (*Leucaena leucocephala*), Guinea grass (*Urochloa maxima*), and escaped sugar cane (*Saccharum officinarum*). The abundant growth of vegetation along the banks thoroughly shades the stream along most of this reach.

Survey Methods

On August 20, 2009, *AECOS*, Inc. biologists surveyed approximately 2.5 mi (4 km) of Waikapū Stream to identify aquatic biota present and characterize the quality of the stream water. Field measurements of water quality and grab samples were collected from three locations in the stream. Analytical methods and instrumentation utilized for the analysis of water quality are listed below in Table 1.

Table 1. Analytical methods and instruments used for August 20, 2009 water quality analyses of Waikapū Stream, central Maui.

Analysis	Method	Reference	Instrument
Ammonia	EPA 350 M	Grasshoff et al. (1986)	Technicon AutoAnalyzer II
Conductivity	SM 2510 B	Standard Methods 20th Edition (1998)	Hydac Conductivity Meter
Dissolved Oxygen	SM 4500-O G	Standard Methods 20th Edition (1998)	YSI Model 85 DO meter
Nitrate + Nitrite	EPA 353.2 Rev 2.0	EPA (1993)	Technicon AutoAnalyzer II
pH	SM 4500 H+	Standard Methods 20th Edition (1998)	Hannah pocket pH meter
Temperature	thermister calibrated to NBS cert. thermometer SM 2550 B	Standard Methods 20th Edition (1998)	YSI Model 550A DO meter
Total Nitrogen	persulfate digestion/EPA 353.2	Grasshoff et al (1986)/ EPA (1993)	Technicon AutoAnalyzer II
Total Phosphorus	persulfate digestion/EPA 365.1 Rev 2.0	Grasshoff et al. (1986)/EPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	Method 2540 D	Standard Methods 20th Edition (1998)	Mettler H31 balance
Turbidity	EPA 180.1 Rev 2.0	EPA (1993)	Hach 2100N Turbidimeter

EPA. 1993. Methods for the Determination of Inorganic Substances in Environmental Samples. EPA 600/R-93/100.
Grasshoff, K., M. Ehrhardt, & K. Kremling (eds). 1986. Methods of Seawater Analysis (2nd ed). Verlag Chemie, GmbH, Weinheim.
Standard Methods. 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. 1998. (Greenberg, Clesceri, and Eaton, eds.). APHA, AWWA, & WEF. 1220 p.

Station "Wai'ale" was located directly across from the terminus of Wai'ale Road at East Waiko Road (Figure 2). Station "Upstream" was collected approximately 3950 ft (1200 m) upstream from the Wai'ale Road-East Waiko Road intersection, near the southern terminus of Nuna Place. Station "Downstream" was collected from approximately one mile downstream from the project intersection, just downstream of the Kuihelani Highway bridge crossing. An alga sample was collected for microscopic identification from a location approximately one mile upstream of the project site.

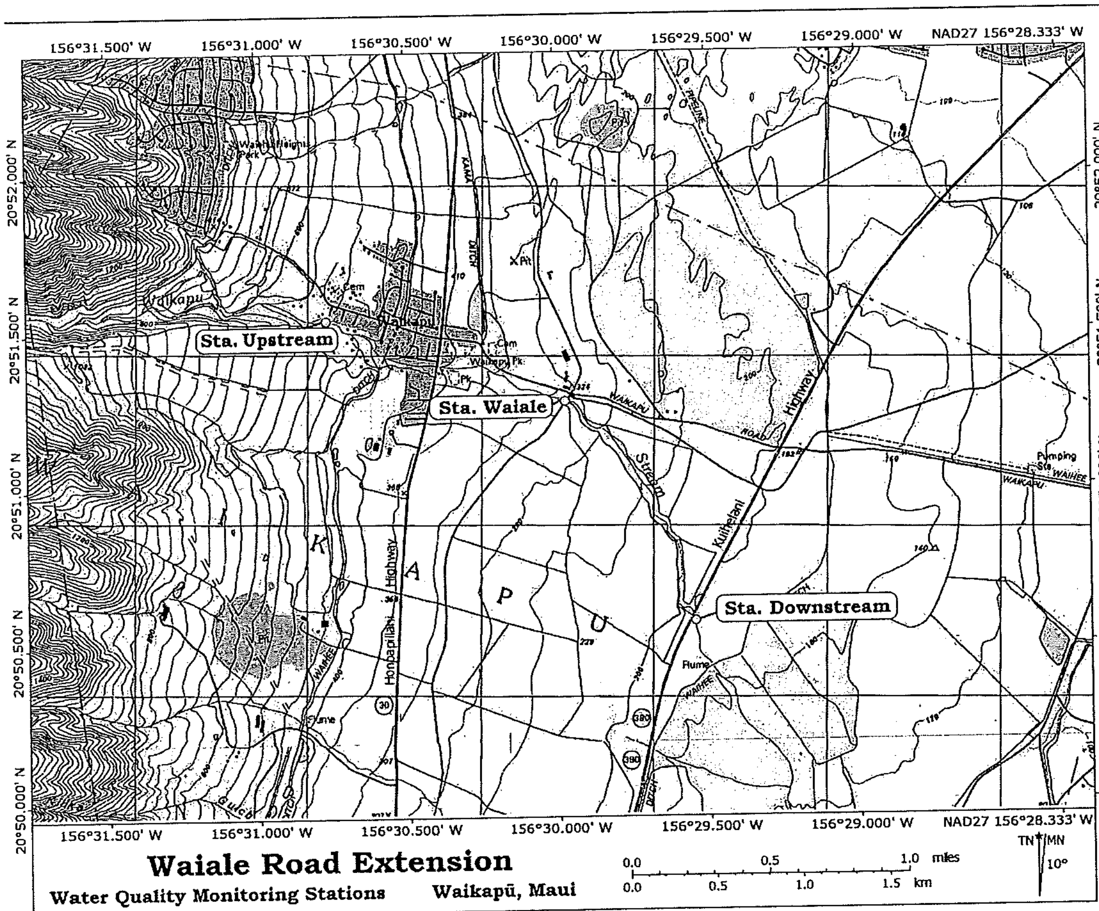

Figure 2. Location of water quality sampling stations on Waikapū Stream

Survey Results

Water Quality

Table 2 presents results for all water quality analyses on samples collected from stations located in Waikapū Stream on the August 20, 2009 survey date. Stream flow was good in segments upstream and near the project site with water flowing throughout the width of the stream channel. Downstream of the project site, near Kuihelani Highway, stream flow is relatively poor and wetted widths are generally less than half the stream channel. Total suspended solids concentrations and turbidity levels are low, indicative of the clear water and good visibility observed during the time of sampling. Concentrations of total nitrogen, nitrate-nitrite, and total phosphorus are low indicating good stream water quality at the proposed project site.

Table 2. Water quality characteristics of Waikapū Stream on August 20, 2009.

Station	Time (hh:mm)	Temp. (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% sat.)	pH --	Conductivity (μmhos/cm)
Upstream	1430	23.7	7.85	93	6.71	125
Wai'ale	1300	24.6	8.05	97	6.41	98
Downstream	1100	24.6	7.83	94	6.55	109
	TSS (mg/l)	**Turbidity (ntu)**	**Ammonia (μg N/l)**	**Nitrate+ Nitrite (μg N/l)**	**Total N (μg N/l)**	**Total P (μg P/l)**
Upstream	1.0	1.80	< 9	16	60	20
Wai'ale	1.0	1.30	< 9	< 9	60	20
Downstream	2.2	1.42	11	18	80	20

Aquatic Biota

Aquatic biota identified from Waikapū Stream during the August 2009 survey are listed in Table 3. The segment of the stream extending from approximately 360-ft down to 120-ft (110-m to 36-m) elevation, which includes the project site, is nearly devoid of aquatic life. Only cane toad (*Bufo marinus*) adults and tadpoles were observed as present the stream. A few crayfish (*Procambarus clarkii*) carcasses were encountered in a dry, concrete rock masonry (CRM) lined ditch entering the stream downstream from the Wailae Road terminus. No fishes or macroalgae were observed. Approximately 4600 ft (1400 m) upstream from the project site aquatic biota become more evident. Poeciliid fishes—guppies (*Poecilia reticulata*) and mosquitofish (*Gambusia affinis*)—are occasionally sighted. Cane toads and crayfish are also occasional in this reach of the stream. A chlorophyte (alga) of the genus *Cloniophora* is rare, growing on boulders in an unshaded part of the stream. This short segment is located approximately one mile (1.6 km) upstream of the project site.

Table 3. Checklist of aquatic biota observed by *AECOS*, Inc. biologists in Waikapū Stream, central Maui.

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status	Location
	ALGAE			
CHLOROPHYTA, CHLOROPHYCEAE, CHAETOPHORALES				
CHAETOPHORACEAE				
Cloniophora sp.	green algae	R	Ind	1
	AQUATIC PLANTS			
PTERIDOPHYTA, FILICOPSIDA, HYDROPTERIDALES				
AZOLLACEAE				
Azolla filiculoides Lam	mosquito fern	R	Nat	1
	INVERTEBRATES			
MOLLUSCA, GASTROPODA BASOMMATOPHORA				
PHYSIDAE				
unid.	pouch snail	R	Nat	5
MOLLUSCA, BIVALVIA VENEROIDEA				
CORBICULIDAE				
Corbicula fluminea O.F.Mueller†	Asiatic clam	R	Nat	4

Table 3 continued

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status	Location
ARTHROPODA, INSECTA				
ODONATA				
AESHNIDAE				
Anax junius Drury	green darner	R	End	4
ARTHROPODA, INSECTA				
TRICHOPTERA				
unid.	caddisfly larva	R	Nat	5
ARTHROPODA, MALACOSTRACA, DECOPODA				
CAMBARIDAE				
Procambarus clarkii Girard	American crayfish	C	Nat	1,2,5
	FISHES			
CHORDATA, ACTINOPTERYGII, CYPRINODONTIFORMES				
POECELIIDAE				
Gambusia affinis Baird&Girard	mosquitofish	U	Nat	1
Poecilia reticulata Peters	guppy	O	Nat	1
	AMPHIBIANS			
AMPHIBIA, ANURA				
BUFONIDAE				
Bufo marinus L.	cane toad	A	Nat	1,2,3
	BIRDS			
AVES, CICONIIFORMES				
ARDEIDAE				
Nycticorax nycticorax L.	black-crowned night heron	R	End	1

KEY TO SYMBOLS USED:

† - identified from shell only; living organism not present

Abundance categories:

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

Status categories:

- End – Endemic – species found only in Hawai'i
- Ind – Indigenous – species found in Hawai'i and elsewhere
- Nat – Naturalized – species were introduced to Hawai'i intentionally, or accidentally.

Location codes:

- 1 – identified on August 20, 2009 at an elevation of 450 to 700 ft.
- 2 – identified on August 20, 2009 at an elevation of 240 to 360 ft.
- 3 – identified on August 20, 2009 at an elevation of 120 to 240 ft.
- 4 – identified on August 4, 2003 at an elevation of 200 ft.
- 5 – identified on August 6, 2003 at an elevation of 1000 to 1040ft.

A previous survey conducted by *AECOS*, Inc in the stream in August 2003 likewise reported very little aquatic biota present. Pouch snails (Family Physidae), crayfish, a green darner (*Anax junius*), and caddisfly larva were the only organisms identified to be present in or near the stream at locations 2.2 mi (3.6 km) upstream and 1.1 mi (1.7 km) downstream of the current project site (AECOS, 2003).

Assessment

Waikapū Stream is classified by the State of Hawai'i as a perennial stream (state perennial stream code: 6-2-10). The stream appears on the Hawai'i Department of Health list of impaired waters in Hawai'i (HDOH, 2008), prepared under federal Clean Water Act, §303(d). The listing indicates that water quality within the stream may not meet State of Hawai'i water quality criteria for streams (Table 4, above). The stream is listed as impaired for turbidity during the dry season (May 1-Oct. 31) based on data combined from both the wet and dry season. During our August 2009 survey, water quality was very good with turbidity levels and concentrations of suspended solids, total nitrogen, nitrate-nitrite, and total phosphorus depressed with respect to state water quality criteria for these parameters. Of course, a single sampling event is not necessarily representative of stream conditions during the season sampled, and compliance with state criteria expressed as geometric mean values would require computation of a geometric mean based upon a minimum of three samples from a station within a season.

Published historical data (Maciolek, 1971; DAR, 2009) from biological surveys conducted in the Waikapū watershed indicate that several native aquatic species occur in the watershed. The Waikapū watershed (as defined by the Division of Aquatic Resources) is quite large, encompassing an area of 60.8 sq mi (157.6 sq km) that includes eight named streams. Though most of these native species are historically reported from the estuarine reach of the watershed, near Keālia Pond, endemic *'ōpaekale'ole* (*Atyoida bisulcata*) and unidentified *'o'opu* (Family Gobiidae) are historically reported to inhabit the middle and lower reaches of this watershed. The endemic *'o'opu nōpili* (*Sicyopterus stimpsoni*) is also historically reported present in the upper reaches of the watershed.

Surveys conducted by *AECOS* during August of 2003 and on August 20, 2009 indicate that very little aquatic biota is found in lower Waikapū Stream, and the population that is present in comprised of naturalized (non-native) species. The reported historical presence of native species within the watershed indicates that some recruitment into Waikapū Stream is possible. Any changes to stream morphology should be designed to accommodate the diadromous life cycle of native fish and invertebrates. Migrating native fauna will climb up wetted surfaces of escarpments, but cannot climb out to reach the lip of an overhanging culvert. Culverts when placed or constructed to situate flush against the stream bed will allow the passage of native fauna.

Table 4. State of Hawai'i water quality criteria for streams (geometric mean values) for wet (Nov. 1-Apr. 30) and dry (May 1-Oct. 31) seasons from HAR §11-54-05.2(b) (HDOH, 2004).

Parameter	**Total Nitrogen** (μg N/l)	**Nitrate + Nitrite** (μg N/l)	**Total Phosphorus** (μg P/l)	**Turbidity** (NTU)	**Total Suspended Solids** (mg/l)
Not to exceed given value (dry season)	180.0	30.0	30.0	2.0	10.0
(wet season)	250.0	70.0	50.0	5.0	20.0
Not to exceed more than 10% of the time (dry season)	380.0	90.0	60.0	5.5	30.0
(wet season)	520.0	180.0	100.0	15.0	50.0
Not to exceed more than 2% of the time (dry season)	600.0	170.0	80.0	10.0	55.0
(wet season)	800.0	300.0	150.0	25.0	80.0

- pH – shall not deviate more than 0.5 units from ambient and not be lower than 5.5 nor higher than 8.0.
- Dissolved oxygen – not less than 80% saturation.
- Temperature – shall not vary more than 1 °C from ambient.
- Conductivity – not more than 300 micromhos/cm.

Keālia Pond, into which Waikapū Stream flows approximately 4.2 mi (6.8 km) downstream from the project site, is a National Wildlife Refuge. The seasonal pond and wetland within the refuge are habitat for over 30 species of birds including the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica alai*), and Hawaiian duck (*Anas wyvilliana*) (USFWS, 2009).

None of the aquatic species observed during *AECOS* surveys is listed as threatened or endangered by the U.S. Fish and Wildlife Service under the

Endangered Species Act of 1973, as amended, or by the State of Hawaii under its endangered species program (DLNR 1998; USFWS, 2009).

Design and implementation of effective Best Management Practices (BMP's) during construction will be necessary to prevent degradation to water quality and aquatic biota that may recruit to the project site.

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APPENDIX E.

Biological and Botanical Surveys

BIOLOGICAL RESOURCES SURVEY

for the

WAI'ALE ROAD EXTENSION PROJECT

WAIKAPU, MAUI, HAWAII

by

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Prepared for: Munekiyo & Hiraga , Inc.

BIOLOGICAL RESOURCES SURVEY
WAI'ALE ROAD EXTENSION PROJECT
Waikapü, Maui, Hawaii

INTRODUCTION

The Wai'ale Road Extension Project is an approximately 1.5 mile long by 80 ft. wide roadway corridor that will extend south from the present terminus of Wai'ale Road on Waikö Road and connect with Honoapi'ilani Highway 1.5 miles south of Waikapu Town as part of a Federal Aid highway development plan. An additional alternative 0.5 mile long route perpendicular to this corridor and connecting with Honoapiilani Highway opposite the Maui Tropical Plantation entrance was also included in this study (see Figure 1). This study was initiated in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

The project corridor passes through gently sloping lands on the southeastern slopes of West Maui. Deep, well-drained alluvial soils of the Pulehu Cobbly Silt Loam, 'Iao Clay and Pulehu Cobbly ClayLoam series (Foote et al, 1972) make up over 95% of the substrate, while a small area of Jaucas Sand series occupies the northern tip of the project route. Elevations range from 280 ft. to 320 ft, above sea level. Rainfall averages about 20 inches per year with the bulk falling during the winter months (Armstrong, 1983).

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Wai'ale Road Extension corridor which was conducted during June and July 2009. 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 along a 1.5 mile long by 100 foot wide corridor covering the entire project area. The riparian strip along Waikapu Stream was examined more intensively because of its special habitat. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation on more than 90% of this corridor is cultivated sugar cane (*Saccharum officinarum*) growing in a dense monoculture. This area is dissected by numerous plantation access roads along which grow a variety of agricultural weeds. This area is on a 1.5 to 2 year cycle that involves plowing, planting, burning and harvesting that creates a highly altered agricultural environment.

The Waikapu Stream is a small but very distinctive riparian habitat. The intermittent stream was dry at the time of the survey and has an unvegetated stream bed consisting of boulders and gravel. The banks are densely forested with medium sized to large trees including Java plum (*Syzygium cumini*) and smaller numbers of koa haole (*Leucaena leucocephala*) and parasol leaf tree (*Macaranga tanarius*).

The small areas on either side of Waikapu Sream are not used agriculturally and are vegetated with dry grasses including buffelgrass (*Cenchrus ciliaris*) and Guinea grass (*Panicum maximum*) and by brush species including koa haole and sourbush (*Pluchea carolinensis*).

A total of 67 plant species were recorded during the survey. By far the most abundant species was the sugar cane in the fields. Of this total only one common natives species was found, the ʻuhaloa (Waltheria indica) which is indigenous in Hawaii but also widespread in the Pacific. The remaining plants are all non-native agricultural crop plants or weeds.

DISCUSSION AND RECOMMENDATION

The vegetation along the project corridor is dominated by non-native species. Only one common indigenous species was found. No federally listed Endangered or Threatened species (USFWS, 1999) were found, nor do any plants proposed as candidates for such status occur on the property.

Waikapu Stream is a sensitive environment that needs to be carefully managed, although it is not a special habitat in that it has no Endangered or Threatened plants or animals living in or around it. The stream is diverted for agricultural irrigation that contributes to it being periodically dry. Were it not diverted it would almost certainly be a perennial running stream with increased possibilities of harboring native species. As it is now no native plants were found within this riparian channel.

No wetlands occur on the site. Streams are technically not wetlands by federal definition. The remainder of the proposed highway corridor consists of dry upland habitat.

As a result of the above findings it is determined that there is little of botanical concern and that the proposed project is not expected to have a significant negative impact on the botanical resources in this part of Maui.

It is recommended that any bridge built over Waikapu Stream be engineered so that it does not impede the natural flow of the stream in any way.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants (Monocots and Dicots) 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-geographic 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 = all those plants brought to Hawaii during the course of Polynesian migrations.
   - non-native = all those plants brought to the islands intentionally or accidentally after western contact.
4. Abundance of each species within the project area:
   - abundant = forming a major part of the vegetation within the project area.
   - common = widely scattered throughout the area or locally abundant within a portion of it.
   - uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   - rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
THELYPTERIDACEAE (Marsh Ferns)			
Christella parasitica (L.) H. Lev.	-----------------	non-native	rare
MONOCOTS			
ASPARAGACEAE (Asparagus Family)			
Furcraea foetida (L.) *Haw.*	Mauritius hemp	non-native	rare
COMMELINACEAE (Spiderwort Family)			
Commelina diffusa N.L. Burm.	honohono	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus involucratus Rottb.	umbrella sedge	non-native	rare
Cyperus rotundus L.	nut sedge	non-native	rare
POACEAE (Grass Family)			
Cenchrus ciliaris L.	buffelgrass	non-native	common
Chloris barbara (L.) Sw.	swollen fingergrass	non-native	uncommon
Coix lacryma-jobi L.	Job's tears	non-native	rare
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	uncommon
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Panicum maximum Jacq.	Guinea grass	non-native	common
Pennistum purpureum Schumach.	Napier grass	non-native	rare
Saccharum officinarum L.	sugar cane	Polynesian intro	abundant
Setaria verticillata (L.) P. Beauv.	bristly foxtail	non-native	uncommon
DICOTS			
ACANTHACEAE (Acanthus Family)			
Justicia betonica L.	white shrimp plant	non-native	rare
Thunbergia fragrans Roxb.	sweet clock-vine	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	Khaki weed	non-native	rare
Amaranthus spinosus L.	spiny amaranth	non-native	uncommon
Atriplex suberecta Verd.	saltbush	non-native	uncommon
Chenopodium carinatum R.Br.	keeled goosefoot	non-native	rare
ASTERACEAE (Sunflower Family)			
Bidens pilosa L.	Spanish needle	non-native	uncommon
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Emilia sonchifolia (L.) DC.	violet pualele	non-native	rare
Lactuca sativa L.	prickly lettuce	non-native	rare
Pluchea carolinensis (Jacq.) G.Don	sourbush	non-native	uncommon
Sonchus oleraceus L.	pualele	non-native	rare
Tridax procumbens L.	coat buttons	non-native	rare
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Xanthium strumarium L.	kikania	non-native	rare
BIGNONIACEAE (Bigonia Family)			
Spathodea campanulata P. Beauv.	African tulip tree	non-native	rare
BORAGINACEAE (Borage Family)			
Carmona retusa (Vahl) Masam.	Fukien tea	non-native	rare
Heliotropium procumbens Mill.	fourspike heliotrope	non-native	uncommon
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea triloba L.	little bell	non-native	rare
CURCURBITACEAE (Gourd Family)			
Momordica charantia L.	balsam pear	non-native	uncommon
EUPHORBIACEAE (Spurge Family)			
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	rare
Euphorbia heterophylla L.	kaliko	non-native	rare
Macaranga tanarius (L.) Mull. Arg.	parasol leaf tree	non-native	uncommon
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Family)			
Chamecrista nictitans (L.) Moench	partridge pea	non-native	rare
Crotalaria incana L.	fuzzy rattlepod	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	rare
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	rare
Indigofera hendcaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffructicosa Mill.	iniko	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	uncommon
Macroptilium atropurpureum (DC.) Urb.	siratro	non-native	uncommon
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	rare
Prosopis pallida (Humb.& Bonpl.ex Willd.) Kunth	kiawe	non-native	rare
LAMIACEAE (Mint Family)			
Hyptis pectinata (L.) Poit.	comb hyptis	non-native	rare
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malva parviflora L.	cheese weed	non-native	rare
Malvastrum cormandelianum (L.) Garcke	false mallow	non-native	rare
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Waltheria indica L.	'uhaloa	indigenous	rare
MYRTACEAE (Myrtle Family)			
Psidium guajava L.	common guava	non-native	rare
Syzygium cumini (L.) Skeels	Java plum	non-native	common
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Mirabilis jalapa L.	four-o'clock	non-native	rare
SOLANACEAE (Nightshade Family)			
Nicandra physalodes (L.) Gaertn.	Apple of Peru	non-native	rare
Nicotiana glauca R.C. Graham	tree tobacco	non-native	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	rare
Stachytarpheta cayyenensis (Rich.) Vahl	nettle-leaved vervain	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the 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

No mammals were seen during the course of the survey including two daytime visits and one evening visit. Lack of activity is due to the lack of moisture and the parched condition of most of the vegetation. The stream was dry and the cane fields were without irrigation water, part of the cane ripening process prior to harvest. Taxonomy and nomenclature follow Tomich (1986).

Mammals one would expect to find in this area would include eaxis deer (Axis axis), Rats (Rattus spp., mice (Mus domesticus), feral cats (Felis catus) and mongoose (Herpestes auropuntatus). All of these mammals are secretive and elusive and most of these with the exception of the mongoose are nocturnal in their activities.

A special effort was made to look for the native Hawaiian hoary bat by making an evening survey of the area. Focus was made on the Waikapu Stream area as this would be the most attractive habitat. When present in an area these bats can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the flow of twilight. No evidence of such activity was observed though visibility was excellent. In addition a bat detecting device was used, set to the frequency of 27,000 to 28,000 hertz which is the typical range within which these bats are known to function. No activity was detected using this device.

BIRDS

Birdlife was rather sparse on the project area and surroundings due to the dry summer conditions and the scarcity of food resources. Nine species of non-native birds were observed during three site visits to the area. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

<u>Spotted dove</u> (*Streptopelia chinensis*) – Many of these large doves were seen flying overhead toward a nearby cattle feedlot where food is plentiful.

<u>Zebra dove</u> (*Geopelia striata*) – Many of these small doves were also seen flying toward this feedlot.

<u>House finch</u> (*Carpodacus mexicanus*) – Several of these finches were seen in trees along the Waikapu Stream.

Common myna (*Acridotheres tristis*) – A few mynas were seen along this long corridor and during the evening in trees along the stream.

House sparrow (*Passer domesticus*) – A few sparrows were seen along this long corridor and during the evening in trees along the stream.

Northern cardinal (*Cardinalis cardinalis*) – A few of these red cardinals were heard calling from trees near Waikapu Stream during the evening.

Japanese white-eye (*Zosterops japonica*) – Three of these small green birds were seen in flight during the evening.

Red-crested cardinal (*Paroaria coronata*) – One of these bright red-headed birds was seen feeding in a clearing.

Black francolin (*Francolinus francolinus*) – One black francolin was flushed from the edge of a cane field where it had taken cover.

A number of other non-native bird species might be expected in this area and at different times of year. These include ethe gray francolin (*Francolinus pondicerianus*), cattle egret (*Bubulcus ibis*) and the northern mockingbird (*Mimus polyglottos*). Migratory Pacific golden-plovers (*Pluvialis fulva*) can be seen during the fall and winter months when they are here during their non-breeding phase. The indigenous black-crowned night-heron (*Nycticorax nytcicorax hoactli*) can often be seen along the stream fishing and roosting in trees when the stream is running.

INSECTS

While insects in general were not tallied, one native Sphingid moth, Blackburn's sphinx moth (*Manduca blackburni*), has been put on the federal Endangered species list and this designation requires special focus (USFWS, 2000). Blackburn's sphinx moth has been found in central Maui about two miles from this area. Its native host plants are species of 'aiea (*Nothocestrum spp.*) and a non-native alternative host plant is tree tobacco (*Nicotiana glauca*). There are no 'aiea on or near the project corridor, but about a dozen tree tobacco were found in the northern part of the corridor. Each of these shrubs was carefully examined and no Blackburn's sphinx moth or their larvae were observed.

Six endemic damsel flies (*Megalagrion spp.*) are candidates for the Endangered species list. One of these, (*Megalagrion xanthomelas*), could possibly occur in the habitat along Waikapu Stream, but due to the dry state of the stream, these running stream obligates cannot reproduce. None of these damselflies were seen.

CONCLUSIONS AND RECOMMENDATIONS

This proposed road corridor passes through a highly altered area which has been the focus of large scale agriculture for over 100 years. Only the narrow Waikapu Stream channel shows some resemblance of its original character.

No native bats were detected during the survey. This area does not represent good habitat for these bats. However, theses bats do occur in many parts of Maui and are known to be highly mobile both on a daily (nightly) basis and seasonally. They have been observed from sea level to high elevations. Their movements appear to coincide with surges in insect activities and are thus likely to be tied to food availability for the bats. While bats may occasionally pass through this area, there is little about the habitat that would be significant for them or merit any special management or protection.

Birdlife here, as well, is dominated by widespread introduced species that merit no special environmental protections. The habitat is unsuitable for Hawaii's native forest birds that are presently restricted to native habitats at higher elevations, beyond the range of mosquitoes that are carriers of lethal avian diseases for which these native birds have almost no resistance.

One indigenous waterbird, the auku'u or black-crowned night-heron, while not seen during the survey, often can be found in Waikapu Stream's forested channel when the water is running. They feed on mollusks, crustaceans and small fish. These birds are relatively common throughout Hawaii as well as in the Western USA and Mexico and carry no special protected federal status under the Endangered Species Act.

No Endangered Blackburn's sphinx moths or candidate damselflies were seen during the survey.

Thus, no Endangered or Threatened fauna were observed during the course of the survey. In fact, not any native fauna at all were seen. The habitat is highly altered from its original state and does not support any vegetation associations conducive to the presence of any protected fauna.

As a result of these findings it is determined that there is little of environmental concern with regard to animal life within the proposed road corridor. The road construction project is not expected to have a significant negative effect on the fauna resources in this part of Maui.

While no protected seabirds were found on the property, the 'ua'u and 'a'o are known to overfly the area at dawn and dusk to their burrows high in the mountains between the months of March and November. In late fall young birds fledge from their burrows to take their first tentative flights out to sea. These inexperienced birds are easily confused and distracted by bright lights and often crash to the ground where they are particularly vulnerable to being run over by vehicles or killed by predators.

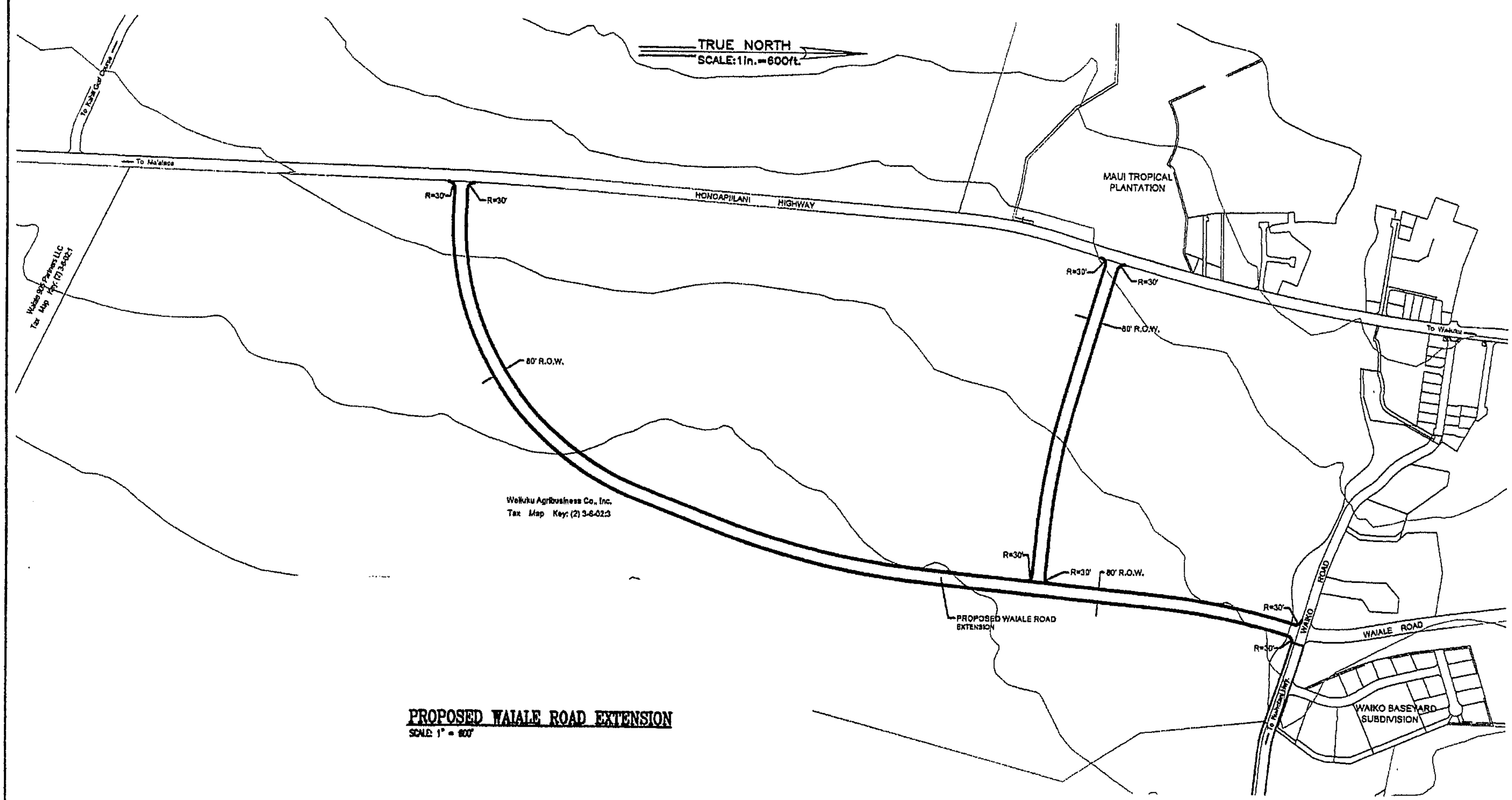
It is recommended that any significant outdoor lighting such as street lights or flood lights that are incorporated into the project design be shielded to direct the light downward so that it is not visible from above.

ANIMAL SPECIES LIST

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

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:
   - endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   - indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   - non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
   - migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.
4. Abundance of each species within the project area:
   - abundant = many flocks or individuals seen throughout the area at all times of day.
   - common = a few flocks or well scattered individuals throughout the area.
   - uncommon = only one flock or several individuals seen within the project area.
   - rare = only one or two seen within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
BIRDS			
Spotted dove	*Streptopelia chinensis*	non-native	common
Zebra dove	*Geopelia striata*	non-native	common
House finch	*Carpodacus mexicanus*	non-native	uncommon
Common myna	*Acridotheres tristis*	non-native	uncommon
House sparrow	*Passer domesticus*	non-native	uncommon
Northern cardinal	*Cardinalis cardinalis*	non-native	uncommon
Japanese white-eye	*Zosterops japonicus*	non-native	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Black francolin	*Francolinus francolinus*	non-native	rare



PRELIMINARY ALIGNMENT EXHIBIT

WAIALE ROAD EXTENSION

WAIKAPU, MAUI, HAWAII

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS • HONOLULU, WAILUKU, HAWAII

PROPOSED WAIALE ROAD EXTENSION

EXHIBIT 1

JOB NO. M-08-557
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JUNE 2008

Figure 2 View east from Maui Tropical Plantation intersection
Across newly planted sugar cane field

Figure 3 Waikapu Stream corridor, dry rocky stream bed

Figure 4 Waikapu Stream corridor, densely wooded section
near proposed bridge

Figure 5 Vacant land section south of Waikapu Stream corridor along
proposed route

Figure 6 Proposed route south of Waikapu Stream crossing recently harvested and replanted sugar cane.

Figure 7 Southern end of proposed route crosses sugar cane lands

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APPENDIX F.

Archaeological Inventory Survey

SCS Project Number 1008-3

ARCHAEOLOGICAL INVENTORY SURVEY REPORT FOR THE WAI`ALE ROAD EXTENSION AND WAIKO ROAD IMPROVEMENT PROJECT IN WAIKAPŪ AHUPUA`A, WAILUKU DISTRICT, MAUI ISLAND, HAWAI`I [TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003 and 3-8-005:999]

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ABSTRACT

Scientific Consultant Services, Inc. (SCS) conducted an Archaeological Inventory Survey on an approximate 2.5 kilometer long corridor of the proposed Wai`ale Road extension and 1.3 km long by 20 meter wide (6.5 acres) corridor of the proposed Waiko Road improvement project in Waikapū Ahupua`a, Wailuku District, Maui Island, Hawai`i [TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003 and 3-8-005:999]. The Inventory Survey consisted of a 100% pedestrian survey and the excavation of 64 backhoe trenches within the project area. The extensive subsurface testing failed to yield any traditional Hawaiian or historic era cultural layers, features or materials.

One site was documented during the pedestrian survey portion of the Inventory Survey. The site (SIHP No. 50-50-04-6668) consisted of an historic boulder terrace located on the south bank of Waikapū Stream. It is believed that the terrace represents either a water diversion feature or possibly a footing for a former footbridge. No soil or sediments were observed within the site.

Site -6668 was assessed as significant under Criterion D of Hawai`i's State Historic Preservation criteria. Based on the results of this survey and depth of documentation, the site has yielded all potential information important to this historic period. No additional archaeological mitigation is recommended within the project area.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Scientific Consultant Services, Inc. (SCS) conducted Archaeological Inventory Survey on an approximate 2.5 kilometer long corridor of the proposed Wai`ale Road extension and 1.3 km long by 20 m wide (6.5 acres) corridor of the proposed Waiko Road improvement in Waikapū Ahupua`a, Wailuku District, Maui Island, Hawai`i [TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003 and 3-8-005:999] (Figures 1 and 2). The proposed Wai`ale Road extension will extend across Waiko Road and through existing sugarcane fields, conjoining with Honoapi`ilani Highway south of Maui Tropical Plantation. The proposed Waiko Road improvement project includes the portion of the road extending from Kuihelani Highway to Wai`ale Road. The Inventory Survey included historic background research and settlement pattern analysis prior to fieldwork, a complete pedestrian survey of the project area, representative subsurface testing via backhoe, and reporting of findings.

Fieldwork was conducted between August 3, 2009 and August 14, 2009 by SCS personnel David Perzinski, B.A. and Brian Armstrong, B.A. under the overall direction of Principle Investigator Michael Dega, Ph.D. Only one site was documented during this project, through both intensive survey and testing.

Archaeological Inventory Survey of the project area was conducted to determine the presence/absence of archaeological deposits in surface and subsurface contexts through complete systematic survey and representative subsurface testing. The ultimate goals were to determine if historically significant archaeological sites occurred on the parcel and to provide recommendations to the State Historic Preservation Division (SHPD) concerning site mitigation during future land use of the project area.

ENVIRONMENTAL SETTING

LOCATION

The project area lies immediately southeast of Waikapū town, at the base of the West Maui Mountains. The Wai`ale Road extension is proposed to extend across Waiko Road and Waikapū Stream, crossing active sugarcane fields and tying into Honoapi`ilani Highway approximately 1.25 km south of Maui Tropical Plantation and just east of Kāhili Golf Course. The Waiko Road improvement extends from Wai`ale Road to Kuihelani Highway (a distance of approximately 1350 m).

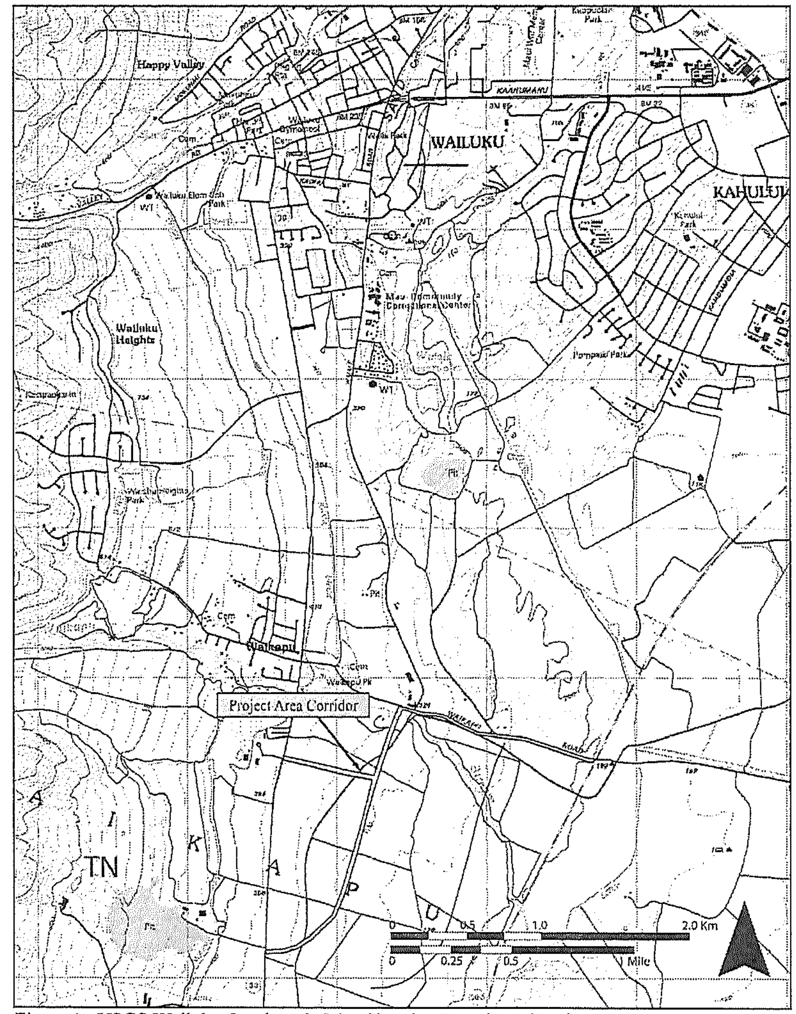

Figure 1: USGS Wailuku Quadrangle Map Showing Location of Project Corridor.

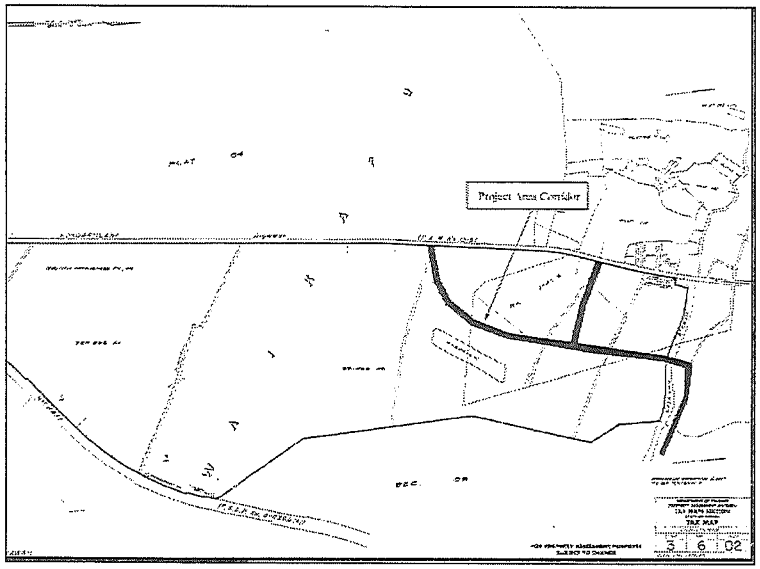

Figure 2: Tax Map Key [TMK (2) 3-6-02] Showing Project Area.

VEGETATION AND SOILS

Vegetation in the project area is dominated by cultivated sugarcane (*Saccharum officinarum*). Along Waikapū Stream, vegetation includes elephant grass (*Pennisetum purpureum*), *Haole koa (Leucaena leucocephala)*, and java plum (*Syzygium cumini*). Native vegetation was not documented within the project area.

According to Foote *et al.* (1972:46–47, 100), soils in the project area consist of ʻĪao cobbly silty clay (IcB) and Pulehu cobbly silt loam (PrB) along the Waiʻale Road corridor and . Puuone Sand (PZUE), Jaucus Sand (JaC), Pulehu Clay Loam (PsA) and Ewa Silty Clay Loam (EaA) along Waiko Road. ʻĪao cobbly silty clay is characterized by 3 to 7 percent slopes. These soils are typically "well-drained soils on valley fill and alluvial fans. These soils developed in alluvium derived from basic igneous rock." (*ibid.*:46). Pulehu cobbly silt loam are part of the Pulehu series and "consist of well-drained soils on alluvial fans and stream terraces and in basins." (*ibid.*: 115). Along Waiko Road, a more diverse series of soils exist including Puuone Sand that is found on "sandhills near the ocean… the surface layer is grayish brown, calcareous sand about 20 inches thick. This is underlain by grayish-brown, cemented sand" (*ibid.*:117). Jaucus Sand and clay loam are also noted as being extant along the corridor. Jaucus sands are present on all of the islands and are noted for their association with traditional Hawaiian burials.

CLIMATE

Rainfall in this intermediate environment is very modest. The project area receives an average annual rainfall of only 33 to 44 centimeters (Price 1983:63), with much of this rainfall occurring during the winter months (November–April). Seasonal variation in rainfall amount follows normal orographic patterns for leeward-type areas of Maui. The project area occurs just to the south of what may be considered the leeward-windward boundary. At higher elevations within Wailuku Ahupuaʻa, the amount of rainfall doubles and triples that of the project area. To the north, from ʻĪao Stream Valley area toward Waiheʻe Valley, rainfall is much more intensive, with combined rainfall and geographic patterns being more conducive to traditional types of agricultural cultivation (*i.e.*, *loʻi*, sweet potato). The rainfall in this gently sloping project area drains downhill to the east and provides an additional water source for traditional Hawaiian agriculture in the lowland flats to the east of the project area (see Handy and Handy 1972).

HISTORICAL BACKGROUND

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 1969, Vol. 6:248]). Land was considered the property of the king or *ali`i `ai moku* (the *ali`i* who rules 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`āina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua`a*) that 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 next in importance to the *ahupua`a* and were administered by the chief who controlled the *ahupua`a* in which it was located (*ibid*:33; Lucas 1995:40). The *mo`o`āina* were narrow strips of land within an *`ili*. The land holding of a tenant or *hoa `āina* residing in an *ahupua`a* was called a *kuleana* (Lucas 1995:61). The project area is located in the *ahupua`a* of Waikapū, which translated means literally "water [of] the conch" and refers to a shell located in a cave that could be heard everywhere in the Hawaiian Islands until it was stolen by a supernatural dog named Puapualenalena (Pukui *et al.* 1974:223).

MYTHOLOGICAL AND TRADITIONAL ACCOUNTS

Wailuku District, is frequently mentioned in historical texts and oral tradition as being politically, ceremonially, and geographically important during traditional times (Cordy 1981, 1996; Kirch 1985). Wailuku was considered a "chiefly center" (Sterling 1998:90) with many of the chiefs and much of the area's population residing near or within portions of `Īao Valley and lower Wailuku. The importance of the district is reflected by the relatively large number of *heiau* that were reportedly present in pre-Contact times. Oral tradition accounts surrounding these *heiau* provide examples of how religion tied into political power in the traditional Wailuku setting. Indeed, the period immediately preceding contact with the Europeans was one of considerable upheaval and conflict. *Wailuku*, meaning 'water of destruction,' succinctly

describes the area in the late 1700s. Political power emanating from Moloka`i was an active element during the mid-eighteenth century. The resulting battle at Kalae`ili`ili (A.D. 1765) led to the expulsion of Ke`eaumoku and the Moloka`i *ali`i* and the beginning of Kahekili's reign (Kamakau 1992). Kahekili successfully defended his capital in Wailuku throughout the 1770s, until his defeat at the hands of Kamehameha's forces.

Wailuku District inhabits the eastern side of the West Maui Mountains (Mauna Kahalawai) and occupies the isthmus through the center of the island to coastal reaches in Kahukui and Mā`alaea. Wailuku, together with Waikapū, Waihe`e, and Waiehu, is one of the *Na Wai `Ehā*, or "the four waters," known for the occupancy of chiefly individuals (Kame`eleihiwa 1992; Pukui and Elbert 1992; and Creed 1993). The many *heiau* constructed in the Wailuku area indeed point to its ceremonial and religious importance during pre-Contact times.

Although it has been said that Waikapū Valley contained "many temples and sites", most of their locations were not recorded (Ashdown 1970:58). Thrum refers to a *heiau* that was reportedly located on Pu`u Hele, but he did not confirm this (1917). Thrum also mentions two *heiau* located below the road but again, they were not investigated and their name and function had been lost (1916). One *mo`olelo* recounting the origin of its name was published in *Ka Nupepa Kuokoa* in 1872:

> This place, Waikapu, has a cave away up the stream, about a mile or more from the village. On the left side of the stream is a cave and in the cave was the conch. It sounded all the time, unseen by the public, but a prophet of Kauai listened for it and came to seek with the idea of finding it.
>
> On the northeast side of that stream on the opposite side of the conch that sounded, on the cliff, was a dog named Puapualenalena. Because he feared it, he sought diligently to find it but he did not succeed. Those who guarded the conch were very watchful. The dog kept studying ways of obtaining it.
>
> The owners of the conch did not believe, perhaps, that any supernatural being would succeed in taking it away, so they tried to be a little careless. It was not taken, but on the day that Puapualenalena did get it away, they had been utterly careless. After he took it, it sounded no more to this day. It used to be heard every where in these islands and was annoying to some people. From this conch, the whole of the place was named Waikapū (Water of the Conch). This is the legend of how it received its

> name and is a place much visited by strangers who wish to see it (W.K. Kualililehua in Sterling 1998:93).

At the traditional boundary of Wailuku and Waikapū sits a rock known for its excellent properties. A story of its significance was told by Moses Manu and recorded in *Ka Nupepa Kuakoa* and reprinted in Sterling (1998:94):

> As Kihapiilani and his wife traveled on, they saw many people filling the road. At the stream of Wailuku *[Waikapu?]* the people were innumerable. Said the wife to the chief, "What are these people doing who are congesting the road?" Kihapiilani said, "It would seem that it has to do with adzes."
>
> When they arrived at this place, they decided to go on from the place where it was so crowded with people. There was a huge rock directly above the stream of Waikapu, mauka of the road which still passes at this time. This adze rock is the boundary between Wailuku and Waikapu and it remains there until this day.

Oral traditions preserved by Fornander (1969) and Kamakau (1963) contribute to our knowledge of Waikapū. The battle of Ahulau ka piipii i Kakanilua featuring the elite `Ālapa warriors of Kalaniopu`u was fought in 1776 on the sand hills southeast of Wailuku:

> ...Taking part of his forces around by water, *Kalaniopuu* landed again at Kiheipukoa, near the Kealia or salt marsh between Kalepolepo and Maalaea...The detachment or regiment known as the *Alapa*, mustering eight hundred men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, now known as the Waikapu common, determined, as the legend says, "to drink the waters of the Wailuku that day." This regiment was considered the bravest and best of *Kalaniopuu's* army, every man in its ranks being a member of "*la haute noblesse*" of Hawaii. They are said to have all been of equal stature and their spears of equal length; and the legend represents their appearance-with their feather cloaks-reflecting the sunshine and the plumes of their helmets tossing in the wind-as a gorgeous and magnificent spectacle...Offering no resistance to the enemy while crossing the common, *Kahekili* distributed his forces in various directions on the Wailuku side of the common, and fell upon the Hawaii *corps d'arnée* as it was entering among the sandhills south-east of Kalua, near Wailuku. After one of the most sanguinary battles recorded in Hawaiian legends and deeds of valor ...the gallant and devoted Alapa were literally annihilated; only two out of the eight hundred escaped alive to tell Kalaniopuu of this Hawaiian Balaclava...[Fornander 1969:153].

In a similar version, Kamakau recounts:

> ...The Alapa were led by Inaina, Kua`ana, Kane-ha`i-lua, and Keawe-hano. There were 800 of them, all expert spear-point breakers, every one of whose spears went straight to the mark, like arrows shot from a bow, to drink the blood of a victim. Across the plains of Pu`u`ainako and Kama`oma`o shone the feather cloaks of the soldiers, woven in the ancient pattern and colored like the hues of the rainbow in red, yellow, and green, with helmets on their heads whose arcs shone like a night in summer when the crescent lies within the moon...Said Ka-leo-pu`upu`u to Kahekili, "the fish have entered the sluice; draw in the net." Like a dark cloud hovering over the Alapa, rose the destroying host of Ka-hekili seaward of the sandhills of Kahalu`u, the "smoke head" (*po`ouahi*) and the "red coconut" (*niu`ula*) divisions. They slew the Alapa on the sandhills at the southeast of Kalua. There the dead lay in heaps strewn like *kukui* branches; the corpses lay heaped in death; they were slain like fish enclosed in a net. This great slaughter was called *Ahulau ka Pi`ipi`i Kakanilua*...[1963:65–86].

PRE-CONTACT TO 1800 IN WAIKAPŪ AHUPUA`A

Where Waikapū Stream exits the valley and begins its journey across the isthmus of Maui, major alterations to the pre-historic landscape by agricultural activities has left little in the way of surface archaeological deposits. Despite the paucity of evidence of pre-Contact land use, traditional accounts, LCA testimonies and the limited sites that have been documented point to an area "anciently developed in terraced taro culture" (Handy and Handy 1972:497).

Creed (1993) has written extensively on the traditional background of the Waikapū area, much of which directly applies to the open landscape of the current project area just to the north of Waikapū. Many classes of sites are found or may have existed in the Waikapū-Wailuku area during traditional times. Creed (1993:19–21) provides an extensive list, including some site types that would not apply to the current parcel due to its distance from major drainages, the coastline, and its open land classification. Traditional sites that would apply include agricultural sites (*kula* lands, *wauke* patches, *hala* trees, pigs, and potato patches), boundary walls, burials (sometimes located in habitation terraces), feather gathering areas (particularly in the mountains to the west), habitation loci, and *pohaku* (an adze stone marks the border between Wailuku and Waikapū).

Handy and Handy (1972) describe Waikapū as the last of "The Four Streams" and, "from the base of Waikapū to a considerable distance below the valley are the vestiges of extensive wet-taro plantings, now almost obliterated by sugar-cane cultivation" (Handy and Handy 1972:497).

While populations were predominantly centered in `Īao Valley and Waikapū Valley, there was agricultural and habitation activity in the open grasslands of the current project area above the coastal flats. Much evidence for such activities has not yet been found through archaeological means, a situation that places much culpability on historic land use that may have erased or scattered this evidence. As such, there is much more evidence for historic activities occurring in the area.

THE GREAT MÀHELE

In 1848, during the late historic period, commissioners of the Great Māhele instigated an extreme modification to traditional land tenure on all islands that resulted in a division of lands and a system of private ownership. The Māhele was based upon the principles of western law. While 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 society to that of a market economy (Kuykendall Vol. I 1938:145 footnote 47 *et passim*; Daws 1968:111; Kame`eleihiwa 1992:169–170, 176).

Once lands were made available and private ownership was instituted, native Hawaiians, including the *maka`āinana* (commoners), were able to claim land plots upon which they had been cultivating and living. Oftentimes, foreigners were simply just given lands by the *ali`i*. However, in the case of commoners, they would only make claims only if they had first been made aware of the foreign procedures (*kuleana* lands, land commission awards). These claims could not include any previously cultivated or currently fallow land, *okipu*, stream fisheries, or many other natural resources necessary for traditional survival (Kame`eleihiwa 1992:295; Kirch and Sahlins 1992). Awarded parcels were labeled as Land Commission Awards (LCAs). If occupation could be established through the testimony of witnesses, the petitioners were issued a Royal Patent number and could then take possession of the property. Commoners claiming house lots in Honolulu, Hilo, and Lāhainā were required to pay commutation to the government before obtaining a Royal Patent for their awards (Chinen 1961:16).

Wailuku District was declared Crown Land during the Great Māhele and numerous Land Commission Awards, approximately 180, were awarded within Wailuku Ahupua`a while approximately 100 were awarded for Waikapū Ahupua`a (Creed 1993). A handful of foreigners (*i.e.*, Anthony Catalena, James Louzada, E. Bailey) gained control of large parcels of lands that

would later be used for mass cultivation of sugarcane. Significantly, the majority of LCAs were awarded to Hawaiians, a gauge that can be used to measure pre-Contact settlement, since there was little overall change in traditional land use among Hawaiians prior to 1853 (Creed 1993:38).

Similarly, the Wailuku Ahupua`a parcel north of Kuikahi Drive predominantly lists among its LCA records 'property for raising cattle' and 'pasture grounds for cattle' (Dega 2004). There also is some mention of stone walls, *kalo* patches, and *lauhala* trees on the landscape. Perhaps the most significant structures on this adjacent land were built by the American Board of Commissioners for Foreign Missions (A.B.C.F.M.) which consisted of two house lots with adobe walls. The lots occurred "near pasture land," a common theme for the area (Waihona `Aina 2005). In Waikapū, the LCAs reflect *lo`i* cultivation, *kula* lands, and house sites. However, much or all of the evidence related to such settlement of the Waikapū area has been effaced by late-historic and modern cultivation. The current project area is a prime example of this trend.

1850'S TO PRESENT IN WAIKAPŪ

Another influence that brought change to Maui was foreign commercialism. Two Chinese brothers, Ahung and Atai, of Honolulu's Hungtai Company arrived in Wailuku in 1828 to explore the possibility of setting up one of its earliest sugar mills. Atai soon created a plant that processed sugarcane 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. In 1862, The Wailuku Sugar Company was established and would expand sugar production over the next 126 years of its existence (4,450 acres by 1939), still more than three decades before its maximum production levels.

As it expanded its territory, the Wailuku Sugar Company first appeared on maps in the area in the in the 1920s although their acquisition of land south of the project area land may have been as early as the turn of the century (Kennedy and Trimble 1992:4). On November 18, 1875 Henry Cornwell, through Grant 3152, acquired Waikapū Ahupua`a from the state government (ibid.1992). Hawaiian Reports, 4:248 in Sterling (1998:95) contains the following passage entitled the "Opinion of the Court by McCully, J., in the Matter of the Boundaries of Pulehunui (from) which discusses the acquisition of Waikapū from the state government:

> The land of Waikapu, belonging to the Government, was set over to the Department of Education. There is in the office of the Department a map of Waikapu, and survey notes on separate paper taken to refer to it. The notes and the names written on the map

> were in the handwriting of one J.W. Marsh, deceased, who had been a clerk in this Department...

In 1875 the Board of Education sold at auction the "Land known as the ahupua'a of Waikapū, saving grants hitherto made within said ahupua'a, or sales by the Board of Education," to Henry Cornwell, the Government issuing a royal patent in the above terms without survey or statement of area. Mr. Cornwell afterward sold to Claus Spreckels and others the part known as Waikapū Commons. By the turn of the century, a large portion of Waikapū, was under sugarcane cultivation. Wailuku Sugar Company ended production in 1988, having averaged over 30,000 tons of sugar produced annually at its pinnacle in the 1970s (Dorrance and Morgan 2000:66). Owner C. Brewer & Company, Ltd. shut down sugar cultivation, which was then used almost entirely for pineapple cultivation starting no later than 1992 (Kennedy and Trimble 1992:1). The lands were under pineapple for at least the next three years (Tomonari-Tuggle 1991:11) (and probably slightly longer) before transitioning to smaller-scale "garden" plots.

Land use in Wailuku and Waikapū Ahupua'a in the mid to late 19th was largely devoted to the sugar industry. During the 1860s, the sugar business was growing, with plantations and mills at Wailuku, Waihe'e, Waikapū, and Haiku. Many of the plantation camps associated with these mills were centered in the Pu'unene, Kahului, and Wailuku area (see Denham *et al.* 1992:16). Historic utilization of the Waikapū-Wailuku landscape within and near the project area focused on industrial-levels of cultivating sugar cane and pineapple. Water was channeled from traditional sources (*e.g.*, Waikapū Stream, western aquifers or springs) through plantation lands. Both local and imported workers operated on these plantation lands and the area maintained fair population density. Evidence for expansive landscape modifications to accommodate the industrial-level of production is very evident across the current subject parcel in the form of the north-south oriented known historic ditches.

The large scale agricultural endeavors that began in the 19th century in Wailuku and the present project area continue through today. A vast majority of the project area corridor is under sugar cane cultivation or has been dramatically altered by road grading activities effectively erasing any potential surface sites that may have existed prior to pre-Contact or early historic times.

PREVIOUS ARCHAEOLOGY

Multiple archaeological surveys have occurred within and near the current project area (Figure 3). Early work in the region primarily concentrated on known *heiau*. Thrum (1909) conducted the first archaeological survey within Wailuku Ahupua'a. Thrum (1909) first identified the much investigated Halekii and Pihana Heiau. In addition to Thrum's work at the monumental structures, Stokes mapped the site in 1916. Walker also recorded the site in 1931 after his island-wide survey of Maui in which he identified many *heiau* within Wailuku Ahupua'a. Kenneth P. Emory in 1959 was the next archaeologist working at that particular site. During his time he reconstructed portions of Haleki'i and rendered another map of the *heiau*. The most recent work at the site was conducted by Yent (1983, 1984, 1995) who undertook systematic survey, mapping, and excavations as part of a restoration plan. Yent's (1995) work yielded plan views of the site and detailed profiles of the *heiau*, as well as revealed construction techniques utilized to build the features.

In 1989 PHRI conducted an archaeological inventory survey of over 600 acres within the Waikapū Mauka Partners Golf Resort located to the north of the current project area (Brisbin *et al.*1991). The report documenting the findings of this survey (Haun 1989 in Brisbin *et al.* 1991) does not appear to be available to the public at this time. Based on the findings and recommendations of Haun's Inventory Survey, Archaeological Data Recovery was subsequently conducted of the nine sites (comprised of over 46 features) newly identified during the initial survey report (Haun in Brisbin *et al.* 1991). These nine sites indicated that this area was utilized for extensive traditional dryland agriculture with limited habitation and some historic ranching activities. The findings of this survey indicate that only a few habitation sites were located below 500 feet amsl and that the agricultural sites were "continuously distributed" throughout the project area.

During 1989 and 1990, Archaeological Consultants of Hawaii (ACH) conducted archaeological inventory survey of the lands immediately adjacent and *mauka* (west) of the above-mentioned PHRI project area (Kennedy 1991). During this survey a total of 18 sites, comprised of 74 features, were newly identified. These sites also indicated that the area was primarily utilized for traditional agriculture, although there was some evidence of limited habitation, including burials, and ceremonial use.

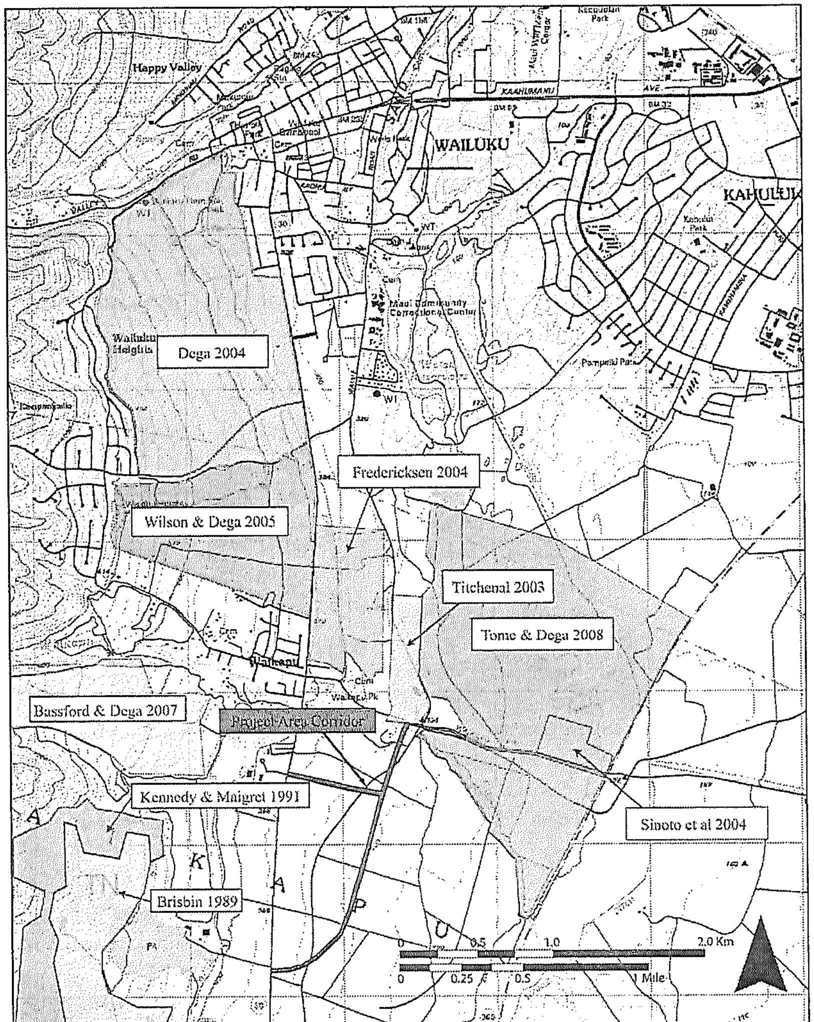

Figure 3: USGS Map Showing Locations of Previous Archaeological Studies in the Vicinity of the Project Area.

Kennedy concluded that these sites can only be a continuation of the occupation described by Brisbin *et al.* (1991). Five charcoal samples collected from test excavations of several of the features were submitted for radiocarbon dating. These samples yielded dates ranging from A.D. 1040 through 1950.

Archaeological Inventory Survey was conducted on approximately 100 acres of land that included five separate lots and a proposed road corridor in the Kehalani Mauka Subdivision (Dega 2003). Three historic sites were documented during this Inventory Survey. State Site Number 50-50-04-5473 has been assigned to Hopoi Reservoir. This reservoir predates Hopoi Camp and was present at least by 1922 (see Dega 2003). Occurring to the immediate east of Hopoi Reservoir and running north-south to Waikapū is Kama Ditch (State Site No. 50-50-04-5474), a water conduit carrying the precious commodity to dry southern lands. A single basalt adze (Site 50-50-04-5478) was recovered from the northern flank of Lot 21 along the eastern flank of the parcel. Extensive survey and testing in the area of the isolated find failed to produce additional artifacts or cultural deposits. Representative subsurface testing (18 trenches) on the lots only revealed highly homogenous soil matrices across the open, barren intermediate area.

A second SCS Inventory Survey Report dealing with these same Kehalani Mauka lands (Dega 2004) documented lots not surveyed in the first study. This survey recorded six additional sites, all historic. Similar to the present project area, a series of un-named, lesser ditches was found within Kehalani Mauka, represented by State Site Numbers 50-50-04-5490 and 50-50-04-5493. Waihe`e Ditch (Site -5197) flows from this former SCS project area into the present project area. Historic-modern roadways (50-50-04-5489), a historic surface artifact scatter (50-50-04-5491), and several plantation-era clearing mounds (50-50-04-5492).

In summary, the results of the Kehalani Mauka Subdivision Inventory Survey roughly duplicate the present project area's findings. Aside from a lone traditional artifact (an adze), which could remain despite a century of cultivation, larger traditional sites were destroyed during the sugar-era.

Sinoto and Titchenal (2003) conducted Archaeological Inventory Survey for the proposed Phase VII Residential Project of the Maui Lani Development Area in which 15 trenches were excavated via mechanical means. The results of this project were also negative.

Following an Archaeological Inventory Survey of approximately 100-acres in 2003 of Tax Map Keys: (2) 3-8-7: 101 (POR.) and 3-5-02: 01 (POR.), Fredericksen (2004) recommended a section of the Kama Ditch (found during the survey) for preservation. Although abandoned an estimated 30 years prior to the survey, the non-functional ditch was identified as having historic associations with the plantation-era.

A revised Archaeological Inventory Survey by Sinoto *et al*. (2004) on TMK: (2) 3-8-07:89 & 102 (POR.) did not reveal the presence of extant archaeological sites on an approximately 30-acre project area situated between the two main parts of the current project area. The surface survey was supplemented by eight mechanically excavated trenches and it too, did not reveal the presence of subsurface archaeological deposits. Approximately 75% of the survey area of TMK: (2) 3-8-07:89 & 102 (POR.) had been previously impacted due to mechanical means.

Wilson and Dega (2005) conducted an Archaeological Inventory Survey on TMK: (2) *3-5-02: 02 and* 03 within the Waikapū Ahupua`a and recorded seven archaeological sites associated with plantation/historic times: Waihe`e Ditch (State Site 50-50-04-5197); Waikapū Ditch (50-50-04-5493); an un-named, lesser ditch (50-50-04-5729); a second un-named, lesser ditch (50-50-04-5726); a large, un-named reservoir (50-50-04-5727); a series of fourteen sugarcane-field erosion-control, soil berms (50-50-04-5728); and a County dirt road named "Old Waikapū Road" (50-50-04-5730). No traditional Hawaiian sites were found in this project area.

Bassford and Dega (2007) conducted an inventory survey of 208 acres of land just west of the current project area. No significant surface or subsurface cultural deposits or human remains were observed. Some modern materials associated with recent land use practices of commercial sugarcane cultivation, including plastic, black irrigation hosing, concrete aggregate chunks, were noted. As a result, no further work is recommended for the project area.

Bassford and Dega (2007) conducted Archaeological Inventory Survey of TMK: (2) 3-6-04: 03 (POR.) and 06 (POR.). The project yielded only negative results for any surface features, subsurface cultural deposits, or human remains. Some modern materials were observed in many of the trench profiles (*e.g.*, plastic, black irrigation hosing, concrete aggregate chunks) and were interpreted as remnants of the previous land use practices of commercial sugarcane cultivation in the area.

Tome and Dega (2008) conducted an inventory survey just northeast of the current study parcel and inclusive of the portion along Waiko Road. Two previously recorded archaeological sites were re-located in the project area: a portion of the Spreckels Ditch (State Site 50-50-04-

1508) and the location of a single, *in situ* human burial (State Site 50-50-04-5504). Only one new archaeological site was identified during the current Inventory Survey and consisted of a subsurface firepit/*imu* that was subsequently assigned State Site No. 50-50-04-6578. A total of 201 mechanically excavated trenches and five manually excavated units were placed throughout the project area. While 200 of the trenches and manual test trenches yielded negative results, one trench (ST-90) revealed the presence of Site -6578, a subsurface fire put/*imu*. Overall data derived from stratigraphic analysis indicated a large number of ground alteration events through use of the lands for industrial agricultural production (*e.g.*, sod farming, sugarcane), as well as natural processes (*e.g.*, flooding and deposition via upslope runoff). The manual excavation of stratigraphic trenches in the immediate vicinity of Site -5504, did not reveal additional human remains or associated cultural deposits.

SETTLEMENT PATTERN

Archaeological investigations within the currently studied portion of Wailuku-Waikapū have revealed relatively little regarding traditional settlement patterns due to the dearth of supporting empirical evidence. Archival research and analyses of the generalized settlement pattern for Wailuku District, however, have been the foremost sources for discerning an established settlement pattern for the current project area.

Archaeological evidence suggests that early settlement in the Hawaiian Islands occurred along windward shoreline areas between the A.D. 4th and 11th centuries. Pollen evidence suggests a settlement date of the A.D. 9th century (see Athens 1997). For the most part, these populations used local resources and seldom ventured into upland valleys. Cordy (in Creed 1993) suggests, however, that upper valley areas on windward coasts were likely populated before the A.D. 1100s. Coastal settlement was still dominant, but populations began exploiting and living in more upland *kula* zones. Greater population expansion to inland areas did not occur until the *c.* A.D. 12th century but continued through the 16th century. Large scale or intensive agricultural endeavors were implemented in association with habitation. Coastal lands were used for settlement and taro was cultivated in near-coastal reaches and in the uplands. Upland areas of Maui such as the Waiohuli-Kula area contained large garden enclosures, ceremonial structures, and permanent habitation sites by *c.* A.D. 1600.

Nearer the coast in intermediate lands such as the current project area (*c.* 60–85 meters amsl), taro was cultivated along stream courses, dryland taro was grown on *kula* lands such as the project area, and populations were settled. It is possible that the *kalo* patches described in the aforementioned LCA accounts originated during the "Expansion Period" of A.D. 1400 to 1600, perpetuating through historic times (Kirch 1985). However, most of the LCAs for the area describe almost no cultivation occurring in the area during the 1850s as pasture land and sugar cane cultivation were already dominating the use of the land (Creed 1993:74). Primary settlement and resource zones lay outside the current medial environmental zone in Wailuku proper, near perennial water sources (`Īao Valley, Waihe`e, Waiehu). The only substantial settlement along this medial isthmus zone between 300 and 600 feet amsl was at Waikapū, to the north of the current project area, near the base of Waikapū Stream Valley (see Creed 1993). As the current project area does not contain a perennial water source and is primarily open grassland, the area is considered to lie at the periphery of the more resource-rich zones in Wailuku.

Historic utilization of the Wailuku-Waikapū landscape was dominated by the cash cropping of sugar cane and pineapple, made possible by water channeled from traditional sources (*e.g.*, Waikapū Stream) through plantation lands. Historic features associated with this period are represented as water features in the form of reservoirs (Hopoi Reservoir) and water channels (Waikapū Ditch, Waihe`e Ditch). This area was also an important transportation corridor linking both the south and north flanks of the Maui isthmus, with Honoapi`ilani Highway having been demarcated as a Government Road on area maps by 1882 (Creed 1993:20).

PROJECT AREA EXPECTATIONS

Prior to commencing archaeological fieldwork, a review of archival resources and the results of previous archaeological work conducted in the area was undertaken to assess possible findings during fieldwork. Based on previous archaeological work near the project area and on LCA information, site patterns prior to intensive historic land alteration activities show systematic use of the terrain as taro planting areas, limited habitation, and divisions of pastureland. Previous archaeological investigations within this portion of the Wailuku-Waikapū corridor have revealed very little data to confirm these patterns, this not surprising considering the impact that long and intensive agricultural exploitation has had on the surface of the area and subsurface strata. Traditional site components expected prior to these land-altering activities consist of dryland taro patches, associated agricultural components such as *`auwai* and/or terracing, house sites, boundary walls, and pasture walls. Expectations for identifying such data sets were low, however, due to the aforementioned historic land uses.

Traditional sites that may once have been present within the current project area were not expected to remain unaltered. Given LCA testimony and general settlement patterns for this inland, intermediate area, land use patterns for the current project area were thought to be most

obviously related to historic-period settlement and cultivation—but on a very limited scale. At present, an empirically-based chronology of this area has yet to be provided, given intensive historic land modifications and the lack of datable archaeological evidence. According to Creed (1993:77):

> . . . we have no carbon dates to indicate the possible beginnings for this wetland agriculture in Waikapū Valley. Moreover, this area has been in constant use for crops and habitations at least since the time of the *Māhele*, if not long before and modern uses may have destroyed all traces of prehistoric uses. However, the LCA records and early maps document the extent of the *lo`i* agriculture in the 1850s. The stream valley in its upper reaches may have some remnants of these *Māhele* period *lo`i* or *`auwai.*

Expectations for this project area rested on several assumptions, some of which were proven valid at the end of fieldwork. First, the project area, lying in an open, intermediate zone containing hard soil composed of silty clay with cobbles was not intensively occupied during traditional times. Traditional and early historic-period populations were focused elsewhere in areas such as Waikapū, `Īao Valley, Waihe`e Valley, and Waiehu Valley. Thus, there were low expectations for identifying larger, intact sites or deposits; they simply were not constructed in this area. Secondly, there was the possibility that sand sediment could be present along the eastern flank of the project area. The association of sand and traditional/historic burials and cultural deposits has been well documented (see Kirch 1985). Thus, if sandy deposits did occur along the eastern flank, cultural deposits could be present. Third, the area was heavily modified for industrial cultivation. Based on the primarily negative results from other archaeological projects conducted along the intermediate Wailuku-Waikapū corridor, there were limited expectations for identifying intact traditional-period architectural structures or intact cultural deposits lying beneath the tilled surface. However, historic structures related to irrigation and were likely, considering they were previously documented near the parcel (see Dega 2003). In all, some of these expectations were met during the current study.

METHODS

Fieldwork was conducted between August 3, 2009 and August 14, 2009 by SCS personnel David Perzinski, B.A. and Brian Armstrong, B.A. under the overall direction of Principle Investigator Michael Dega, Ph.D. The inventory survey included a 100% pedestrian survey along the project area corridor that had been previously demarcated by surveyors from Austin Tsutsumi and Associates. When sites/features were encountered, the location was flagged, noted on a project area map and recorded. The sites were documented with written descriptions, photographs and scale plan view maps. The site boundaries were delineated based on the horizontal extent of the site visible on the ground surface.

In addition to the pedestrian survey, 64 backhoe trenches were excavated throughout the subject parcel. Trenches were generally 4 to 8 m in length and excavated to depths of up to 200 cm below surface. Trenches were distributed relatively evenly across the project area at approximate 150 foot intervals. Once trenches were completely excavated, the stratigraphic sequence was recorded using Munsell Soil Charts with sediment texture, consistency, plasticity and structure being noted in the descriptions.

Archival research entailed investigating the historic and archaeological background of the general project area. This examination included a documentary search of previous archaeological research conducted in this region of Maui as well as a review of archival literature relating to Land Commission Awards and local mythology. The review of historical documents was accomplished in order to understand the impact of post-Contact events on the cultural and archaeological landscape of the region.

All laboratory work was conducted in the Maui office of SCS and included the drafting of site plan view maps and trench profiles. All documentary materials are currently being curated at the SCS office in Maui.

RESULTS OF FIELDWORK

The archaeological inventory survey included documentation of surface sites, as well as the stratigraphic sequence of 64 backhoe trench profiles throughout the project area. Surficially, only one site (SIHP No. 50-50-04-6668) consisting of an historic terrace along Waikapū Stream was documented during the inventory survey. No traditional sites were observed during the survey. In all, 64 backhoe trenches were excavated to aid in analysis of the subsurface deposits across the project area (Figure 4).

The stratigraphic sequences of the trenches excavated across the sugar cane fields showed a history of repeated tilling and all contained sterile sediments below the till zone. The trenches generally consisted of a 50-60 cm thick layer of dark brown (10 YR series) previously tilled stony silt loam overlying a nearly identical layer of stony or extremely stony silt or silt loam. The abundance of waterworn pebbles, cobbles and boulders encountered resulted from deposition related to Waikapū Stream, and as the trenches approached the stream, the volume of cobbles and boulders notably increased. This pattern continued across the proposed Wai`ale Road extension corridor, with the sediment becoming more stony in the northern portion of the corridor.

Subsurface testing commenced in the southwestern extreme of the project area corridor, just east of Honoapi`ilani Highway. In this portion of the project area, the sediments consisted of a 53 cm thick layer of very dark brown (10 YR 2/2) pebbly loam that was structureless and slightly plastic (Figures 5 and 6). The stratum represented the "till zone" that has been repeatedly disturbed for decades. Stratum II consisted of very dark brown (10 YR 2/2) clay loam that was slightly hard, with a medium granular structure and slight plasticity. The stratum extended to the base of excavation (to 163 cm below surface). This stratigraphic pattern extended approximately 500 m north into the cane fields.

The second area of subsurface testing along the central portion of Wai`ale Road improvement corridor showed a stratigraphic sequence similar to the southern portion. Stratum I consisted of a 60 cm thick layer of dark grayish brown (10 YR 4/2) pebbly silt loam that was hard, structureless and lacked plasticity and contained modern plastic trash (i.e. sheeting and irrigation pipe) (Figures 7 and 8). Stratum II consisted of a 30 cm thick layer of dark grayish brown (10 YR 4/2) cobbly silt loam. The stratum had weak, fine granular structure and contained approximately 50-60% basalt cobbles.

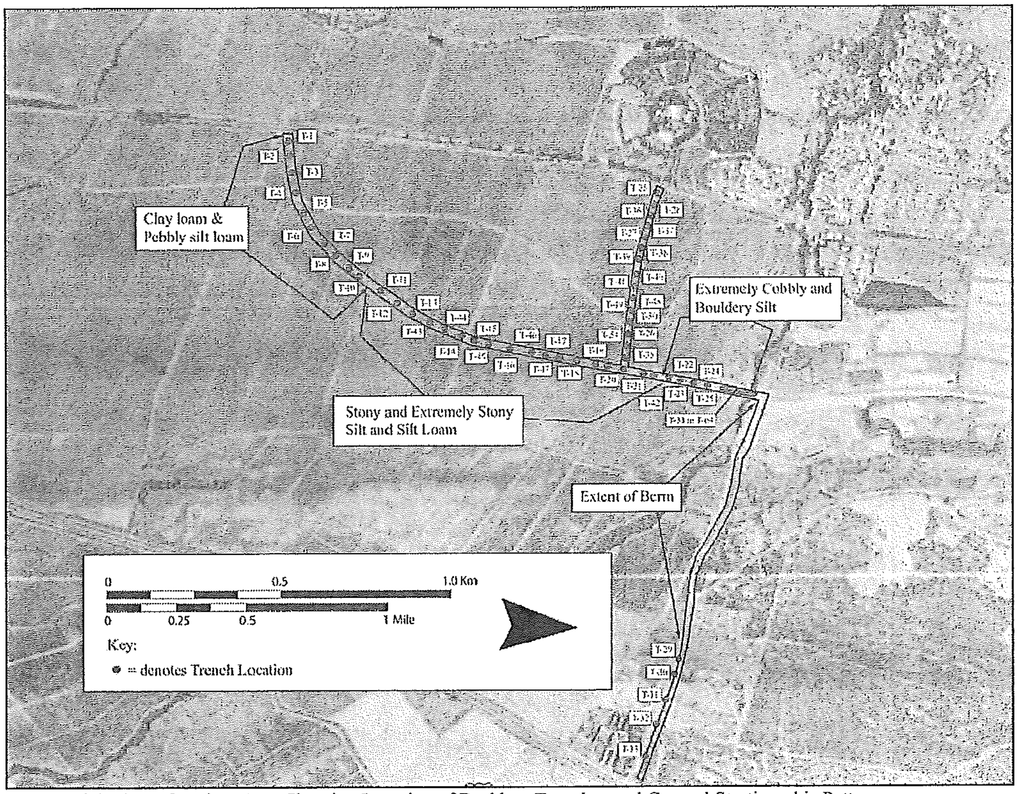

Figure 4: Aerial View of Project Area Showing Location of Backhoe Trenches and General Stratigraphic Pattern.

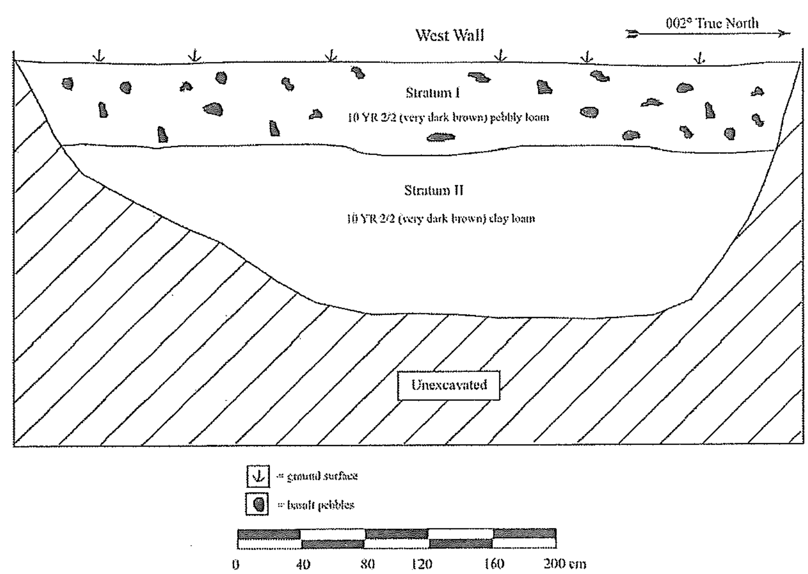

Figure 5: Plan View of Trench 1 Showing Stratigraphic Sequence.

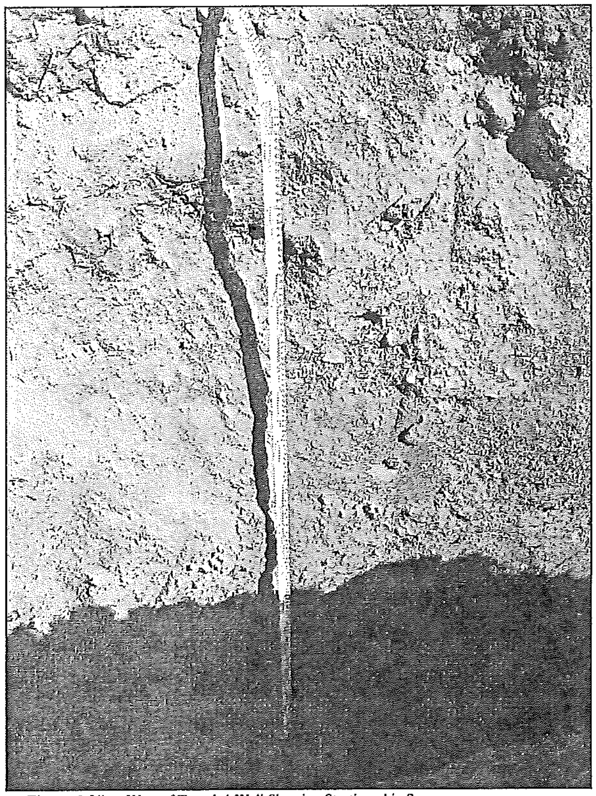

Figure 6: View West of Trench 1 Wall Showing Stratigraphic Sequence.

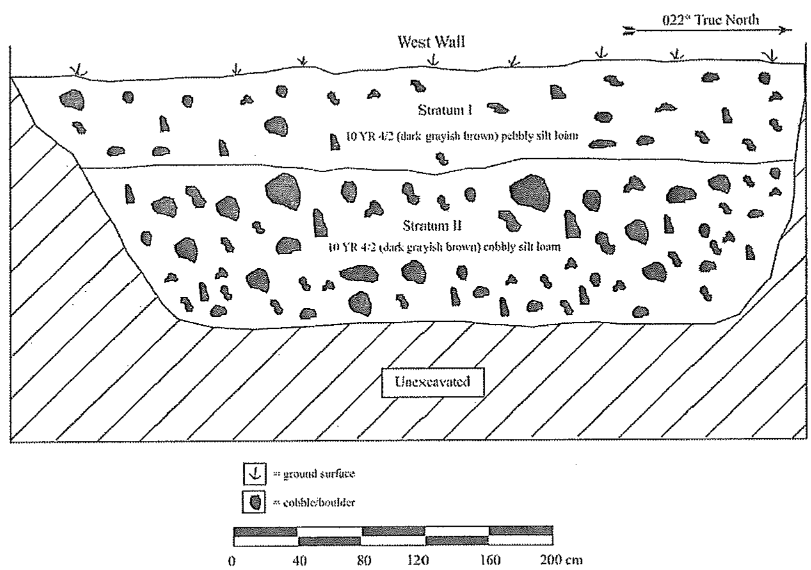

Figure 7: Profile of West Wall of Trench 12 Showing Stratigraphic Sequence.

Figure 8: View East of Trench 12 Showing Stratigraphic Sequence.

Stratum III consisted of brown (10 YR 4/3) silt that had strong, fine granular structure and was sterile. Excavation was terminated within this stratum. This group of soil was also encountered along the east/west running extension that intersects with Honoapi'ilani Highway near the Maui Tropical Plantation.

The third area of subsurface testing occurred along the northern extent of the proposed road extension, just south of Waikapū Stream. This portion of the project area included an area that is used as a dumping ground for old machinery, cars, timbers and other equipment. In general, the stratigraphic sequence consisted of dark brown (10 YR 4/2) stony silt loam that was structureless and lacked plasticity (Figures 9 and 10). The layer was comprised of approximately 20-30% waterworn pebbles and cobbles. Stratum II consisted of dark brown (10 YR 3/3) stony silt that was structureless and had no plasticity. The layer was comprised of 70-80% waterworn cobbles and boulders.

Along the Waiko Road improvement corridor on the south side of Waiko Road, the stratigraphic sequence showed the presence of a sandier matrix. This sediment was more similar to sediments located north of the project area (e.g. Maui Lani) though it was clear that had the sand dunes extended this far south, they were likely graded to their current status for Waiko Road. Trenching along the north side of Waiko Road was limited to the eastern extent of the corridor due to the presence of a 2-3 m high man-made berm and high voltage power lines overhead and possible buried utilities below. As a result of this encumbrance, only the eastern third of the proposed improvements were subjected to subsurface testing.

The stratigraphic sequence encountered during excavation along the southern portion of Waiko Road consisted mainly of sandy sediments with the top 40-60 cm appearing to have been previously disturbed (Figures 11 and 12). Stratum I consisted of brown (7.5 YR 4/2) silty sand that was loose, structureless, had no plasticity and contained abundant modern trash (i.e. beer cans, plastic bottles and bags, rubber tires, etc.) Stratum II consisted of brown (10 YR 4/3) sandy silt that was also loose and structureless. It is believed that this was the naturally deposited layer that likely represented the southern extent of the dune complex located immediately to the north. No traditional Hawaiian cultural materials or layers were encountered during the subsurface testing.

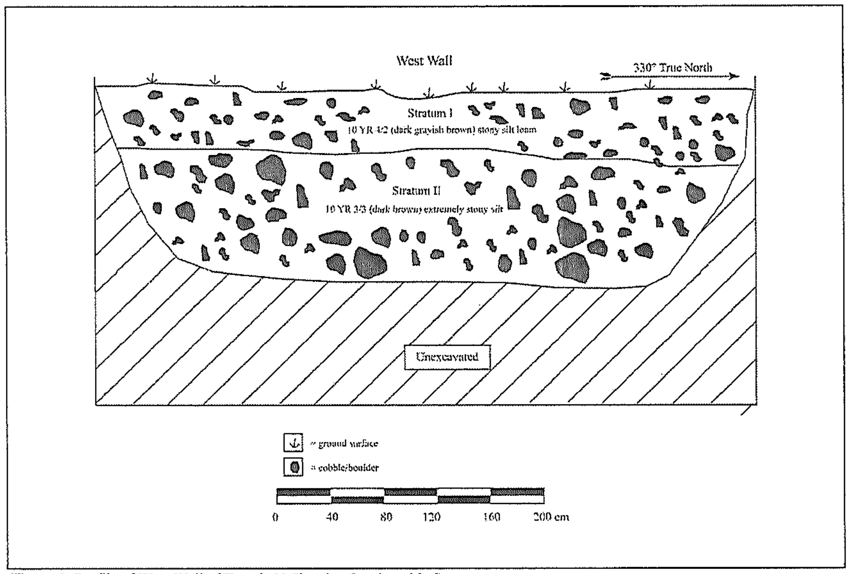

Figure 9: Profile of West Wall of Trench 55 Showing Stratigraphic Sequence.

Figure 10: View Northwest of Trench 55 Showing Stratigraphic Sequence.

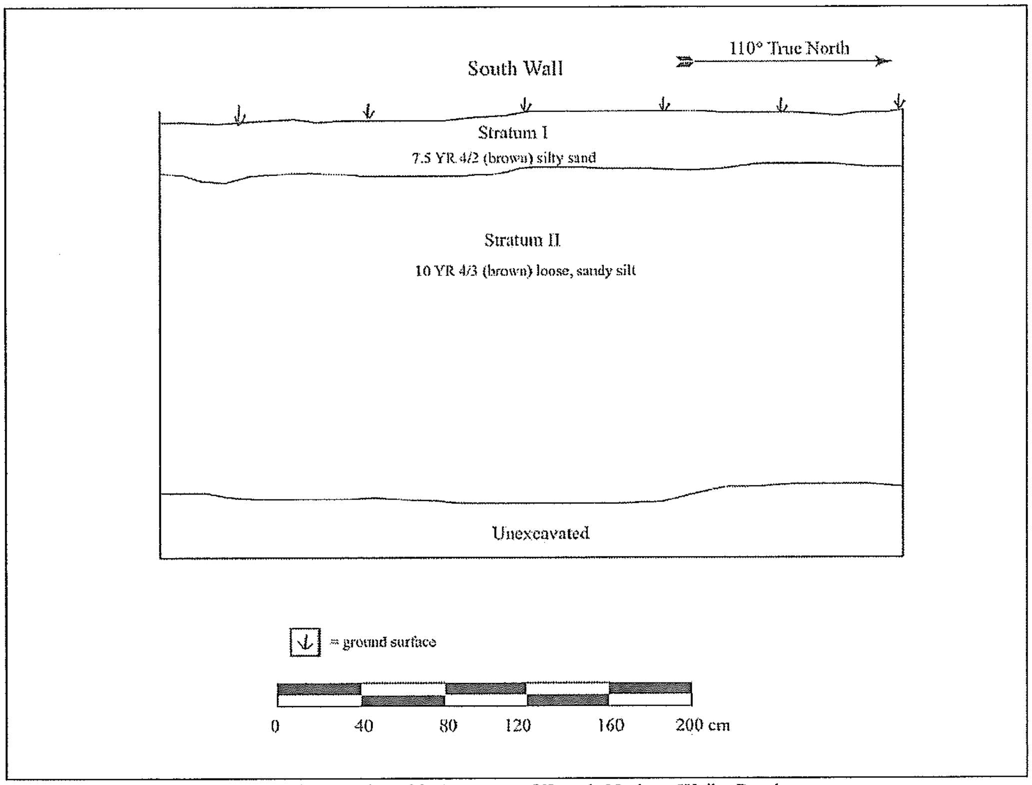

Figure 11: Representative Profile Showing Stratigraphic Sequence of Trench 33 along Waiko Road.

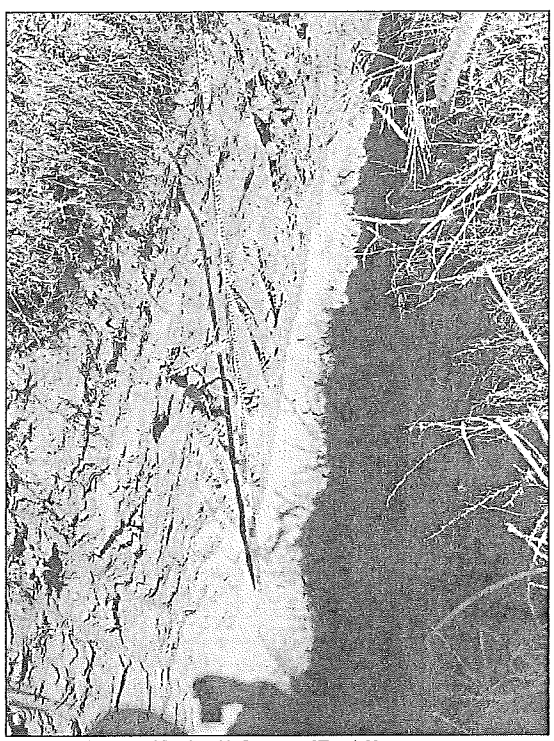

Figure 12: View East of Stratigraphic Sequence of Trench 33.

SIHP NO.: 50-50-04-6668
Site Type: Terrace
Function: Water diversion
Feature (#): 1
Age: Historic
Significance: Criterion D

Condition: Fair to Good

Description: Site -6668 (Figures 13-15) consists of a 6 m long terrace feature located along the south bank of Waikapū Stream within the corridor for the proposed Wai'ale Road extension. The terrace is constructed of waterworn basalt boulders with a maximum height of 110 cm and width of 40-80 cm. The terrace is stacked a maximum of 4 courses and contains no sediment or soil deposit. A 1 m by 1 m manually excavated test unit was attempted, but efforts were halted when it became apparent that no subsurface sediments existed with boulders visible through the terrace to the base of the slope. No cultural materials or layers were encountered.

The terrace is in fair to good condition and is suggested to be of an historic age. Its function is indeterminate, but could have been used as a footing for a small footbridge over the stream or possibly as a flood control measure.

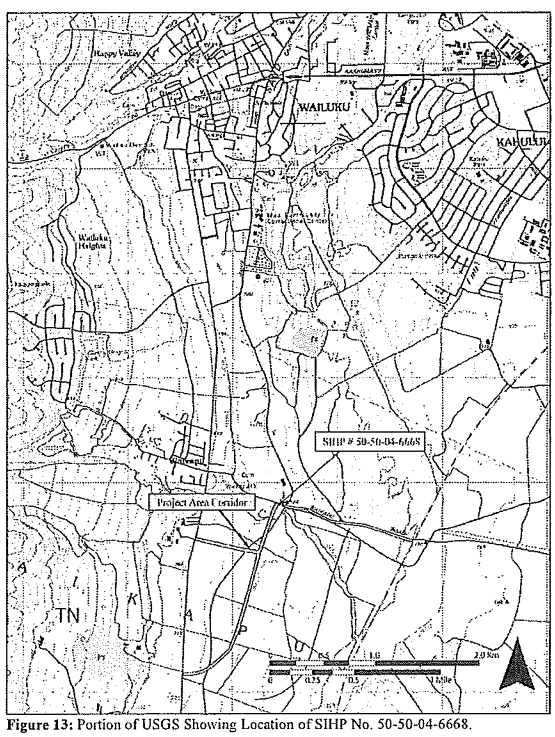

Figure 13: Portion of USGS Showing Location of SIHP No. 50-50-04-6668.

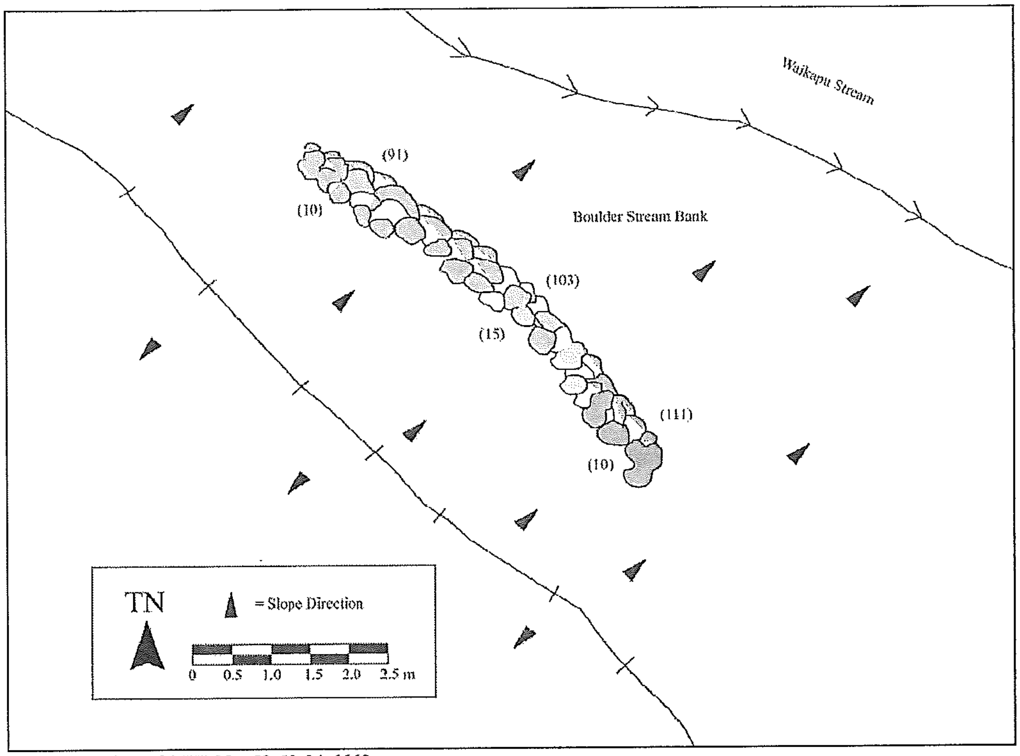

Figure 14: Plan View of SIHP No. 50-50-04-6668.

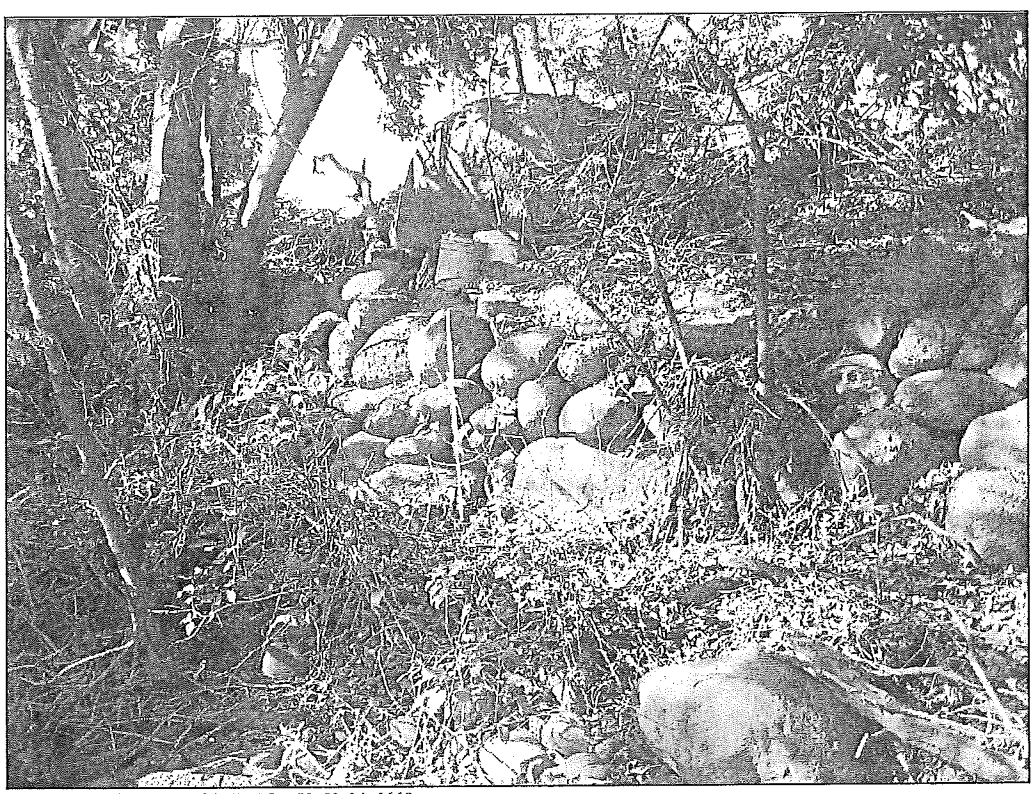
Figure 15: View East of SIHP No. 50-50-04-6668.

SUMMARY

An Archaeological Inventory Survey on an approximate 2.5 kilometer long corridor of the proposed Wai`ale Road extension and 1.3 km long corridor of the proposed Waiko Road improvement in Waikapū Ahupua`a, Wailuku District, Maui Island, Hawai`i [TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003 and 3-8-005:999]. The proposed Wai`ale Road extension will extend across Waiko Road and through existing sugarcane fields, joining up to Honoapi`ilani Highway just south of Maui Tropical Plantation. The proposed Waiko Road widening project includes the portion of the road extending from Kuihelani Highway to Wai`ale Road. In all, one site (SIHP No. 50-50-04-6668) consisting of an historic terrace constructed of waterworn basalt boulders was documented within the study parcel along the south bank of Waikapū Stream. No traditional Hawaiian sites or cultural materials were encountered during the surface survey or extensive subsurface testing program.

Previous archaeological investigations and historic documentation in the vicinity of the project area suggests that the area was likely utilized in pre-contact times and though historic agricultural used had likely destroyed any remaining surface sites that may have existed.

SIGNIFICANCE ASSESSMENTS

One site composed of a single feature was documented in the project area during Archaeological Inventory Survey. The site (see below) has been evaluated for significance according to the criteria established for the State and National Register of Historic Places. The five criteria are listed 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; probable religious structures or burials present (State of Hawai`i criteria only).

State Site 50-50-04-6668 is designated under Criterion D as a site that has yielded or has the potential to yield information important in prehistory or history. The site has been thoroughly documented with photographs, scale plan view maps and written descriptions

RECOMMENDATIONS

STATE SITE 50-50-04-6668

No further work is recommended for SIHP No. 50-50-04-6668. It is believed that the site has been adequately documented and additional research focused on the site would not contribute to the interpretation of the area, region or Hawaiian prehistory and/or history. It is therefore recommended that no further archaeological work is warranted within the project area.

ARCHAEOLOGICAL MONITORING

Archaeological Monitoring is not recommended during the construction of the Wai`ale Road extension. Subsurface testing clearly demonstrated that no subsurface cultural layers were present and continued use of the corridor for sugar cane cultivation has likely destroyed any surface sites that may have existed. However, should the inadvertent discovery of significant cultural materials and/or burials occur during construction, all work in the immediate area of the find must cease and the SHPD be notified to discuss mitigation.

Along the Waiko Road improvement, however, archaeological monitoring is recommended for any ground disturbing activities associated with the proposed work. With the presence of sand deposits comes a higher likelihood of associated human burials.

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APPENDIX F-1.

State Historic Preservation Division Approval Letter

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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COMMISSION ON WATER RESOURCE MANAGEMENT
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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

March 10, 2010

Michael F. Dega, Ph.D.
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 975
Honolulu, Hawai'i 96813
shpdreply@scshawaii.com

LOG NO: 2010.0589
DOC NO: 1003NM21
Archaeology

SUBJECT: Chapter 6E-8 Historic Preservation Review – Revised Archaeological Inventory Survey of the Waiale Road Extension and Waiko Road Improvement Project
Waikapu Ahupua'a, Wailuku District, Island of Maui, Hawai'i
TMKs: (2) 3-5-002:014; (2) 3-5-002:018; (2) 3-5-002:888; (2) 3-5-027:021; (2) 3-6-002:003;
(2) 3-8-005:999

Thank you for the opportunity to review this report, which our staff received in hardcopy on March 3, 2010 (Perzinski and Dega 2010): An Archaeological Inventory Survey of the Waiale Road Extension...Scientific Consultant Services, Inc.

The survey area as described in the report is comprised of a 2.5 kilometer long corridor for the proposed Waiale Road extension and the 1.3 kilometer Waiko Road improvement project corridor. Fieldwork, carried out between August 3 and 14 of 2009, was comprised of a 100% pedestrian survey and the excavation of 64 backhoe trenches. One new site now on record as SIHP #50-50-04-6668, an historic era boulder terrace which may have functioned as a water feature or is a remnant of a bridge footing, was identified along the south bank of Waikapu Stream. The site is significant under criteria D, which we concur. No further is recommended for site 6668.

Archaeological monitoring is recommended for any work along Wako Road where sand substrates still exist which we concur with this recommendation.

The report contains most of the required information as specified in HAR §13-276 and is now acceptable. Please send one hardcopy of the document, clearly marked FINAL, along with a copy of this review letter and a text-searchable PDF version on CD to the attention of the "SHPD Library" at the Kapolei SHPD office and one hardcopy of the document with copy of this review letter to the Maui office.

Aloha,

Nancy A. McMahon

APPENDIX G.

Cultural Impact Assessment

SCS Project Number 1009-CIA-3

A CULTURAL IMPACT ASSESSMENT OF WAI`ALE ROAD EXTENTION AND EAST WAIKO ROAD IMPROVEMENT, WAIKAPŪ AHUPUA`A, WAILUKU DISTRICT, MAUI ISLAND, HAWAI`I [TMK: (2) 3-5-002:014, 018, 888; 3-5-027:021; 3-6-002:003; 3-8-005:999]

Prepared by:
Leann McGerty, B.A.
and
Robert L. Spear, Ph.D.
Revised October 2011

Prepared for:
Munekiyo & Hiraga, Inc
305 High Street, Suite 104
Wailuku, HI 96793

SCIENTIFIC CONSULTANT SERVICES Inc.

HAWAII

711 Kapiolani Blvd. Suite 975 Honolulu, Hawai`i 96813

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

At the request of Munekiyo & Hiraga, Inc., Scientific Consultant Services, Inc. (SCS) conducted a Cultural Impact Assessment of Wai`ale Road extension and East Waiko Road improvement, Waikapū Ahupua`a, Wailuku District, Maui Island [TMK: (2) 3-5-002: 014, 018, 888; 3-5-027:021; 3-6-002:003; 3-8-005:999] (Figures 1 and 2). The project proposes the extension of Wai`ale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Wai`ale Road to Kuihelani Highway.

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 (HB) 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].

Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs and practices, and resources of native Hawaiians as well as other ethnic groups. Act 50 also 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 (2001) environmental review process.

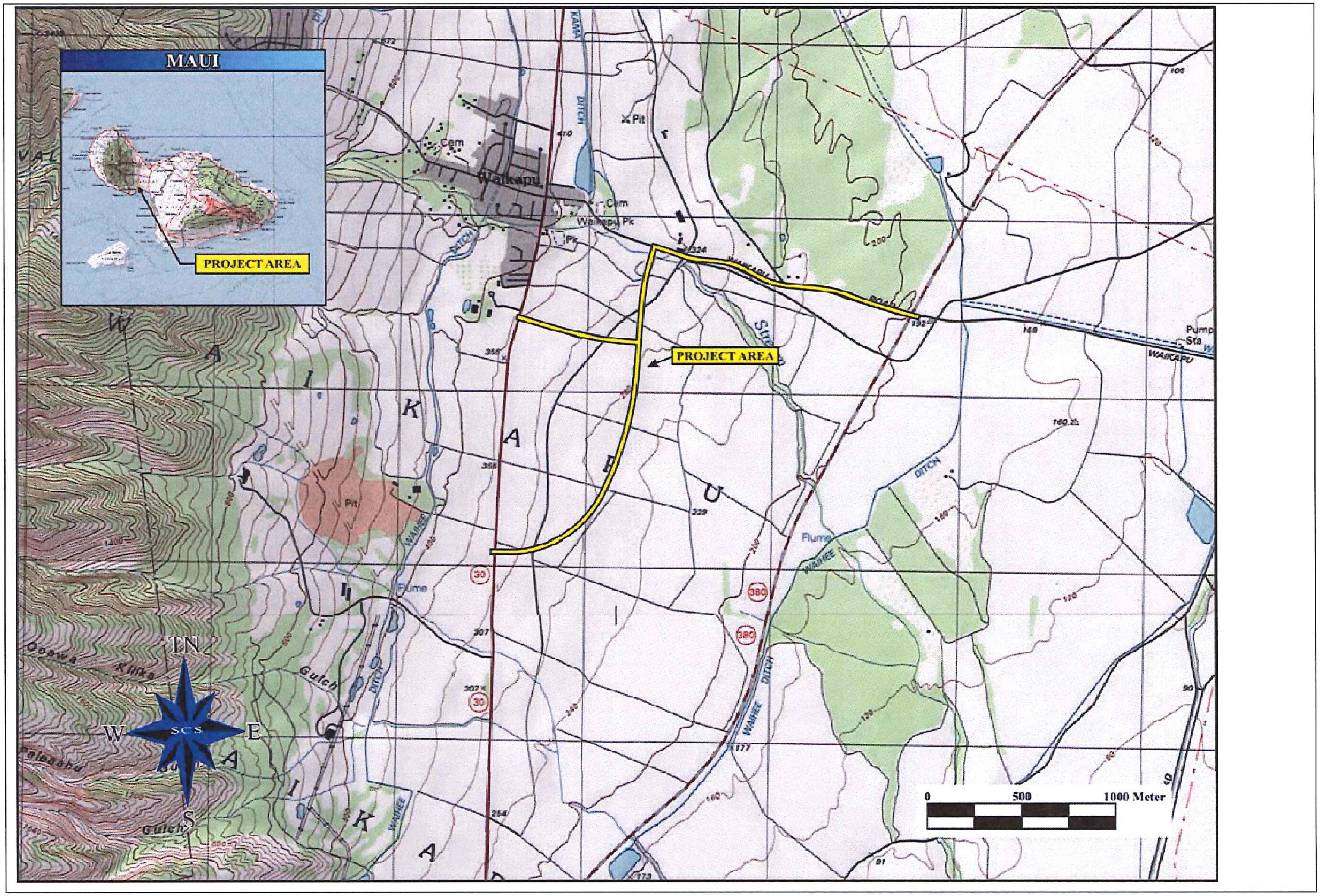

Figure 1: USGS Quadrangle Map Showing Project Area.

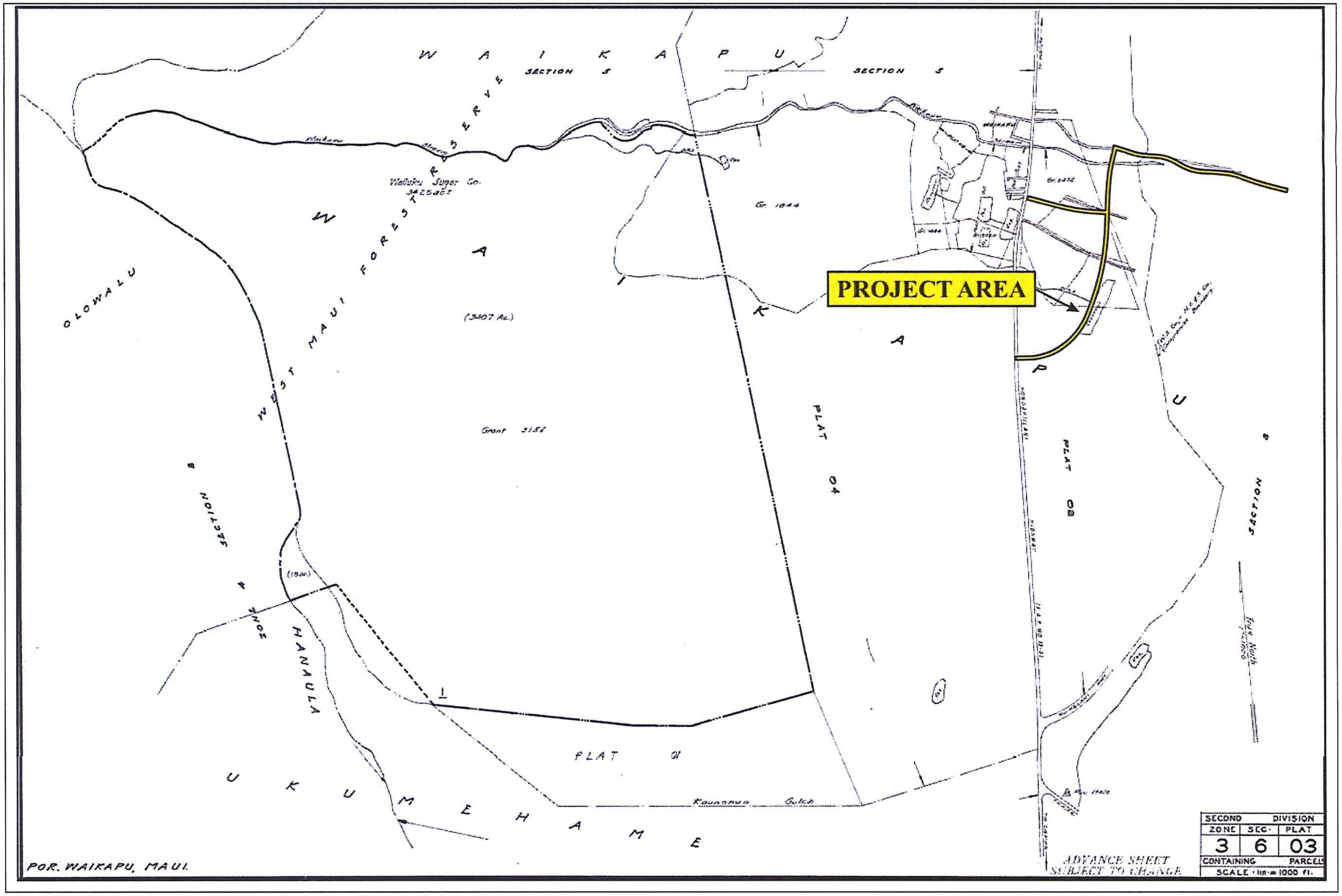

Figure 2: Tax Map Key [TMK] Showing Project Area.

It also re-defined the definition of "significant effect" to include "the sum of effects on the quality of the environment including actions impact a natural resource, limit the range of beneficial uses of the environment, 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). Cultural resources can include a broad range of often overlapping categories, including places, behaviors, values, beliefs, objects, records, stories, etc. (H.B. 2895, Act 50, 2000).

Thus, Act 50 requires that an assessment of cultural practices and the possible impacts of a proposed action 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.

Therefore, the purpose of a Cultural Impact Assessment is to identify the possibility of on-going cultural activities and resources within a project area, or its vicinity, and then assessing the potential for impacts on these cultural resources. The CIA is not intended to be a document of in depth archival-historical land research, or a record of oral family histories, unless these records contain information about specific cultural resources that might be impacted by a proposed project.

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.

The meaning of "traditional" was explained in *National Register Bulletin*:

> Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations', usually orally or through practice. The traditional cultural significance of a historic property, then is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices. . . . [Parker and King 1990:1]

METHODOLOGY

This Cultural Impact Assessment was prepared in accordance with the suggested methodology and content protocol 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. Copies of the letters of inquiry are presented below in Appendix A; copies of posted legal notices are presented in Appendix B; and copies of the second group of letters of inquiry are presented below in Appendix C. This Cultural Impact Assessment was prepared in accordance with the methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997) when possible. The assessment concerning cultural impacts may address, but not be limited to, the following matters:

(1) If consultation is available, 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) if conducted, 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.

If on-going cultural activities and/or resources are identified within the project area, assessments of the potential effects on the cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

PROJECT AREA AND VICINITY

The project areas were located at Wai`ale Road at East Waiko Road to Honoapi`ilani Highway and from East Waiko Road from Wai`ale Road to Kuihelani Highway in Wailuku, Maui (Figure 3).

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 above mean sea level), is composed of large, heavily eroded amphitheater valleys that contain well-developed permanent stream systems that watered fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal areas have witnessed many battles in ancient times and were coveted productive landscapes. Waikapū was the most southern valley of the Na Wai Eha (The Four Streams) a region that was famous as the largest continuous area of wet taro cultivation in the islands (Handy 1940:107).

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 1969, Vol. 6:248]). Land was considered the property of the king or *ali`i `ai moku* (the *ali`i* who rules 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`āina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua`a*) that 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 next in importance to the *ahupua`a* and were administered by the

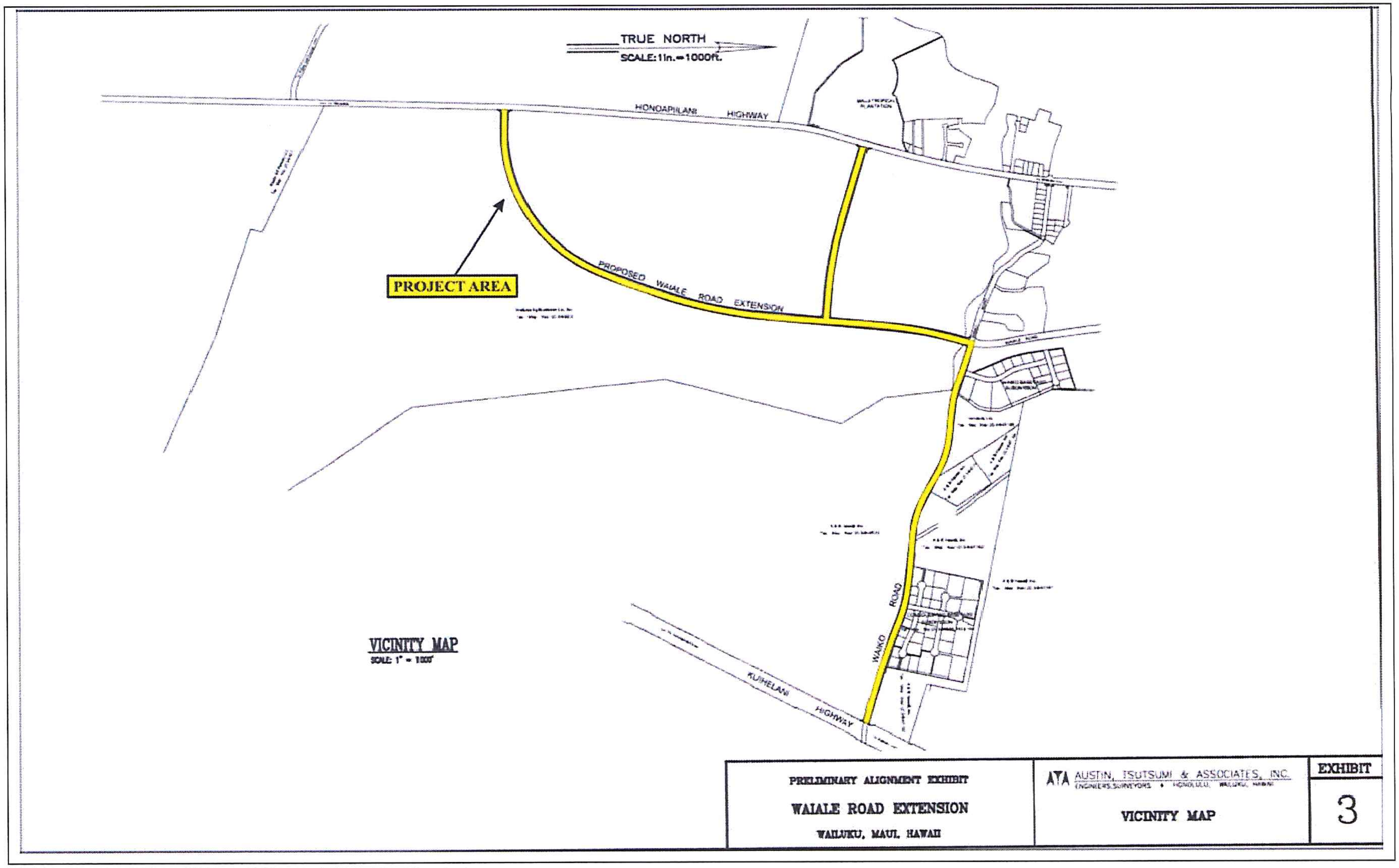

Figure 3: Plan View Map of the Project Area.

chief who controlled the *ahupua`a* in which it was located (*ibid*:33; Lucas 1995:40). The *mo`o`āina* were narrow strips of land within an *`ili*. The land holding of a tenant or *hoa `āina* residing in an *ahupua`a* was called a *kuleana* (Lucas 1995:61). The project area is located in the *ahupua`a* of Waikapū, which translated means literally "water [of] the conch" and refers to a shell located in a cave that could be heard everywhere in the Hawaiian Islands until it was stolen by a supernatural dog named Puapualenalena (Pukui *et al.* 1974:223).

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 when knowledgeable individuals are able to identify cultural resources in, or in close proximity to, the project area. If they have knowledge of traditional stories, practices and beliefs associated with a project area, or if they know of historical properties within the project area, they are sought for additional consultation and interviews. 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 concerning particular cultural resources. Often people are recommended for their expertise, and indeed, organizations, such as Hawaiian Civic Clubs, the Island Branch of Office of Hawaiian Affairs (OHA), 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. It should be stressed again that this process does not include formal or in-depth ethnographic interviews or oral histories as described in the OEQC's *Guidelines for Assessing Cultural Impacts* (1997). The assessments are intended to identify potential impacts to on-going cultural practices, or resources, within a project area or in its close vicinity.

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 usually sent for correction and approval, or dictated by the informant and then incorporated into the document. If no cultural resource information is forthcoming and no knowledgeable informants are suggested for further inquiry, interviews are not conducted. No interviews were conducted for the present project as there were no responses from any of the contacted organizations and/or individuals.

Letters were sent in January 2009 to organizations whose jurisdiction included knowledge of the area. Consultation was sought from Thelma Shimaoka of the Maui Branch of the Office of Hawaiian Affairs; the County of Maui Cultural Resources Commission, Hinano Rodrigues, the SHPD Maui Island historian, the Central Maui Hawaiian Civic Club, Patty Nishiyama of Nā Kupuna O Maui, and Kamika Kepa`a of the Native Hawaiian Preservation Council (Appendix A). In addition, a Cultural Impact Assessment Notice was published on January 11, 14, 15, 2009 in *The Honolulu Advertise*r and *The Maui News* , on January 11, 14, 15, 2009 (Appendix B). These notices requested information of cultural resources or activities in the Waikapū area of the proposed project, gave the TMK number and where to respond with information. Based on the responses, an assessment of the potential effects on cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

TRADITIONAL SETTLEMENT PATTERNS

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 produced. 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). In the valleys of West Maui, intensified agriculture, including irrigation channels and stone-faced pond fields, was likely to have begun in what is referred to as the Expansion Period (A.D. 1200–1400, Kirch 1985).

WAHI PANA (LEGENDARY PLACES)

Although it has been said that Waikapū Valley contained "many temples and sites", most of their locations were not recorded (Ashdown 1970:58). Thrum refers to a *heiau* that was reportedly located on Pu`u Hele, but he did not confirm this (1917). Thrum also mentions two heiau located below the road but again, they were not investigated and their name and function had been lost (1916). One *mo`olelo* recounting the origin of its name was published in *Ka Nupepa Kuokoa* in 1872:

> The Wai-Ka-pū now being discussed was named by some of the ancients and it remains by this name to this day. This place, Waikapu, has a cave away up the stream, about a mile or more from the village. On the left side of the stream is a cave and in the cave was the conch. It sounded all the time, unseen by the public, but a prophet of Kauai listened for it and came to seek with the idea of finding it...

On a cliff above the stream and opposite the cave was a dog named Puapualenalena who had also heard the conch and was searching for it. However, those that guarded the conch were very attentive and, so far, the dog had not located it.

> The owners of the conch did not believe, perhaps, that any supernatural being would succeed in taking it away, so they tried to be a little careless. It was not taken, but on the day that Pualenalena did get it away, they had been utterly careless. After he took it, it sounded no more to this day. It used to be heard everywhere in these islands and was annoying to some people. From this conch, the whole of the place was named Waikapū (Water of the conch). This is the legend of how it received its name and is a place much visited by strangers who wish to see it [W. K. Kaualililehua, *Ka Nupepa Kuokoa,* Sept 21, 1872].

Oral traditions preserved by Fornander (1969) and Kamakau (1963) contribute to our knowledge of Waikapū. The battle of Ahulau ka piipii i Kakanilua featuring the elite `Ālapa warriors of Kalaniopu`u was fought in 1776 on the sand hills southeast of Wailuku:

> ...Taking part of his forces around by water, *Kalaniopuu* landed again at Kiheipukoa, near the Kealia or salt marsh between Kalepolepo and Maalaea...The detachment or regiment known as the *Alapa*, mustering eight hundred men, was selected for this hazardous expedition, and with high courage they started across the isthmus of Kamaomao, now known as the Waikapu common, determined, as the legend says, "to drink the waters of the Wailuku that day." This regiment was considered the bravest and

> best of *Kalaniopuu's* army, every man in its ranks being a member of "*la haute noblesse*" of Hawaii. They are said to have all been of equal stature and their spears of equal length; and the legend represents their appearance-with their feather cloaks-reflecting the sunshine and the plumes of their helmets tossing in the wind-as a gorgeous and magnificent spectacle...Offering no resistance to the enemy while crossing the common, *Kahekili* distributed his forces in various directions on the Wailuku side of the common, and fell upon the Hawaii *corps d'arnée* as it was entering among the sandhills south-east of Kalua, near Wailuku. After one of the most sanguinary battles recorded in Hawaiian legends and deeds of valor ...the gallant and devoted Alapa were literally annihilated; only two out of the eight hundred escaped alive to tell Kalaniopuu of this Hawaiian Balaclava...[Fornander 1969:153].

In a similar version, Kamakau recounts:

> ...The Alapa were led by Inaina, Kua`ana, Kane-ha`i-lua, and Keawe-hano. There were 800 of them, all expert spear-point breakers, every one of whose spears went straight to the mark, like arrows shot from a bow, to drink the blood of a victim. Across the plains of Pu`u`ainako and Kama`oma`o shone the feather cloaks of the soldiers, woven in the ancient pattern and colored like the hues of the rainbow in red, yellow, and green, with helmets on their heads whose arcs shone like a night in summer when the crescent lies within the moon...Said Ka-leo-pu`upu`u to Kahekili, "the fish have entered the sluice; draw in the net." Like a dark cloud hovering over the Alapa, rose the destroying host of Ka-hekili seaward of the sandhills of Kahalu`u, the "smoke head" (*po`ouahi*) and the "red coconut" (*niu`ula*) divisions. They slew the Alapa on the sandhills at the soueast of Kalua. There the dead lay in heaps strewn like *kukui* branches; the corpses lay heaped in death; they were slain like fish enclosed in a net. This great slaughter was called *Ahulau ka Pi`ipi`i Kakanilua*...[1963:65–86].

WAIKAPŪ SETTLEMENT PATTERNS

As part of Na Wai Eha, Waikapū was a vast taro-producing valley requiring a large population to maintain its terraces and pond fields (*lo`i*). Handy and Handy describe the "Four Streams" system below:

> The old *`okana* (land division) named Na Wai Eha...comprised four great valleys which cut far back into the slopes of West Maui and drain the eastward watershed of Pu`u Kukui and the ridges radiating northeastward, eastward, and southeastward from it. Two of the great valleys, Waihe`e and Waiehu, open toward the ocean and their streams empty into it. Wailuku is partly land bound, but its stream slows into Kahului Bay, which has been eroded by the ocean out of what was formerly the stream mouth. Waikapu is land bound. The waters of its

> great stream, now utilized for irrigating a great acreage of sugar cane, formerly was diverted into *lo`i* and its overflow was dissipated on the dry plains of the broad isthmus between West and East Maui [1972:496].

Given the amount of intensive agricultural development within Waikapū, it seems probable that these coastal valleys were recognized for their production potential and were settled early. Waikapū and similar valleys lent support to the increasingly stratified and expanding Hawaiian population, whose centralized ruling class congregated in the coastal region near its religious complexes. Such a vast agricultural complex suggests habitation existed throughout and on the margins of these features.

Descriptions found in journals surviving from the 1800s record that the valleys of Wailuku and Waikapū still supported a substantial population and traditional life-style, as well as providing an alternative explanation for the valleys' name:

> The first village of any not on the way to Wai-lu-ku is Wai-kapu. It contains a population of about 500. Here the forces of Kamehameha the Great once assembled for a battle at the sounding of the conch shell. Hence the name, Wai-ka-pu (water of the conch or trumpet) [Bates 1854:309].

In *Ke Au Okoa* (Nov. 6, 1865), S.W. Nailiili stated, "Waikapu, a district known for its majesty and splendid living. Whose native songs gather flowers in the dew and weave wreaths of ohelo berries." Twenty years later, opinions of what was "splendid living" seems to have been heavily influenced by western thought. In an interesting anecdote, Mr. Kaualililehua describes the life of the Waikapū villagers in the 1800s:

> The life of the people is pleasant and there are no frequent deaths as there were before. Men and women are all working together for the white men. In the past days death among infants was frequent because the parents did not give them proper care.

Mr. Kaualililehua continues his commentary expressing his newly formed, missionary-influenced attitudes:

> In the months of June and July, the native dance called the hula pu`ili came in and many of the church members have indulged in this filthy past time of an ignorant period. The officers and pastor have tried hard to quench this worthless activity but no attention was paid to them. It has grown less and today this benighted activity has ceased, but it has a substitute, the dance of the white people under the

leadership of a half-white person. Some of the members are sticking around in this occupation that is not becoming to a Christian...The church is weak in carrying on with the work of the Lord...There was strength here once but now, only a portion desire to do God's work...If the conch still continues to sound, it will sound for Christian righteousness in this church. No, Puapualenalena took it, so it sounds no more [Ka Nupepa Kuokoa: Sept. 21, 1872].

The present project area lies below the actual valley of Waikapū on sand dunes created during the Pleistocene lower stand of the sea (southern periphery of the Wailuku Sand Hills). The sand dunes were left unsettled by the Hawaiians who appear to have mainly utilized the coastal margins of the sand hills for burials. However, as recorded ethnographically, warfare did occasionally occur on the dunes and burials have been uncovered within the Wailuku Sand Hills area.

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 (Kuykendall 1938 Vol. I:145; Daws 1962:111; Kelly 1983:45, 1998:4; Kame`eleihiwa 1992:169–70, 176). 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 thus made available and private ownership was instituted, the *maka`āinana* (commoners), 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). One hundred and forty LCAs were claimed for Waikapū and of these, 22 were not awarded. No LCAs were identified in the project area. The project lands were purchased from the Hawaiian government as Grants.

HISTORIC LAND USE

Large tracks of land that became available for purchase after the Māhele were put into sugar cane. As early as 1828, James Louzada, a Spaniard, was making cane syrup in Waikapū. The project area is located on land that was once a part of Royal Patent Grant 3152 belonging to Mr. Cornwall and was under cultivation by the Waikapū Sugar Company. Kamehameha III (Kauikeaouli) obtained some of these lands for his own sugar venture, but by 1862, Waikapū, Waihe`e, and Wailuku cane lands combined to form Wailuku Sugar (Conte and Best 1973). In 1895, a railroad was installed to transport cane from Waikapū to the mill in Wailuku. Eventually, all these lands passed into the control of Alexander and Baldwin as did neighboring sugar lands originally awarded to Claus Spreckles by King Kalākaua for his Hawaiian Commercial and Sugar Company.

Walls and terraces, evidence of traditional wet-taro plantings extended north and south from the base of Waikapū for some distance below the valley and was still noted in the 1930s. Within the historic time period, these agricultural features remained valuable not only to the Hawaiians but to other cultures that settled in Hawai`i:

> ...below the valley are the vestiges of extensive wet-taro plantings, now almost obliterated by sugar cane cultivation; a few here and there are preserved in plantation camps and under house and garden sites along the roads. Among these gardens there were, in 1934, a few patches of dry Japanese taro. Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground showed the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizable *kuleana* where, in 1934, old terraces were used for truck gardening. In the larges of these a few old patches were flooded and planted with Hawaiian wet taro, and there was some dry Japanese taro. Several terraces were used as ponds planted with lotus for their edible seed. There were probably once a few small terraces on the narrow level strips of valley bottom in the lower canyon [*ibid.*:497].

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 know of cultural resources and activities that may be affected by the project or who know its history, conducting 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 might mean an entirely different level of research activity.

In the case of the present parcel, letters were sent to organizations whose jurisdiction included knowledge of the area. Consultation was sought from Thelma Shimaoka of the Maui Branch of the Office of Hawaiian Affairs; the County of Maui Cultural Resources Commission, Hinano Rodrigues who is the SHPD Island historian, the Central Maui Hawaiian Civic Club, Patty Nishiyama of Nā Kupuna O Maui, and Kamika Kepa`a of the Native Hawaiian Preservation Council. In addition, a Cultural Impact Assessment Notice was published on January 11, 14, 15, 2009 in *The Honolulu Advertise*r and *The Maui News*, on January 11, 14, 15, 2009. These notices requested information of cultural resources or ongoing cultural activities in the Waikapū area of the proposed project, gave the TMK number and where to respond with information.

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 2009 Data base.

In depth archaeological information concerning the project area and vicinity can be found in the appropriate Archaeology section of the Environmental Impact Statement that covers the archaeological studies associated with this project. Individual reports can be found on file at the State Historic Preservation Division.

Archaeology deals with material remains, and although cultural beliefs are often reflected through some sort of architecture, like *heiau*, or *ko`a,* there are many examples of cultural associations still important to the community with no physical structures to mark their significance. One such place, *Ulukukui O Lanikāula*, located on Moloka`i, is considered an extremely sacred spot. Another might be Kīlauea and Halema`uma`u, home of Pele o Hawai`i Island. These places have become important sites supporting a traditional belief system still held by the many peoples of Hawai`i. They contain no identified archaeological features, however they are highly meaningful "...because of [their] association with cultural practices or beliefs of a living community . . ." (King 2003:3).

CIA INQUIRY RESPONSE

No specific suggestions of further contacts were received from the January 2009 inquiry letters sent to Thelma Shimaoka of the Maui Branch of the Office of Hawaiian Affairs; the County of Maui Cultural Resources Commission, Hinano Rodrigues who is the SHPD Island historian, the Central Maui Hawaiian Civic Club, Patty Nishiyama of Nā Kupuna O Maui, and Kamika Kepa`a of the Native Hawaiian Preservation Council. An inquiry was made by phone regarding *The Maui News* notice. Wallet Pellegrino called to investigate where exactly the project would be and what the proposed project entailed. SCS faxed a copy of the location and project information was relayed. There were no responses to *The Honolulu Advertiser* notice of cultural assessment.

A letter arrived from the main OHA Office, located on O`ahu, in March of 2009 recommending consultation with several suggested referrals, including Timothy Bailey, Ke`eaumoku Kapu, Kamika Kepa`a, Leslie Kuloloio, Charles Maxwell, the Central Island Hawaiian Civic Club, Lahaina Hawaiian Civic Club and the Maui Cultural Resources. Letters were sent on Aug 30, 2011 to those who had not previously been sent letters by SCS, including Charles Maxwell, Ke`eaumoku Kapu, Leslie Kuloloio, Lahaina Hawaiian Civic Club (Appendix C). No contact address was available for Timothy Bailey.

No further comments or referrals have been received from the second group of letters of inquiry concerning the potential for cultural resources or cultural activities to occur in the project area, or with additional suggestions for further contacts.

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). As previously noted the project area had been used for sugar cane since before 1862 and became part of the combined lands owned by the Waikapū Sugar Company. During that time, nothing but cane producing activities took place on parcel and those with knowledge about its history before 1862 are long gone. In view of this, it is understandable that the inquiries for information concerning cultural resources and ongoing cultural activities met with no response. It is an unfortunate truth that much cultural information has been lost through post-Contact, Western introduced projects, such as large scale sugar cane production, that have impacted huge land areas on our islands.

To our knowledge, the project area has not been used for traditional cultural purposes within recent times. Based on the above research, 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 on a portion of Parcel 019. Because there were no cultural activities identified within the project area, there are no adverse effects. The visual impact of the project from surrounding vantage points, e.g. the highway, mountains, and coast is minimal.

CULTURAL ASSESSMEMNT

Based on the above research, 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 on a portion of Parcel 019. Because there were no cultural activities identified within the project area, there are no adverse effects.

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APPENDIX A: LETTER INQUIRIES

(enclosures not included)

SCIENTIFIC CONSULTANT SERVICES, Inc.
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai'i 96813

January 12, 2009

Kamika Kepa`a
Native Hawaiian Preservation Council
606 Kalo Place
Lahaina, HI 96761

Dear Mr. Kepa`a:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs...The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural which support such cultural beliefs...

We are asking you for any information that might contribute to the knowledge of traditional activities, or traditional rights that might be impacted by development of the property. The assessment results are dependent on the response and contributions made by individuals and organizations such as yours. Enclosed is a map showing the proposed project area. Please contact me at our SCS Honolulu office at (808) 597-1182; my cell phone, 225-2355; or home, (808) 637-9539, with any information or recommendations concerning this Cultural Impact Assessment.

Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

Ph: 808-597-1182 SCS... SERVING ALL YOUR *ARCHAEOLOGICAL* NEEDS Fax: 808-597-1193
Neighbor Island Offices • Hawai'i Island • Maui • Kaua'i

SCIENTIFIC CONSULTANT SERVICES, Inc.
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai'i 96813

January 12, 2009

Patty Nishiyama
Nā Kupuna O Maui
320 Kaeo Place
Lahaina, Hawaii 96761

Dear Ms. Nishiyama:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi'ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

Ph: 808-597-1182 SCS... SERVING ALL YOUR *ARCHAEOLOGICAL* NEEDS Fax: 808-597-1193
Neighbor Island Offices • Hawai'i Island • Maui • Kaua'i

SCIENTIFIC CONSULTANT SERVICES, Inc.

711 Kapiolani Blvd., Suite 975 Honolulu, Hawai'i 96813

Central Maui
Hawaiian Civic Club
310 Ka'ahumanu Ave.
Kahului, Maui 96732

January 12, 2009

Dear Members:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi'ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

SCIENTIFIC CONSULTANT SERVICES, Inc.
HAWAII
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai'i 96813

Hinano Rodrigues, Cultural Historian
DLNR Maui Office
130 Mahalani Street
Wailuku, HI 96791

January 12, 2009

Dear Hinano:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

SCIENTIFIC CONSULTANT SERVICES, Inc.
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai'i 96813

January 12, 2009

Thelma Shimaoka
c/o Office of Hawaiian Affairs
140 Hoohana St.
Suite 206
Kahului, HI 96732

Dear Ms. Shimaoka

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi'ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

Ph: 808-597-1182 SCS... SERVING ALL YOUR *ARCHAEOLOGICAL* NEEDS Fax: 808-597-1193
Neighbor Island Offices • Hawai'i Island • Maui • Kaua'i

SCIENTIFIC CONSULTANT SERVICES, Inc.
HAWAII
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

January 12, 2009

County of Maui
Department of Planning
Cultural Resources Commission
250 S. High Street
Wailuku, HI 96793

Dear Sir or Madam:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

Ph: 808-597-1182 SCS... SERVING ALL YOUR *ARCHAEOLOGICAL* NEEDS Fax: 808-597-1193
Neighbor Island Offices • Hawai`i Island • Maui • Kaua`i

APPENDIX B: PUBLIC NOTIFICATIONS AFFIDAVIT

The Honolulu Advertiser
605 KAPIOLANI BLVD
HONOLULU, HI 96813

LEGAL ADVERTISING 01/06/09 04:10 PM

RECEIPT

CLASSIFIED: (808) 525-7420
FAX: (808) 525-5448

Please note: Check your ad the FIRST day it appears in the paper.
The Honolulu Advertiser will not be responsible for errors after the first insertion of any advertisement.

2i

Account Information

Name:	
Company:	SCIENTIFIC CONSULTANT SERVICES
Address:	711 KAPIOLANI BLVD 975
City:	HONOLULU, HI 96813
Account ID:	23090
Account #:	
Telephone:	(808) 597-1182

Publications:	Start	Stop	Inserts
The Honolulu Advertiser	01/11/09	01/15/09	3
Online	01/11/09	01/15/09	3

Ad Information

Ad ID:	620595
Run dates:	01/11/09 to 01/15/09
Class:	Legal Ads
Sales Person:	TOYAMA
Printed by:	TOYAMA
Inserts:	6
Lines:	28
Columns:	1
Depth (Inches):	2.0
Net Cost:	$180.00
Tax:	$8.48
Paid Amount:	$188.48
Amount Due:	$0.00
Keywords:	
P.O. number:	1009

Payments:

Method	Card Type	Name on Card	Last 4 Digits	Expire Date	Check Number	Amount Paid
CC	MC	SUARRA BAKER	5287	03/09		$188.48

Ad Copy: (Actual Size)

CULTURAL IMPACT ASSESSMENT NOTICE:
Information requested by SCS of cultural resources or ongoing cultural activities on or near this parcel in Waikapū, Wailuku, Maui TMK: (2) 3-6-02:001, 003. Please respond within 30 days to SCS at (808) 597-1182.
(Hon. Adv.: Jan. 11, 14, 15, 2009) (A-620595)

Proj 1009

AFFIDAVIT OF PUBLICATION

1009

STATE OF HAWAII, } ss.
County of Maui.

Rhonda M. Kurohara being duly sworn deposes and says, that she is in Advertising Sales of the Maui Publishing Co., Ltd., publishers of THE MAUI NEWS, a newspaper published in Wailuku, County of Maui, State of Hawaii; that the ordered publication as to

CULTURAL IMPACT ASSESSMENT NOTICE

of which the annexed is a true and correct printed notice, was published 3 times in THE MAUI NEWS, aforesaid, commencing on the 11th day of January, 2009, and ending on the 15th day of January, 2009, (both days inclusive), to-wit: on

January 11, 14, 15, 2009

and that affiant is not a party to or in any way interested in the above entitled matter.

This 1 page Cultural Impact, dated January 11, 14, 15, 2009, was subscribed and sworn to before me this 15th day of January, 2009, in the Second Circuit of the State of Hawaii, by Rhonda M. Kurohara

LEILA ANN L. LEONG NOTARY PUBLIC No. 03-691 STATE OF HAWAII

Notary Public, Second Judicial Circuit, State of Hawaii

LEILA ANN L. LEONG
My commission expires 11-23-11

CULTURAL IMPACT ASSESSMENT NOTICE

Information requested by SCS Of cultural resources or on-going cultural activities on or near this parcel in Waikapū, Wailuku, Maui. TMK: (2) 3-6-02:001,003 Please respond within 30 days to SCS at (808) 597-1182

(MN: Jan. 11, 14, 15, 2009)

APPENDIX C: UPDATED INQUIRIES

SCIENTIFIC CONSULTANT SERVICES, Inc.

HAWAII

711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

August 30, 2011

Leslie Kuloloio
469 Maalo Street
Kahului, HI 96732

Dear Mr. Kuloloio:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

SCIENTIFIC CONSULTANT SERVICES, Inc.
HAWAII
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

Mr. Charles Maxwell
157 Aiea Place
Pukalani, HI 96768

August 30, 2011

Dear Mr. Maxwell:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs…The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural which support such cultural beliefs…

We are asking you for any information that might contribute to the knowledge of traditional activities, or traditional rights that might be impacted by development of the property. The assessment results are dependent on the response and contributions made by individuals and organizations such as yours. Enclosed is a map showing the proposed project area. Please contact me at our SCS Honolulu office at (808) 597-1182; my cell phone, 225-2355; or home, (808) 637-9539, with any information or recommendations concerning this Cultural Impact Assessment.

Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

SCIENTIFIC CONSULTANT SERVICES, Inc.
HAWAII
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

August 30, 2011

Ke`eaumoku Kapu
Kuleana Kuikahi, LLC.
P.O. Box 11524
Lahaina, Maui 96791

Dear Mr.Kapu:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

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Leann McGerty

Leann McGerty, Senior Archaeologist
Enclosure (1)

SCIENTIFIC CONSULTANT SERVICES, Inc.
HAWAII
711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

Lahaina Hawaiian Civic Club
P.O. Box 10965
Lahaina, HI 96761

August 30, 2011

Dear Members:

Scientific Consultant Services, Inc. (SCS) has been contracted by Munekiyo & Hiraga, Inc., to conduct a Cultural Impact Assessment (CIA) of the Waiale Road Extension Project (TMK:3-6-02:001, 003), that includes the extension of Waiale Road at East Waiko Road to Honoapi`ilani Highway and the improvement of East Waiko Road from Waiale Road to Kuihelani Highway. According to documents supplied by Munekiyo & Hiraga, Inc, SCS has been asked to assess the probability of impacting cultural values and rights within the project area and its vicinity. According to the *Guidelines for Assessing Cultural Impacts* (Office of Environmental Quality Control, Nov. 1997):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs…The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural which support such cultural beliefs…

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Sincerely yours,

Leann McGerty

Leann McGerty,
Senior Archaeologist
Enclosure (1)

APPENDIX H.

Acoustic Study

ACOUSTIC STUDY FOR THE WAIALE ROAD EXTENSION AND EAST WAIKO ROAD IMPROVEMENTS; WAIKAPU, MAUI, HAWAII

Prepared for:

MUNEKIYO & HIRAGA, INC.

Prepared by:

Y. EBISU & ASSOCIATES
1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

MAY 2010

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I. SUMMARY

The existing and future traffic noise levels in the environs of the proposed Waiale Road Extension and East Waiko Road Improvements Project in Waikapu on the island of Maui were studied to evaluate potential noise impacts associated with the Build Alternative. Noise measurements were obtained, traffic noise predictions developed, and noise abatement alternatives evaluated.

Existing traffic noise levels in the project area currently do not exceed the U.S. Federal Highway Administration (FHWA) and Hawaii State Department of Transportation, Highways Division (HDOT) noise abatement criteria along East Waiko Road. Future (CY 2030) traffic noise levels are not expected to exceed the "71 Leq" HDOT noise abatement criteria for industrial or commercial uses along East Waiko Road under the Build or No-Build Alternatives. The "66 Leq" noise abatement criteria will not be exceeded at noise sensitive dwelling units, at any public use facilities, or at park lands in the project environs and within the limits of project construction. Traffic noise mitigation measures should not be required along East Waiko Road under the Build Alternatives. Along the Waiale Road Extension under either Build Alternatives 1 or 2, traffic noise mitigation measures should not be required since the lands along the new roadway are currently undeveloped.

The following general conclusions can be made in respect to the number of impacted structures and lands which can be expected by CY 2030 under the Build Alternative. These conclusions are valid as long as the future vehicle mixes and average speeds do not differ from the assumed values.

- The HDOT's ">15 dB increase" criteria for substantial change in traffic noise levels will not be exceeded at any noise sensitive structure. Maximum increases in traffic noise levels in the project area should not exceed 5.8 dB as a result of growth in traffic volumes and the construction of the project.

- Along the existing section of Waiale Road north of East Waiko Road, noise sensitive residences are located. Future traffic noise levels are anticipated to increase by 4.4 dB without the project, and by an additional 1.4 dB under Alternatives 1 or 2. Future traffic noise levels at these residences are predicted to exceed the "66 Leq" noise abatement criteria with or without the project. The primary reason for this is the relatively high average vehicle speeds (43 mph) which were observed when compared to the posted speed limit of 20 mph. Because these residences are outside the limits of project construction, special noise mitigation measures at these residences are not included with the project improvements.

- Future traffic noise levels at existing residences along the westernmost section of East Waiko Road are predicted to increase by 4.8 dB without the project and by 2.2 dB with the project. Future traffic noise levels at these residences are predicted to exceed the "66 Leq" noise abatement criteria without the project and not exceed the "66 Leq" noise abatement criteria with the project. Because these residences are also outside the limits of project construction and because the project should not cause future traffic noise levels to exceed the "66 Leq" criteria, special noise mitigation measures at these residences are not included with the project improvements.

- No parks or public structures (such as churches) are located within the limits of project construction; therefore, none should be affected by the proposed project or require noise mitigation measures under Build Alternatives 1 or 2.

- Future traffic noise levels at the existing commercial structures along East Waiko Road should not exceed the "71 Leq" noise abatement criteria with or without the project.

Potential short term construction noise impacts are possible during the project construction period primarily in the developed areas of East Waiko Road and in the residential areas west and north of the Waiale Road intersection with East Waiko Road. However, minimizing these types of noise impacts is possible using standard curfew periods, properly muffled equipment, administrative controls, and construction barriers as required.

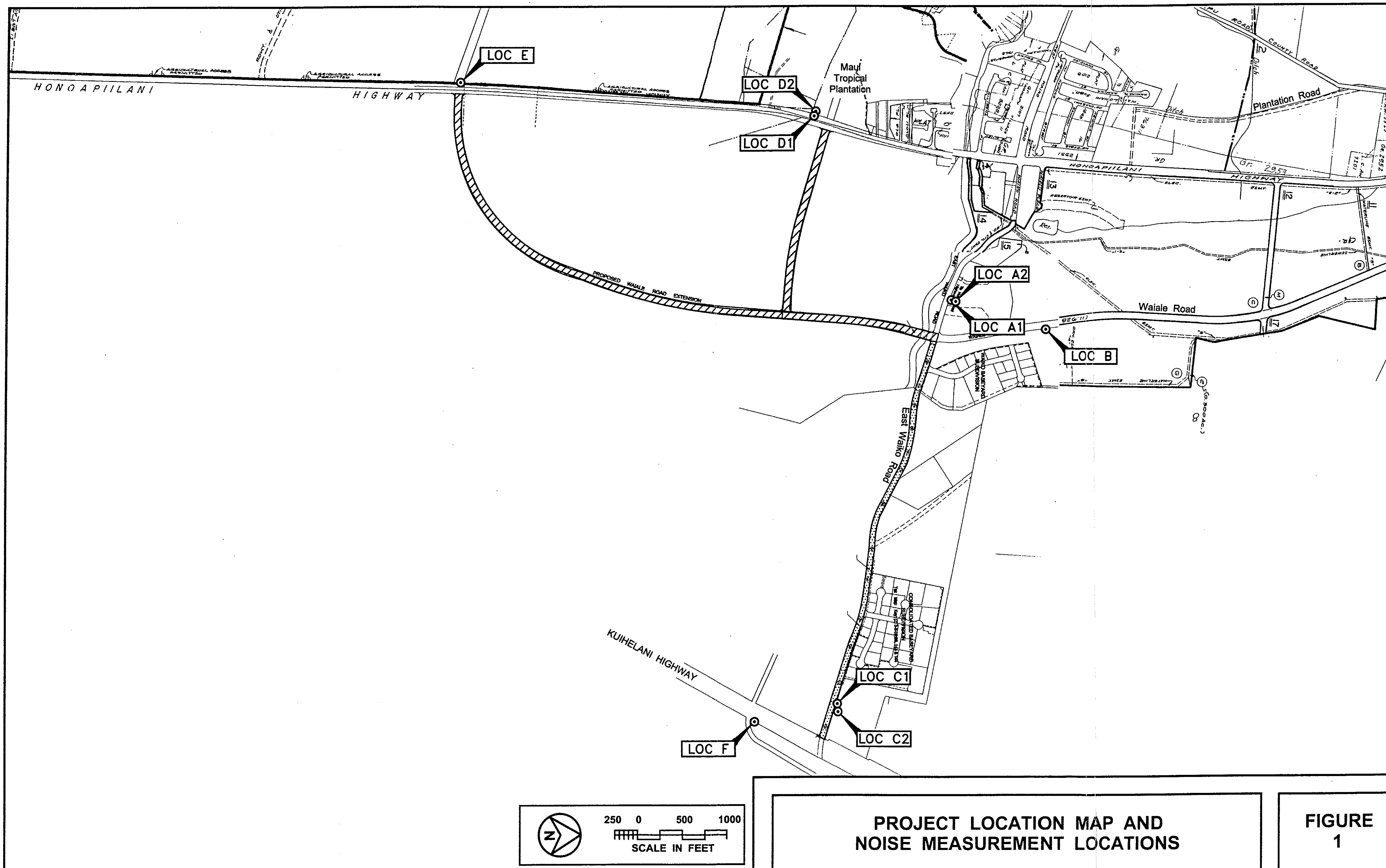
CHAPTER II. GENERAL STUDY METHODOLOGY

Noise Measurements. Existing traffic and background ambient noise levels at nine locations in the project area were measured in April 2010. The traffic noise measurements were used to calibrate the traffic noise model which was used to calculate the Base Year (CY 2009) and future (CY 2030) traffic noise levels under the No Build and 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.

The noise measurement locations ("A1," "A2," "B," "C1," "C2," "D1," "D2," "E," and "F") are shown in Figure 1. The results of the traffic and background noise measurements are summarized in Table 1. 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. With these input speed adjustments, the agreement between measured and predicted traffic noise levels was considered to be good and sufficiently accurate to formulate the Base Year and future year traffic noise levels.

Base Year traffic noise levels were then calculated in the project environs using Base Year (2009) traffic volume data for the AM and PM peak hours from Reference 2. These traffic volumes are summarized in Appendices C1 and C2. 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 noise monitoring periods. Determinations of the periods of highest hourly traffic volumes along the project corridor were made after reviewing the AM and PM peak hour traffic volumes from Reference 2 and the noise measurement results. Total two-way traffic volumes were generally highest during the AM peak hour, but highest during the PM peak hour along Kuihelani Highway. However, measured traffic noise levels were not significantly different for the AM, midday, and PM peak hours. For the purposes of this study, the AM or PM peak



PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

FIGURE 1

TABLE 1
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	------ Hourly Traffic Volume ------ AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A1	50 FT from centerline of E. Waiko Rd. (4/26/10)	0645 TO 0745	40	351	4	4	60.5	60.9
A2	100 FT from centerline of E. Waiko Rd. (4/26/10)	0645 TO 0745	40	351	4	4	55.4	55.8
B	50 FT from centerline of Waiale Rd. (4/26/10)	0754 TO 0854	43	282	8	6	61.8	61.8
B	50 FT from centerline of Waiale Rd. (4/26/10)	1608 TO 1708	44	473	4	0	63.1	63.2
C1	50 FT from centerline of E. Waiko Rd. (4/26/10)	1458 TO 1558	47	501	9	3	64.9	64.8
C2	84 FT from centerline of E. Waiko Rd. (4/26/10)	1458 TO 1558	47	501	9	3	62.4	61.0

TABLE 1 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	------- Hourly Traffic Volume ------ AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
C1	50 FT from centerline of E. Waiko Rd. (4/27/10)	0645 TO 0745	45	732	19	11	66.3	66.1
C2	84 FT from centerline of E. Waiko Rd. (4/27/10)	0645 TO 0745	45	732	19	11	62.6	62.7
D1	50 FT from centerline of Honoapiilani Hwy. (4/26/10)	1017 TO 1117	52	794	21	7	68.2	68.1
D2	100 FT from centerline of Honoapiilani Hwy. (4/26/10)	1017 TO 1117	52	794	21	7	61.9	61.8
E	50 FT from centerline of Honoapiilani Hwy. (4/26/10)	1131 TO 1231	52	779	18	9	68.1	68.1
F	93 FT from centerline of Kuihelani Hwy. (4/26/10)	1255 TO 1355	57	919	28	21	68.4	68.3

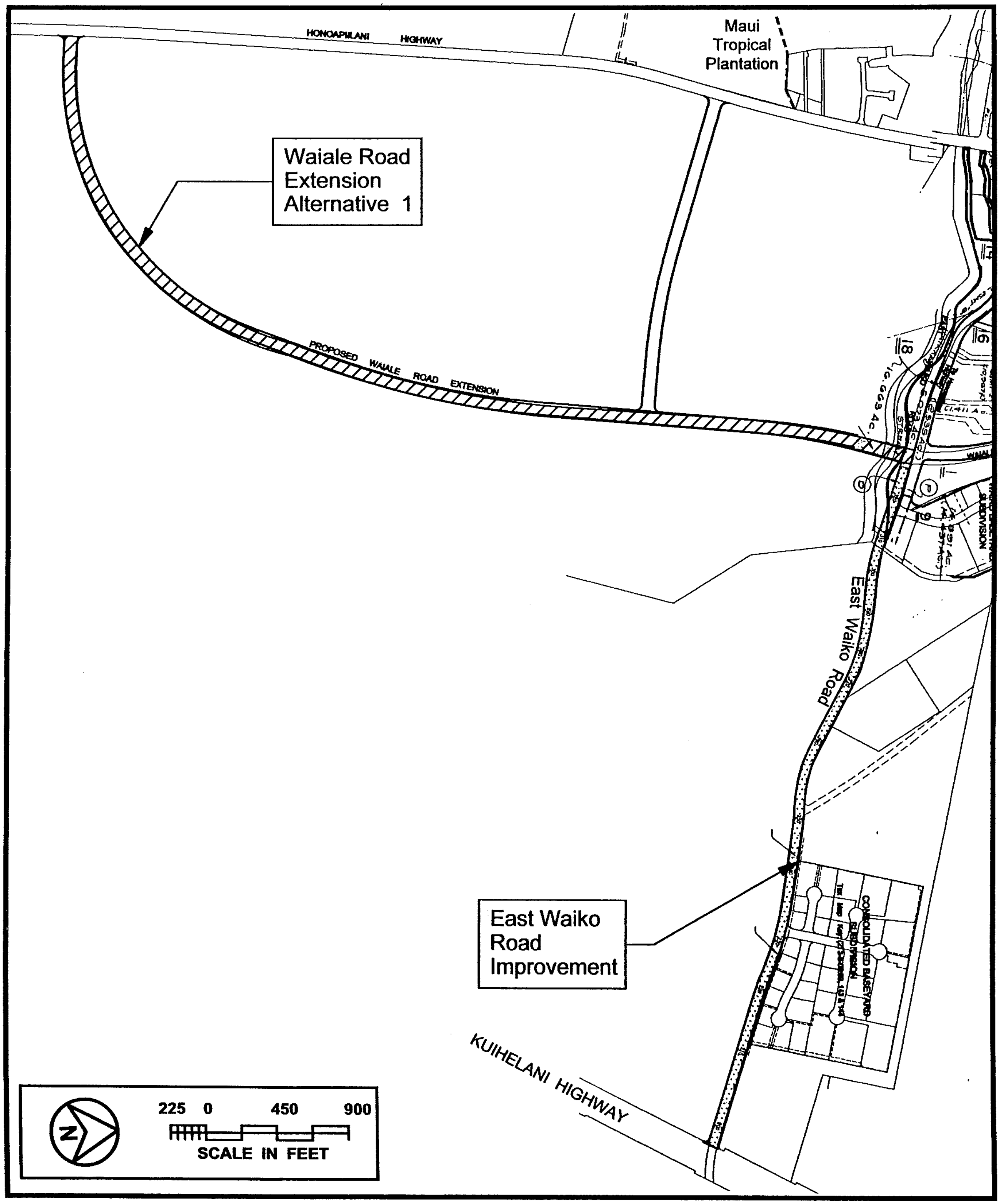
hour (as indicated by the data in Reference 2) was used to model the period with the highest traffic noise levels.

The Equivalent (or Average) Hourly Sound Level [Leq(h)] noise descriptor was used to calculate the Base Year and CY 2030 traffic noise levels as required by Reference 3. Aerial photo maps, tax maps, and project schematic plans (where available) of the area were used to determine terrain, ground cover, and local shielding effects and distances from building structures, which were entered into the noise prediction model. Roadway plans and profiles were not available, so for the purposes of this study, receptor elevations were assumed to be equal to the roadway surface elevations.

Future year (2030) traffic noise levels were then developed for the No Build and Build (roadway improvement) Alternatives using the future traffic assignments of Reference 2. Under the Build Alternative 1, it was assumed that the proposed Waiale Road Extension would be constructed as shown in Figure 2, with traffic volumes in the project environs as shown in Appendix C1. Under the Build Alternative 2, it was assumed that the proposed Waiale Road Extension would be constructed as shown in Figure 3, with traffic volumes in the project environs as shown in Appendix C2. Forecast mixes of vehicle types were assumed to be identical for both existing and future traffic, and vehicle speeds for Year 2030 along existing roadways were assumed to be identical to their Base Year values. Future traffic conditions under the No Build Alternative may worsen, with average vehicle speeds declining as a result of increased congestion. Nevertheless, under the No Build Alternative, average vehicle speeds were assumed to remain the same as current values. Along the new sections of Waiale Road Extension, an average speed of 45 miles per hour was used to model future traffic noise levels under Build Alternatives 1 and 2.

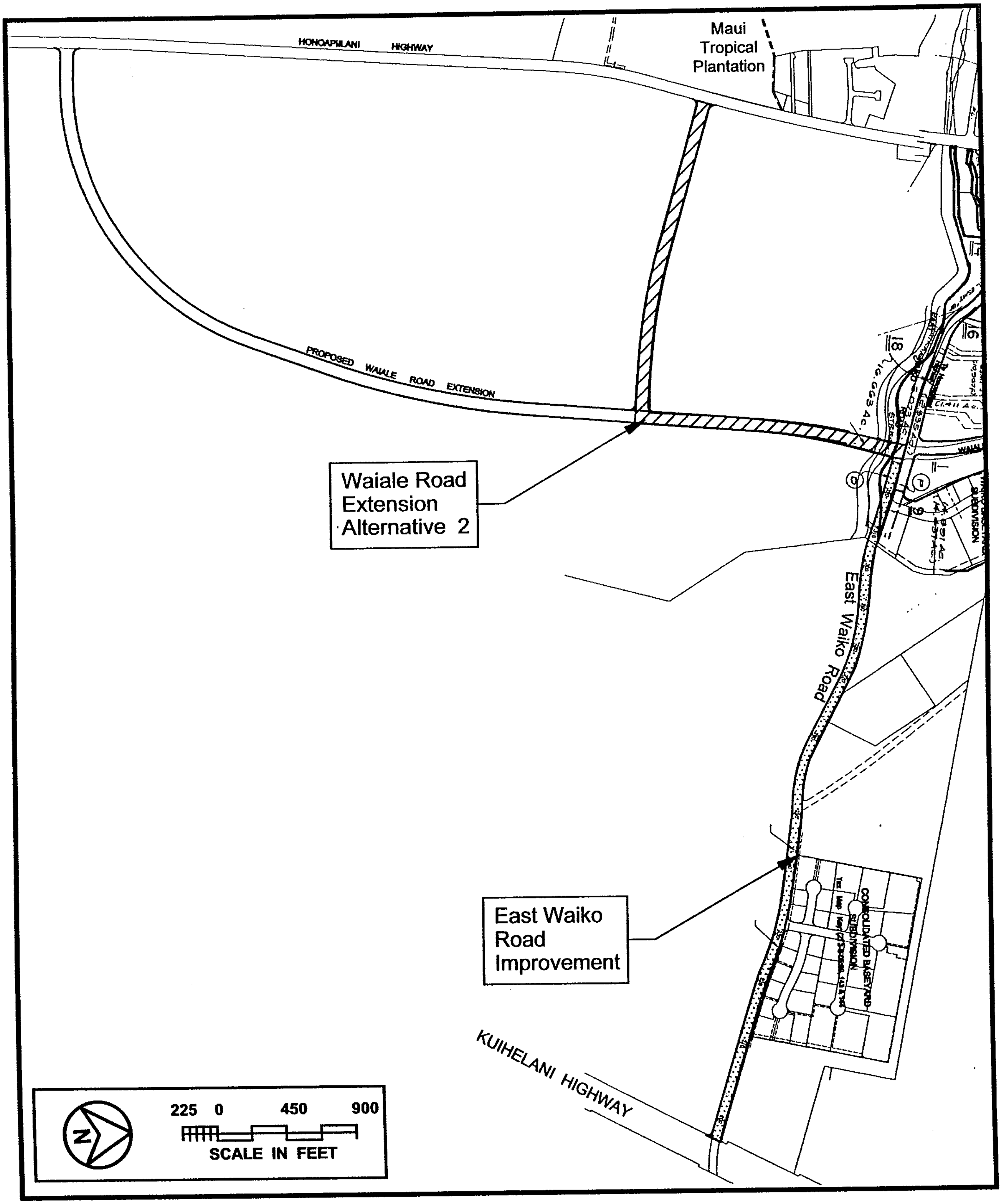
<u>Impact Assessments and Mitigation</u>. Following the calculation of the future traffic noise levels, evaluations of the future traffic noise levels and impacts at existing and potential receptor locations along East Waiko Road and Waiale Road Extension within the limits of construction were made. Comparisons of predicted future traffic noise levels with FHWA and HDOT noise abatement criteria (see Table 2) were made to determine specific locations where the noise abatement criteria are expected to be exceeded.

The HDOT 66 Leq(h) noise abatement threshold criteria and the HDOT "greater than 15 dB increase" criteria were applied to all noise sensitive buildings in the project environs. By Reference 4, the HDOT has replaced the FHWA 67 Leq(h) criteria with their 66 Leq(h) criteria for noise sensitive receptors in Activity Category B. The HDOT 71 Leq(h) noise abatement threshold criteria and the HDOT "greater than 15 dB increase" criteria were applied to all commercial buildings in the project environs and within the limits of project construction. Along the project roadway corridors, the locations of the 66 and 71 Leq(h) traffic noise contours, without the benefit of shielding from natural terrain or man-made sound barriers, were also used to identify noise



PROJECT LOCATION MAP FOR PROJECT ALTERNATIVE 1

FIGURE 2



PROJECT LOCATION MAP FOR PROJECT ALTERNATIVE 2

FIGURE 3

TABLE 2

FHWA NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level– –Decibels (dBA)]

ACTIVITY CATEGORY	LEQ (h)*	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extra–ordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, activity sports areas, parks, residences, motels, hotels, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	------	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

----

* The Hawaii State Department of Transportation, Highways Division, utilizes Leq criteria levels which are 1 Leq unit less than the FHWA values shown.

sensitive and commercial receptor locations, respectively, where the HDOT's noise abatement criteria would not be exceeded, and which would not require more detailed evaluations. In addition, the HDOT's criteria of "greater than 15 dB increase above existing background noise levels" was also used as a noise abatement criteria for this project (from Reference 4).

CHAPTER III. EXISTING ACOUSTICAL ENVIRONMENT

For the purposes of this study, 2009 was used as the Base Year for calculating changes in traffic noise levels associated with the future No Build and Build Alternatives. The Base Year noise environment along the project corridor was described by calculating the Hourly Equivalent Sound Level [Leq(h)] along the existing roadways during the AM or PM peak traffic hour (whichever had the highest traffic volume) for the 2009 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.

Table 3 presents the traffic volume, speed, and mix assumptions used to calculate the Base Year noise levels during the AM or PM peak hour along the existing roadways in the project environs. Shown in Table 3 are the calculated peak hour Leq(h)'s at reference distances of 50, 100, and 150 FT from the geometrical centers of the inbound and outbound lanes of the roadways. The calculated distances to the 66 and 71 Leq noise contour lines under unobstructed, line-of-sight conditions to the roadway are shown in Tables 4A and 4B for the applicable AM or PM peak hour. The actual distances to the contour lines will generally be less than indicated in Tables 4A and 4B when intervening structures or terrain obstructions exist between the roadway and a receptor. This reduction (or shrinkage) of the traffic noise contour distances from the roadway's centerline is the result of noise shielding (or attenuation) effects caused by the intervening structures or terrain features (such as roadway cuts).

By using the traffic noise data shown in Tables 3, 4A, and 4B, and aerial photo maps of the existing improvements on the north and south sides of East Waiko Road and along the roadway corridor for the Waiale Road Extension, the relationship of the existing free-field traffic noise contours to existing structures and commercial buildings in the project area were obtained. No residential dwellings, public use facilities, or park lands border the roadways' corridors within the limits of project construction.

Along East Waiko Road between Waiale Road and Kuihelani Highway, the existing developments consist of livestock yards, and commercial and light industrial buildings. The commercial and light industrial buildings are set back at least 48 feet from the centerline of East Waiko Road. There are no noise sensitive receptors (Activity Category B) along East Waiko Road. From Table 3, existing traffic noise levels at 50 foot setback distance from the centerline of East Waiko Road are approximately 65 Leq. The existing traffic noise levels do not exceed the 71 Leq criteria at existing buildings along East Waiko Road within the limits of project construction.

At the existing residences along Waiale Road north of East Waiko Road, existing traffic noise levels are approximately 63 Leq, and do not exceed the "66 Leq" noise abatement criteria for Activity Category B. Existing traffic noise levels would be approximately 3 Leq units less if existing average vehicle speeds along Waiale Road were 30 mph.

TABLE 3

EXISTING (CY 2009) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS IN PROJECT ENVIRONS (AM OR PM PEAK HOUR)

ROADWAY SECTION (PEAK HR.)	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	150' Leq
Honoapiilani Hwy. South of Old Quarry Rd. (AM)	52	1,236	1,193	31	12	70.0	64.5	61.7
Honoapiilani Hwy. North of Old Quarry Rd. (AM)	52	1,236	1,193	31	12	70.0	64.5	61.7
Honoapiilani Hwy. South of Tropical Plantation (AM)	52	1,236	1,193	31	12	70.0	64.5	61.7
Honoapiilani Hwy. North of Tropical Plantation (AM)	52	1,239	1,196	31	12	70.0	64.5	61.7
E. Waiko Rd. West of Waiale Rd. (AM)	40	310	304	3	3	60.4	55.0	52.2
E. Waiko Rd. East of Waiale Rd. (AM)	45	603	579	15	9	65.2	59.8	57.0
E. Waiko Rd. West of Kuihelani Hwy. (AM)	45	604	580	15	9	65.2	59.8	57.0
Kuihelani Hwy. North of E. Waiko Rd. (PM)	57	1,504	1,426	45	33	74.7	69.8	67.3
Kuihelani Hwy. South of E. Waiko Rd. (PM)	57	1,052	997	32	23	73.1	68.2	65.7
Waiale Rd. North of E. Waiko Rd. (AM)	43	423	404	11	8	63.3	57.9	55.2

Notes:
1. All distances shown are from the center of roadways.
2. Calculated Leq's are for unobstructed line-of-sight conditions.

TABLE 4A

YEAR 2009 AND 2030 DISTANCES TO 66 AND 71 LEQ CONTOURS (ALTERNATIVE 1; AM OR PM PEAK HOUR)

ROADWAY SECTION (PEAK HR.)	66 Leq SETBACK (FT) EXISTING	66 Leq SETBACK (FT) CY 2030	71 Leq SETBACK (FT) EXISTING	71 Leq SETBACK (FT) CY 2030
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	83	123	44	66
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	83	96	44	51
Honoapiilani Hwy. South of Tropical Plantation (PM)	83	96	44	51
Honoapiilani Hwy. North of Tropical Plantation (PM)	83	107	44	57
E. Waiko Rd. West of Waiale Rd. (AM)	24	32	13	17
E. Waiko Rd. East of Waiale Rd. (PM)	45	66	24	35
E. Waiko Rd. West of Kuihelani Hwy. (AM)	45	71	24	37
Kuihelani Hwy. North of E. Waiko Rd. (PM)	171	254	84	125
Kuihelani Hwy. South of E. Waiko Rd. (PM)	137	203	67	101
Waiale Rd. North of E. Waiko Rd. (AM)	35	74	19	39
Waiale Rd. Extension South of E. Waiko Rd. (PM)	N/A	69	N/A	37
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	N/A	61	N/A	32

Notes:

1. All distances shown are from the center of roadway.
2. See TABLES 3, 5A and 5B for traffic volume, speed, and mix assumptions.
3. Setback distances are for unobstructed line-of-sight conditions.

TABLE 4B

YEAR 2009 AND 2030 DISTANCES TO 66 AND 71 LEQ CONTOURS (ALTERNATIVE 2; AM OR PM PEAK HOUR)

ROADWAY SECTION (PEAK HR.)	66 Leq SETBACK (FT) EXISTING	66 Leq SETBACK (FT) CY 2030	71 Leq SETBACK (FT) EXISTING	71 Leq SETBACK (FT) CY 2030
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	83	123	44	66
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	83	123	44	66
Honoapiilani Hwy. South of Tropical Plantation (PM)	83	123	44	66
Honoapiilani Hwy. North of Tropical Plantation (PM)	83	106	44	57
E. Waiko Rd. West of Waiale Rd. (AM)	24	32	13	17
E. Waiko Rd. East of Waiale Rd. (PM)	45	66	24	35
E. Waiko Rd. West of Kuihelani Hwy. (AM)	45	71	24	37
Kuihelani Hwy. North of E. Waiko Rd. (PM)	171	254	84	125
Kuihelani Hwy. South of E. Waiko Rd. (PM)	137	203	67	101
Waiale Rd. North of E. Waiko Rd. (AM)	35	74	19	39
Waiale Rd. Extension South of E. Waiko Rd. (PM)	N/A	69	N/A	37
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	N/A	83	N/A	44

Notes:

1. All distances shown are from the center of roadway.
2. See TABLES 3, 5A and 5B for traffic volume, speed, and mix assumptions.
3. Setback distances are for unobstructed line-of-sight conditions.

Base Year noise levels along Honoapiilani Highway and Kuihelani Highway Rights-of-Way are approximately 70 to 75 Leq due to the higher traffic volumes and higher average vehicle speeds. Existing traffic noise levels along these two highways currently exceed the "66 Leq" noise abatement criteria.

At areas removed from East Waiko Road, Honoapiilani Highway, or Kuihelani Highway, Base Year noise levels are much lower than along the roadway's Rights-of-Way due to distance factors and local shielding effects from buildings and terrain features. Base Year noise levels in areas removed from the high volume roadways are typically less than 55 Leq(h), and possibly as low as 45 Leq(h). Other non-traffic noise sources (birds, distant construction, and foliage moving with the wind) are probably in the order of 45 to 50 Leq(h), with the estimated traffic noise contributions also at 45 to 50 Leq(h) at large distances from the major roadways.

CHAPTER IV. DESCRIPTION OF FUTURE TRAFFIC NOISE LEVELS

The future traffic noise levels in the immediate vicinity of the project during CY 2030 were evaluated for the No Build and Build Alternatives 1 and 2. The same methodology that was used to calculate the Base Year noise levels was also used to calculate the Year 2030 noise levels. Under both the No Build and Build Alternatives, vehicle mixes and average speeds were assumed to be identical to the Base Year values.

Tables 4A, 4B, 5A, and 5B summarize the traffic conditions, noise levels, and setback distances for the two Build Alternatives during the AM or PM peak hour in CY 2030. Tables 6A and 6B also indicate the increases in future traffic noise levels expected under the No Build and Build Alternatives at existing receptor locations along the roadways in the project environs prior to any sound attenuation measures. As indicated in Tables 6A and 6B, future traffic noise levels along East Waiko Road are predicted to increase by approximately 3.4 to 4.8 dB between CY 2009 and CY 2030 solely as a result of projected traffic volume increases under the No Build Alternative. Under the Build Alternatives, the 4.8 dB increase in future traffic noise along the west section of East Waiko Road will be reduced by 2.6 dB (for a net 2.2 dB increase) due to the new Waiale Road extension. The HDOT 71 dB noise abatement criteria will not be exceeded at the existing commercial buildings along East Waiko Road.

Under Build Alternatives 1 or 2, future traffic noise levels along Kuihelani Highway north of East Waiko Road are expected to increase by 0.3 dB as a result of the project. This increase is relatively small when compared to the 2.5 dB increase predicted to occur along the highway without the project.

Under Build Alternatives 1 or 2, future traffic noise levels along Kuihelani Highway south of East Waiko Road are expected to decrease by 0.2 dB as a result of the project. This decrease will occur in addition to the 3.2 dB increase in traffic noise levels predicted to occur along the highway without the project. No adverse noise impacts are anticipated along Kuihelani Highway in the vicinity of the East Waiko Road intersection as a result of this project.

Under Build Alternatives 1 or 2, future traffic noise levels along Honoapiilani Highway south of the proposed intersections with the Waiale Road Extension are expected to increase by 0.4 dB as a result of the project. This increase is relatively small when compared to the 2.9 to 4.1 dB increase predicted to occur along the highway without the project. Along Honoapiilani Highway north of the proposed intersections with the Waiale Road Extension, future traffic noise levels are expected to decline by 1.7 to 2.1 dB as a result of the project. These decreases in traffic noise along Honoapiilani Highway will reduce the expected 2.9 to 4.1 dB increases in future traffic noise levels along Honoapiilani Highway which are predicted to occur without the project. No adverse noise impacts are anticipated along Honoapiilani Highway in the vicinity of the Waiale Road Extension intersections as a result of this project.

TABLE 5A

FUTURE (CY 2030) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS IN PROJECT ENVIRONS (WITH PROJECT ALTERNATIVE 1; AM OR PM PEAK HOUR)

ROADWAY SECTION (PEAK HR.)	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	150' Leq
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	52	2,600	2,509	65	26	73.3	67.7	64.9
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	52	1,625	1,568	41	16	71.2	65.7	62.8
Honoapiilani Hwy. South of Tropical Plantation (PM)	52	1,640	1,583	41	16	71.2	65.7	62.9
Honoapiilani Hwy. North of Tropical Plantation (PM)	52	1,955	1,886	49	20	72.0	66.5	63.7
E. Waiko Rd. West of Waiale Rd. (AM)	40	515	505	5	5	62.6	57.2	54.4
E. Waiko Rd. East of Waiale Rd. (PM)	45	1,275	1,236	26	13	68.2	62.8	60.0
E. Waiko Rd. West of Kuihelani Hwy. (AM)	45	1,365	1,311	34	20	68.7	63.3	60.6
Kuihelani Hwy. North of E. Waiko Rd. (PM)	57	2,865	2,716	86	63	77.5	72.6	70.1
Kuihelani Hwy. South of E. Waiko Rd. (PM)	57	2,065	1,958	62	45	76.1	71.1	68.6
Waiale Rd. North of E. Waiko Rd. (AM)	43	1,605	1,533	40	32	69.1	63.7	61.0
Waiale Rd. Extension South of E. Waiko Rd. (PM)	45	1,380	1,338	28	14	68.6	63.1	60.3
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	45	1,085	1,052	22	11	67.5	62.1	59.3

Notes:
1. All distances shown are from the center of roadways.
2. Calculated Leq's are for unobstructed line-of-sight conditions.

TABLE 5B

FUTURE (CY 2030) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS IN PROJECT ENVIRONS (WITH PROJECT ALTERNATIVE 2; AM OR PM PEAK HOUR)

ROADWAY SECTION (PEAK HR.)	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	150' Leq
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	52	2,615	2,524	65	26	73.3	67.7	64.9
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	52	2,615	2,524	65	26	73.3	67.7	64.9
Honoapiilani Hwy. South of Tropical Plantation (PM)	52	2,615	2,524	65	26	73.3	67.7	64.9
Honoapiilani Hwy. North of Tropical Plantation (PM)	52	1,970	1,901	49	20	72.1	66.5	63.7
E. Waiko Rd. West of Waiale Rd. (AM)	40	515	505	5	5	62.6	57.2	54.4
E. Waiko Rd. East of Waiale Rd. (PM)	45	1,275	1,236	26	13	68.2	62.8	60.0
E. Waiko Rd. West of Kuihelani Hwy. (AM)	45	1,365	1,311	34	20	68.7	63.3	60.6
Kuihelani Hwy. North of E. Waiko Rd. (PM)	57	2,865	2,716	86	63	77.5	72.6	70.1
Kuihelani Hwy. South of E. Waiko Rd. (PM)	57	2,065	1,958	62	45	76.1	71.1	68.6
Waiale Rd. North of E. Waiko Rd. (AM)	43	1,605	1,533	40	32	69.1	63.7	61.0
Waiale Rd. Extension South of E. Waiko Rd. (PM)	45	1,380	1,338	28	14	68.6	63.1	60.3
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	45	1,915	1,858	38	19	70.0	64.5	61.7

Notes:
1. All distances shown are from the center of roadways.
2. Calculated Leq's are for unobstructed line-of-sight conditions.

TABLE 6A

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2030) (WITH ALTERNATIVE 1)

ROADWAY SECTION	NOISE LEVEL INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	2.90	0.40
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	2.90	-1.70
Honoapiilani Hwy. South of Tropical Plantation (PM)	2.90	-1.70
Honoapiilani Hwy. North of Tropical Plantation (PM)	4.10	-2.10
E. Waiko Rd. West of Waiale Rd. (AM)	4.80	-2.60
E. Waiko Rd. East of Waiale Rd. (PM)	3.40	-0.40
E. Waiko Rd. West of Kuihelani Hwy. (AM)	3.50	0.00
Kuihelani Hwy. North of E. Waiko Rd. (PM)	2.50	0.30
Kuihelani Hwy. South of E. Waiko Rd. (PM)	3.20	-0.20
Waiale Rd. North of E. Waiko Rd. (AM)	4.40	1.40
Waiale Rd. Extension South of E. Waiko Rd. (PM)	N/A	23.60
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	N/A	22.50

TABLE 6B

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2030) (WITH ALTERNATIVE 2)

ROADWAY SECTION	NOISE LEVEL INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Honoapiilani Hwy. South of Old Quarry Rd. (PM)	2.90	0.40
Honoapiilani Hwy. North of Old Quarry Rd. (PM)	2.90	0.40
Honoapiilani Hwy. South of Tropical Plantation (PM)	2.90	0.40
Honoapiilani Hwy. North of Tropical Plantation (PM)	4.10	-2.00
E. Waiko Rd. West of Waiale Rd. (AM)	4.80	-2.60
E. Waiko Rd. East of Waiale Rd. (PM)	3.40	-0.40
E. Waiko Rd. West of Kuihelani Hwy. (AM)	3.50	0.00
Kuihelani Hwy. North of E. Waiko Rd. (PM)	2.50	0.30
Kuihelani Hwy. South of E. Waiko Rd. (PM)	3.20	-0.20
Waiale Rd. North of E. Waiko Rd. (AM)	4.40	1.40
Waiale Rd. Extension South of E. Waiko Rd. (PM)	N/A	23.60
Waiale Rd. Extension East of Honoapiilani Hwy. (PM)	N/A	25.00

Under Build Alternatives 1 or 2, future traffic noise levels along Waiale Road north of the intersection with East Waiko Road are expected to increase by 1.4 dB as a result of the project. This increase is relatively small when compared to the 4.4 dB increase predicted to occur along the Waiale Road without the project. Future traffic noise levels will exceed the "66 Leq" noise abatement criteria at existing residences along Waiale Road north of the East Waiko Road intersection with or without the project. No adverse noise impacts are anticipated along Waiale Road in the immediate vicinity of the East Waiko Road intersection and within the limits of project construction as a result of this project.

Because the lands along both sides of the proposed Waiale Road Extension are undeveloped, adverse traffic noise impacts are not expected to occur as a result of the extension project. Future setback distances to the 66 Leq contour are predicted to range from 61 to 83 FT from the centerline of Waiale Road Extension. Future setback distances to the 71 Leq contour are predicted to range from 32 to 44 FT from the centerline of Waiale Road Extension.

The following general conclusions can be made in respect to the impacted structures and lands which can be expected by CY 2030 under the two Build Alternatives. 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 noise sensitive or commercial structure in the project environs or within the limits of project construction. Maximum increases in traffic noise levels at any existing receptor location within the limits of project construction should not exceed 5.8 dB as a result of growth in traffic volumes, the Waiale Road Extension, and improvements to East Waiko Road. Increases in future traffic noise levels are expected to range from 1.2 to 5.8 dB.

- In the now undeveloped lands which the Waiale Road Extension is planned, existing background noise levels are expected to increase by 22 to 25 dB. However, there are no noise sensitive or commercial receptors presently located along the planned Waiale Road Extension under Alternative 1 or 2.

- Within the limits of project construction, exceedances of the "66 Leq" or "71 Leq" noise abatement criteria are not expected to occur.

CHAPTER V. FUTURE TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Future traffic noise levels are not expected to exceed the HDOT 66 or 71 Leq(h) noise abatement criteria by CY 2030 under the two Build Alternatives at existing noise sensitive or commercial structures within the limits of project construction. Therefore, traffic noise mitigation measures should not be required for this project. In addition, the locations of the Waiale Road Extension and the East Waiko Road Improvements are relatively far from existing noise sensitive developments in the project environs, and are located in currently vacant or commercially developed areas rather than residential areas.

It is anticipated that potential noise impacts at any new noise sensitive or commercial establishments located in the project area may be mitigated through the inclusion of sound walls or other noise mitigation measures within the individual lot development plans. In addition, any new commercial establishments, public use facilities, or housing units which may be planned alongside the new or improved roadways represent areas of potential adverse noise impacts if adequate noise mitigation measures are not incorporated into the planning of these future projects. It is anticipated that the project's roadway improvements will be completed prior to any redevelopment of the presently open areas or commercial lots adjacent to a roadway, and that noise abatement measures such as adequate setbacks, sound attenuating walls or berms, or closure and air conditioning will be incorporated into these new developments along the roadway as required. In any event, new structures whose building permits were obtained after the date of this noise study will not qualify for noise abatement measures under existing HDOT procedures.

CHAPTER VI. CONSTRUCTION NOISE IMPACTS

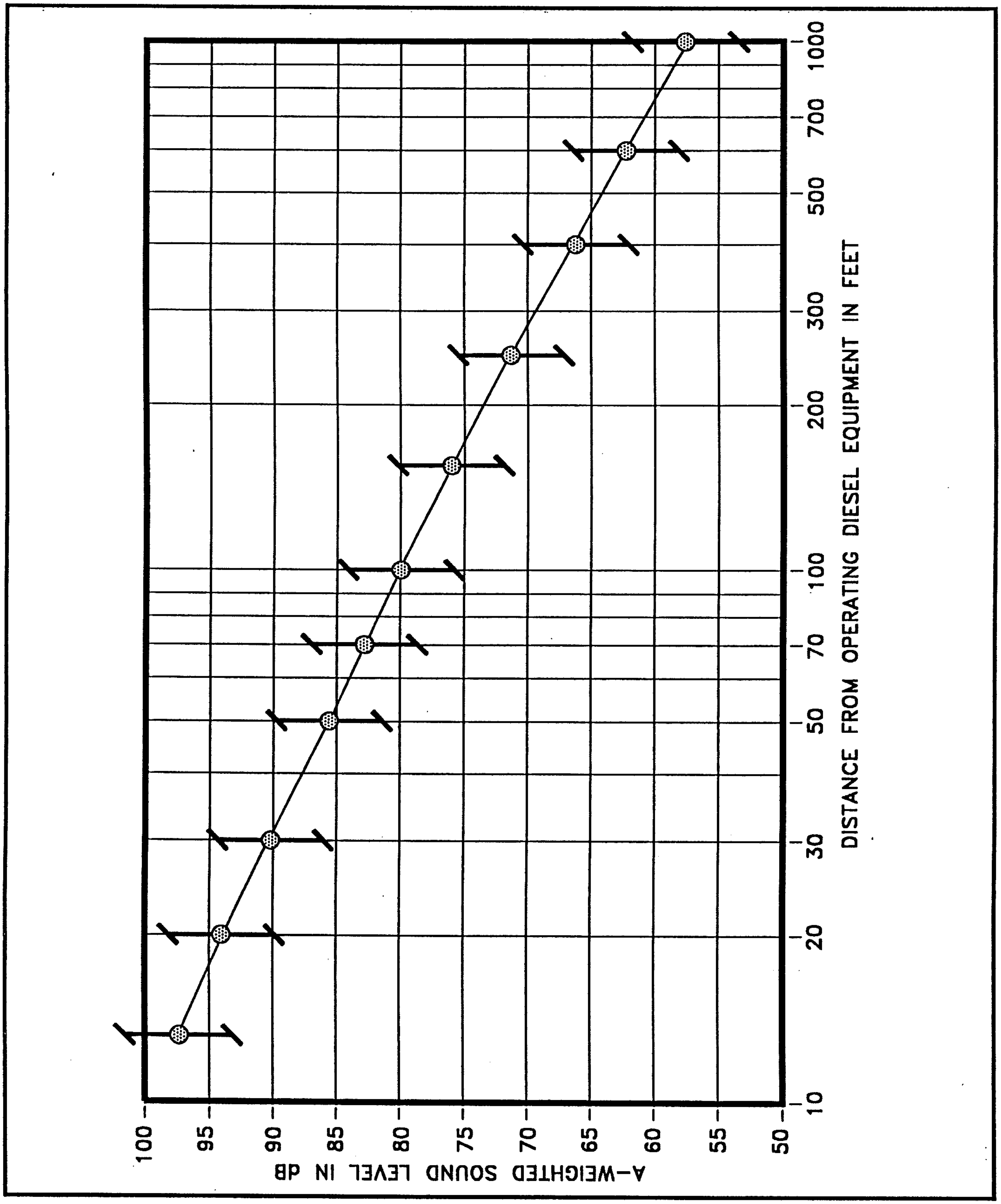
Short-term noise impacts associated with construction activities along the existing and future roadways may occur. These impacts can occur as a result of the short distances (less than 30 FT) between existing commercial structures to the anticipated construction corridor. The total duration of the construction 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 4. 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 4. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project work areas.

Construction noise levels at existing structures can intermittently exceed 90 dB when work is being performed at close distances in front of these structures. Along the East Waiko Road improvement project, distances between the construction sites and receptors are expected to be between 30 and 200 FT, and construction noise levels may intermittently exceed 90 dB. The State Department of Health currently regulates noise from construction activities under a permit system (Reference 5). Under current permit procedures (see Figure 5), noisy construction activities are restricted to hours between 7:00 AM and 6:00 PM, from Monday through Friday, and exclude certain holidays. Noisy construction activities are normally restricted to the hours of 9:00 AM to 6:00 PM on Saturdays, with construction not permitted on Sundays. These restrictions minimize construction noise impacts on noise sensitive receptors (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.

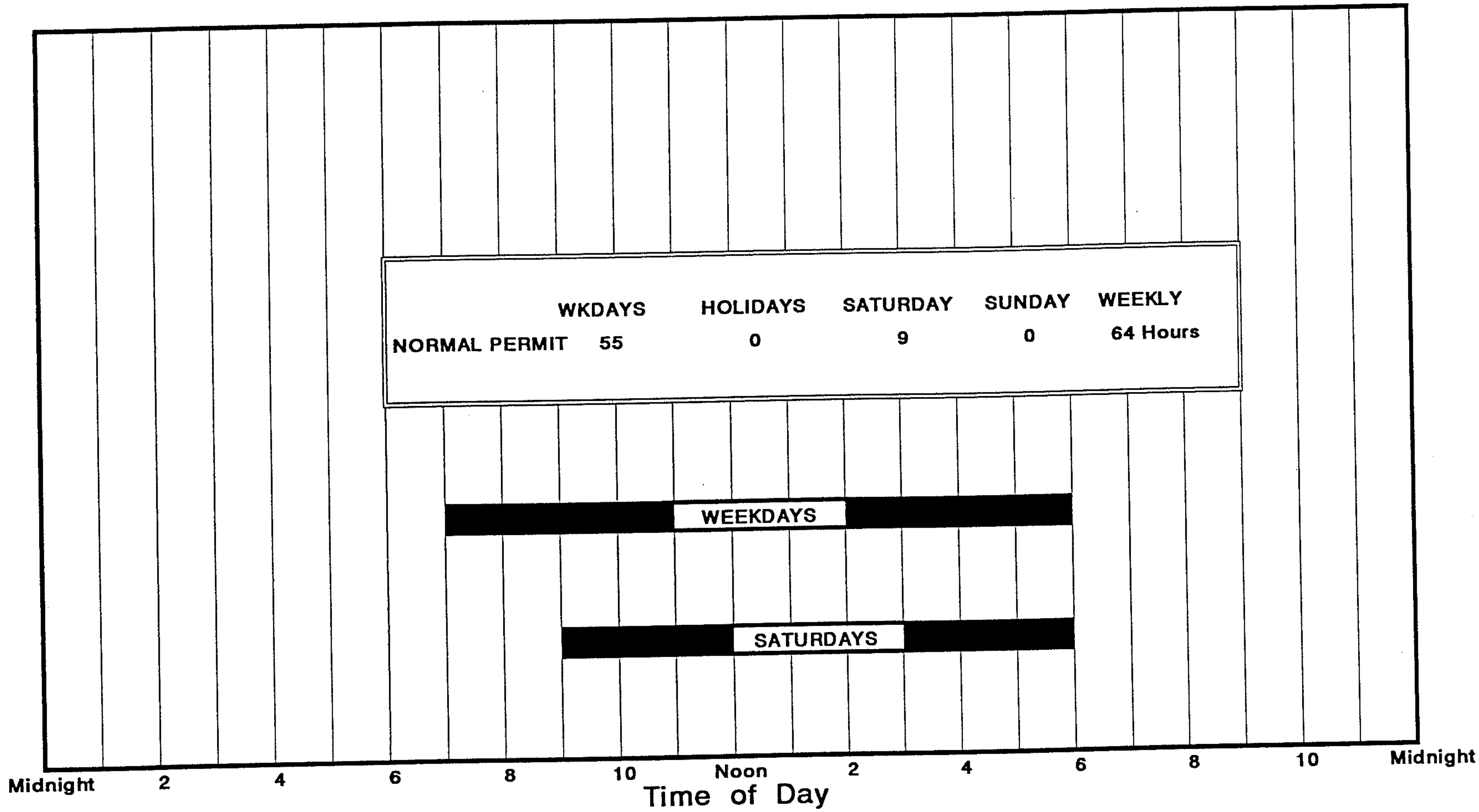
Because primarily commercial establishments are located along East Waiko Road, with the closest residence being at least 1,000 feet from the work areas, the feasibility of performing the improvements along East Waiko Road during the normally non-permitted hours should be considered so as to minimize the impacts on the commercial establishments along East Waiko Road. A Noise Variance from the State Department of Health would be required to perform noisy construction activities during the normally non-permitted hours.

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



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 4



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE 5

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.

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) Draft Traffic Impact Analysis Report, Waiale Road Extension and East Waiko Road Improvements; Austin, Tsutsumi & Associates, Inc.; February 6, 2010.

(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) "Noise Analysis and Abatement Policy;" Hawaii State Department of Transportation, Highways Division, Materials Testing and Research Branch; June 1997.

(5) "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 Over Time(T) [4]	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
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 C1

SUMMARY OF BASE YEAR AND FUTURE YEAR (2030) TRAFFIC VOLUMES ALONG ROADWAYS IN PROJECT ENVIRONS (ALTERNATIVE 1)

ROADWAY LANES	**** CY 2009 *****		CY 2030 (NO BUILD)		CY 2030 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Honoapiilani Hwy., South of Old Quarry Rd. (NB)	641	538	1,000	1,400	1,005	1,455
Honoapiilani Hwy., South of Old Quarry Rd. (SB)	595	557	985	975	1,170	1,145
Two-Way	1,236	1,095	1,985	2,375	2,175	2,600
Honoapiilani Hwy., North of Old Quarry Rd. (NB)	641	538	1,000	1,400	640	935
Honoapiilani Hwy., North of Old Quarry Rd. (SB)	595	557	985	975	695	690
Two-Way	1,236	1,095	1,985	2,375	1,335	1,625
Honoapiilani Hwy., South of Tropical Plantation (NB)	641	538	1,000	1,400	670	960
Honoapiilani Hwy., South of Tropical Plantation (SB)	595	557	985	975	710	680
Two-Way	1,236	1,095	1,985	2,375	1,380	1,640
Honoapiilani Hwy., North of Tropical Plantation (NB)	640	540	1,395	1,580	900	1,055
Honoapiilani Hwy., North of Tropical Plantation (SB)	599	543	1,000	1,545	720	900
Two-Way	1,239	1,083	2,395	3,125	1,620	1,955
E. Waiko Rd., West of Waiale Rd. (WB)	142	152	250	425	185	225
E. Waiko Rd., West of Waiale Rd. (EB)	168	107	505	510	330	270
Two-Way	310	259	755	935	515	495
E. Waiko Rd., East of Waiale Rd. (WB)	245	298	430	585	410	690
E. Waiko Rd., East of Waiale Rd. (EB)	358	204	875	595	840	585
Two-Way	603	502	1,305	1,180	1,250	1,275
E. Waiko Rd., West of Kuihelani Hwy. (WB)	239	287	385	660	405	745
E. Waiko Rd., West of Kuihelani Hwy. (EB)	365	201	967	590	960	555
Two-Way	604	488	1,352	1,250	1,365	1,300
Kuihelani Hwy., North of E. Waiko Rd. (NB)	634	736	1,075	1,335	1,165	1,410
Kuihelani Hwy., North of E. Waiko Rd. (SB)	626	768	1,065	1,370	1,085	1,455
Two-Way	1,260	1,504	2,140	2,705	2,250	2,865
Kuihelani Hwy., South of E. Waiko Rd. (NB)	296	553	520	1,105	520	1,105
Kuihelani Hwy., South of E. Waiko Rd. (SB)	414	499	1,092	1,070	995	960
Two-Way	710	1,052	1,612	2,175	1,515	2,065
Waiale Rd., North of E. Waiko Rd. (NB)	168	202	490	515	690	765
Waiale Rd., North of E. Waiko Rd. (SB)	255	153	680	440	915	735
Two-Way	423	355	1,170	955	1,605	1,500
Waiale Rd. Extension, South of E. Waiko Rd. (NB)	N/A	N/A	N/A	N/A	550	630
Waiale Rd. Extension, South of E. Waiko Rd. (SB)	N/A	N/A	N/A	N/A	490	750
Two-Way	N/A	N/A	N/A	N/A	1,040	1,380
Waiale Rd. Extension, East of Honoapiilani Hwy. (NB)	N/A	N/A	N/A	N/A	425	625
Waiale Rd. Extension, East of Honoapiilani Hwy. (SB)	N/A	N/A	N/A	N/A	460	460
Two-Way	N/A	N/A	N/A	N/A	885	1,085

APPENDIX C2

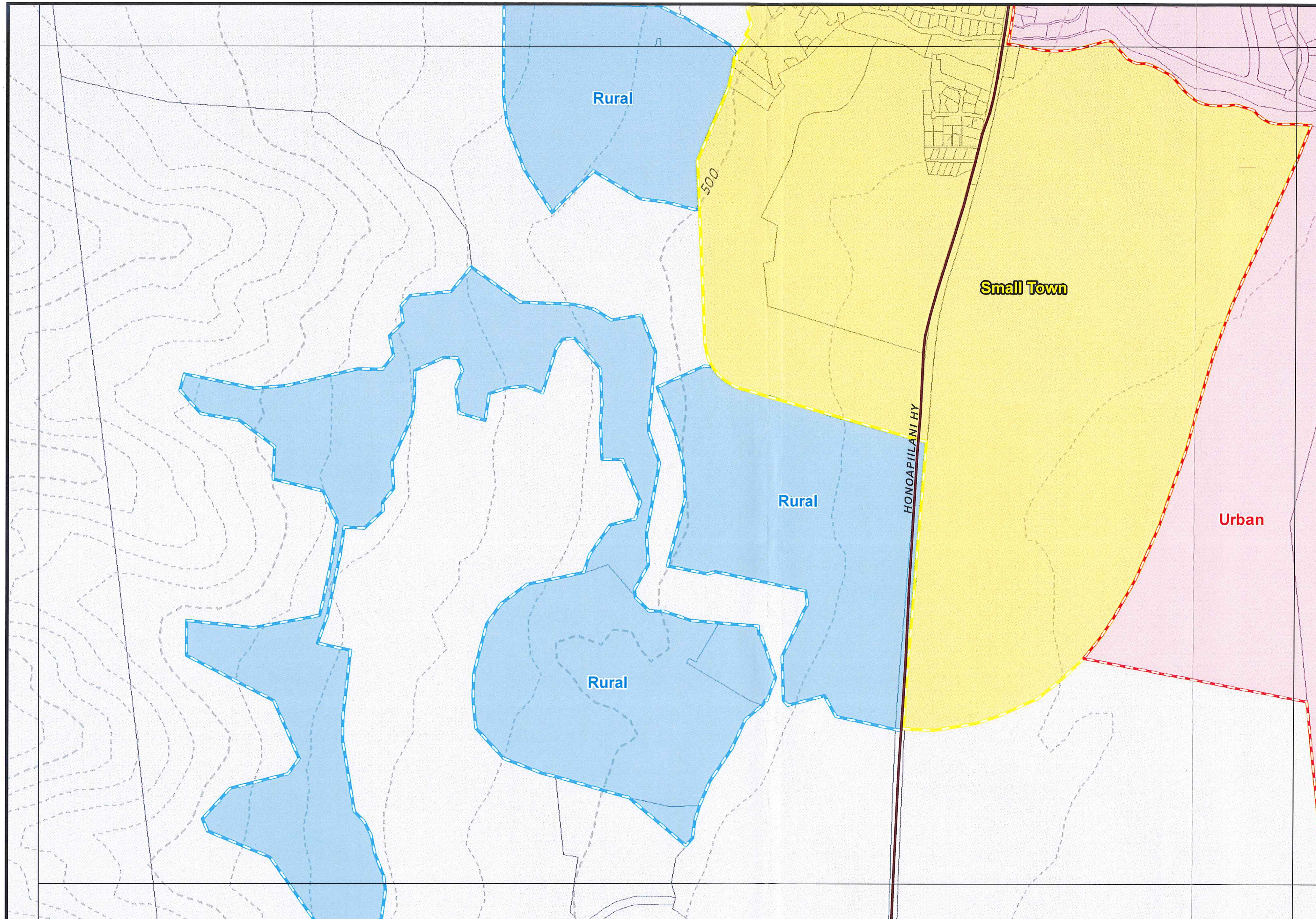
SUMMARY OF BASE YEAR AND FUTURE YEAR (2030) TRAFFIC VOLUMES ALONG ROADWAYS IN PROJECT ENVIRONS (ALTERNATIVE 2)

ROADWAY LANES	**** CY 2009 ***** AM VPH	PM VPH	CY 2030 (NO BUILD) AM VPH	PM VPH	CY 2030 (BUILD) AM VPH	PM VPH
Honoapiilani Hwy., South of Old Quarry Rd. (NB)	641	538	1,000	1,400	1,055	1,530
Honoapiilani Hwy., South of Old Quarry Rd. (SB)	595	557	985	975	1,145	1,085
Two-Way	1,236	1,095	1,985	2,375	2,200	2,615
Honoapiilani Hwy., North of Old Quarry Rd. (NB)	641	538	1,000	1,400	1,055	1,530
Honoapiilani Hwy., North of Old Quarry Rd. (SB)	595	557	985	975	1,145	1,085
Two-Way	1,236	1,095	1,985	2,375	2,200	2,615
Honoapiilani Hwy., South of Tropical Plantation (NB)	641	538	1,000	1,400	1,055	1,530
Honoapiilani Hwy., South of Tropical Plantation (SB)	595	557	985	975	1,145	1,085
Two-Way	1,236	1,095	1,985	2,375	2,200	2,615
Honoapiilani Hwy., North of Tropical Plantation (NB)	640	540	1,395	1,580	905	1,060
Honoapiilani Hwy., North of Tropical Plantation (SB)	599	543	1,000	1,545	730	910
Two-Way	1,239	1,083	2,395	3,125	1,635	1,970
E. Waiko Rd., West of Waiale Rd. (WB)	142	152	250	425	185	225
E. Waiko Rd., West of Waiale Rd. (EB)	168	107	505	510	330	270
Two-Way	310	259	755	935	515	495
E. Waiko Rd., East of Waiale Rd. (WB)	245	298	430	585	410	690
E. Waiko Rd., East of Waiale Rd. (EB)	358	204	875	595	840	585
Two-Way	603	502	1,305	1,180	1,250	1,275
E. Waiko Rd., West of Kuihelani Hwy. (WB)	239	287	385	660	405	745
E. Waiko Rd., West of Kuihelani Hwy. (EB)	365	201	967	590	960	555
Two-Way	604	488	1,352	1,250	1,365	1,300
Kuihelani Hwy., North of E. Waiko Rd. (NB)	634	736	1,075	1,335	1,165	1,410
Kuihelani Hwy., North of E. Waiko Rd. (SB)	626	768	1,065	1,370	1,085	1,455
Two-Way	1,260	1,504	2,140	2,705	2,250	2,865
Kuihelani Hwy., South of E. Waiko Rd. (NB)	296	553	520	1,105	520	1,105
Kuihelani Hwy., South of E. Waiko Rd. (SB)	414	499	1,092	1,070	995	960
Two-Way	710	1,052	1,612	2,175	1,515	2,065
Waiale Rd., North of E. Waiko Rd. (NB)	168	202	490	515	690	765
Waiale Rd., North of E. Waiko Rd. (SB)	255	153	680	440	915	735
Two-Way	423	355	1,170	955	1,605	1,500
Waiale Rd. Extension, South of E. Waiko Rd. (NB)	N/A	N/A	N/A	N/A	550	630
Waiale Rd. Extension, South of E. Waiko Rd. (SB)	N/A	N/A	N/A	N/A	490	750
Two-Way	N/A	N/A	N/A	N/A	1,040	1,380
Waiale Rd. Extension, East of Honoapiilani Hwy. (EB)	N/A	N/A	N/A	N/A	610	1,045
Waiale Rd. Extension, East of Honoapiilani Hwy. (WB)	N/A	N/A	N/A	N/A	850	870
Two-Way	N/A	N/A	N/A	N/A	1,460	1,915

APPENDIX I.

Planning Department Directed Growth Map Wailuku/Kahului C3

Maui Island Plan Directed Growth Boundaries



Legend

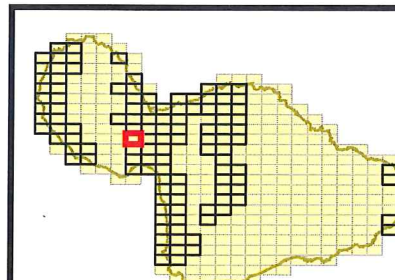
Growth Boundaries

- Urban
- Small Town
- Rural

Reference

- Primary Roads
- 2011 Parcels
- 100 Ft. Contours

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



G-11

Waikapu

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

Feet

0 1,000 2,000 4,000

APPENDIX J.

March 16, 2010 Community Informational Meeting Summary

MUNEKIYO HIRAGA, INC.

MICHAEL T. MUNEKIYO
GWEN OHASHI HIRAGA
MITSURU "MICH" HIRANO
KARLYNN FUKUDA

MARK ALEXANDER ROY

March 29, 2010

MEETING MEMORANDUM

Date of Meeting: March 16, 2010

From: Leilani Pulmano, Project Manager

Subject: Proposed Waiale Road Extension and Waiko Road Improvement

Participants: Milton Arakawa ***(Department of Public Works)***
Chico Rabara ***(Department of Public Works)***
Trang Nguyen ***(Austin, Tsutsumi & Associates, Inc.)***
Keith Niiya ***(Austin, Tsutsumi & Associates, Inc.)***
Matt Nakamoto ***(Austin, Tsutsumi & Associates, Inc.)***
Mich Hirano ***(Munekiyo & Hiraga, Inc.)***
Leilani Pulmano ***(Munekiyo & Hiraga, Inc.)***
Members of the Community ***(See Attached List)***

Purpose of Meeting: Community Informational meeting for the proposed project.

The sign-in sheet for the meeting is attached. The community's concerns and comments were the following:

1. Traffic Safety on Waiale Road

Waikapu Gardens' homeowners were concerned about the additional traffic that will be added on Waiale Road, as well as the existing speeds vehicles travel on the roadway. They currently experience traffic congestion entering and exiting Waikapu Gardens and feel that the Waiale Road Extension will increase the traffic congestion. They suggested that the roadway design look "neighborly". Some examples of "neighborly" roadway design were islands and medians.

2. Bikeway

A community member asked about bike lanes and the possibility of providing an off road bikeway along the entire Waiale Road. Additionally, the bikeway should tie into a regional bikeway system.

3. ***Roundabouts***

A few community members expressed their desire to incorporate roundabouts into the design to slow traffic down along Waiale Road at East Waiko Road and Waikapu Gardens intersections.

Austin, Tsutsumi & Associates, Inc. (ATA) said that they will study roundabouts as part of the project. The results of the study will be included as part of the Traffic Report.

4. ***Landscaping along Waiale Road***

A community member suggested to use grass swales instead of asphalt concrete swales and to provide a landscaping plan along Waiale Road to improve the aesthetics of the road.

5. ***Routing Alternatives***

A community member asked if there were alternatives that were considered, perhaps, a route further south of Waiale Road. ATA informed the community member that as future projects are built out, the projects will be responsible to provide alternative local and regional roadways. This was a specific reference to A&B's Waiale project.

6. ***Number of Lanes***

A community member inquired about the number of lanes for Waiale Road which was confirmed at two (2).

7. ***Flooding on East Waiko Road***

A community member said that flooding occurs during heavy rain on East Waiko Road and was concerned about the drainage system for the improvements.

8. ***Waikapu Community Association***

Waikapu Community Association would like to be a consulted party to the EA/EIS.

Leilani Pulmano
Project Manager

LP:yp
Attachment
cc: Milton Arakawa, Department of Public Works (w/attachment)
Chico Rabara, Department of Public Works (w/attachment)
Trang Nguyen, Austin, Tsutsumi & Associates, Inc. (w/attachment)
Keith Niiya, Austin, Tsutsumi & Associates, Inc. (w/attachment)
Matt Nakamoto, Austin, Tsutsumi & Associates, Inc. (w/attachment)

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COUNTY OF MAUI, DEPARTMENT OF PUBLIC WORKS
Proposed Waiale Road Extension and East Waiko Road
Community Meeting at Waikpu Community Center
Attendance Sheet
March 16, 2010
6:00 p.m.

PLEASE PRINT

Name	Address	E-mail	Telephone
1 RANDY DECAMBRA			
2 Amber Gonsalves Andrew Bartoces			
3 Valerie Standing			
4 Christine Taylor			
* 5 GLENN & Cheryl Adolpho			
6 Kathleen Aoki			
7 Darlene Rogers			
8 Klalette Pellegrino			
9 Michael P Victorino			
10 JACOB & BERTHA VERKERKE			

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Name	Address	E-mail	Telephone
11 Eric Ikeuchi			
12 George Kaya			
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