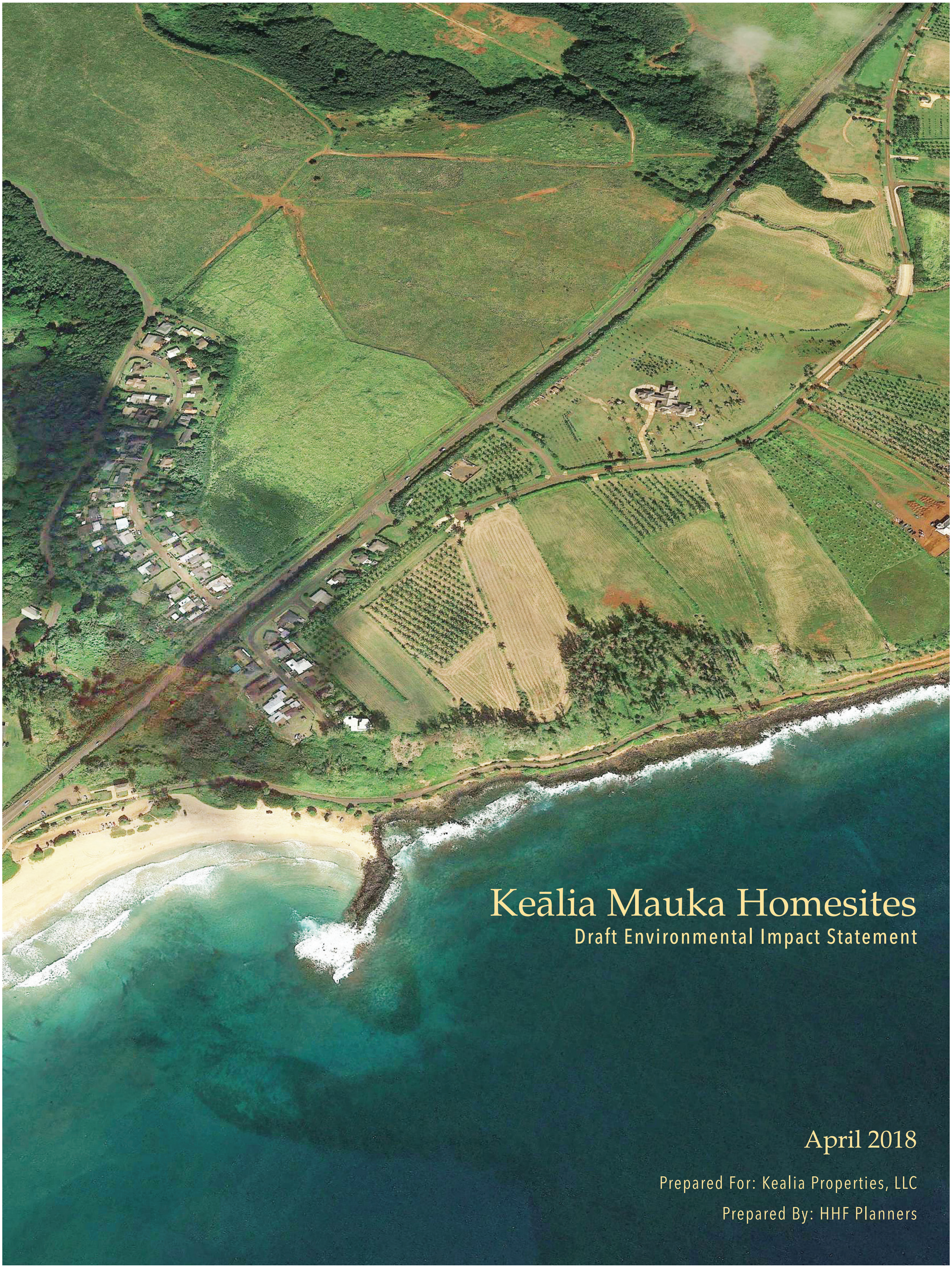

Keālia Mauka Homesites

Draft Environmental Impact Statement

April 2018

Prepared For: Kealia Properties, LLC

Prepared By: HHF Planners

Keālia Mauka Homesites

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Keālia Mauka Homesites

Draft Environmental Impact Statement

Keālia, Kaua'i County

Prepared For: Kealia Properties, LLC

Prepared By: HHF Planners

This final environmental impact statement and all ancillary documents were prepared under the signatory's direction or supervision, and the information submitted, to the best of the signatory's knowledge, fully addresses document content requirements as set forth in Chapter 343, Hawai'i Revised Statutes, and Section 11-200-17, Hawai'i Administrative Rules.

Scott Ezer

4.25.18

Scott Ezer
Vice President
HHF Planners

Date

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TABLE OF CONTENTS

Section Page

List of Figures

List of Tables

Appendices

Acronyms and Abbreviations

AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawai\`i
AMP	Archaeological Monitoring Plan
APE	Area of Potential Effect
ATA	Austin, Tsutsumi & Associates
BFE	Base Flood Elevation
BMP	Best Management Practice
CAA	Clean Air Act
CC&Rs	Covenants, Conditions & Restrictions
CCD	Census County Division
CCR	Consumer Confidence Report
CEDS	Comprehensive Economic Development Strategy
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIA	Cultural Impact Assessment
CSH	Cultural Surveys Hawaiʻi, Inc.
CWRM	State Commission on Water Resource Management
CZMA	Coastal Zone Management Area
CWA	Clean Water Act
CZO	Comprehensive Zoning Ordinance
DAR	Division of Aquatic Resources
dB	decibel
dBA	Sound pressure level ("A" weighting filter)
DBEDT	Department of Business, Economic Development and Tourism
DEIS	Draft Environmental Impact Statement
DHHL	Department of Hawaiian Home Lands
DLNR	State Department of Land and Natural Resources
DOE	State Department of Education
DOH	State Department of Health
EDA	Economic Development Administration
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice

EKDP	East Kauaʻi Development Plan
EMS	Emergency Medical Services

Acronyms and Abbreviations *(continued)*

EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
FHWA	Federal Highway Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FTE	full time equivalent
gpd	Gallons per Day
gpm	Gallons per Minute
HAR	Hawaiʻi Administrative Rules
HDOT	State Department of Transportation
HRS	Hawaiʻi Revised Statutes
HRS	Hawaiʻi Revised Statutes
HSA	Hawaiʻi Stream Assessment
HEER	Hazard Evaluation and Emergency Response
HUD	U.S. Department of Housing and Urban Development
HWP	Hawaiʻi Water Plan
IAL	important agricultural lands
ITE	Institute of Traffic Engineers
km/hr	kilometers per hour
KNIBC	Kauaʻi/Niʻihau Island Burial Council
KUIC	Kauaʻi Island Utility Corporation
KRTDM	Kauaʻi Regional Travel Demand Model
KWA	Kauaʻi Watershed Alliance
KWS	Keālia Water System
Ldn	day-night average sound level
LEED	Leadership in Energy and Environmental Design
$L_{eq(h)}$	Maximum hourly equivalent sound levels
LLC	limited liability corporation
LOS	Level-of-Service
LRFI	Literature Review and Field Inspection
LSB	Land Study Bureau
LUC	State Land Use Commission
mgd	million gallons per day
MLTP	Multimodal Land Transportation Plan
mph	miles per hour
msl	mean seal level
MUTCD	Manual of Uniform Traffic Control Devices
MW	megawatts
NAAQS	National Ambient Air Quality Standards
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Services
NRHP	National Register of Historic Places
OEQC	Office of Environmental Quality Control
OHA	Office of Hawaiian Affairs
PAYT	Pay as You Throw

PER	Preliminary Engineering Report
REC	Recognized Environmental Condition

Acronyms and Abbreviations *(continued)*

ROW	Right-of-Way
SF	Square Feet or Square Foot
SGR	student generation rate
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Places
SLR	sea level rise
SLH	Session Laws of Hawaiʻi
SMA	Special Management Area
TIAR	Traffic Impact Analysis Report
TMK	Tax Map Key
TVR	transient vacation rentals
UBC	Uniform Building Code
UH	University of Hawaiʻi
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WUDP	Water Use and Development Plan
WWTP	Wastewater Treatment Plan

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1.0 INTRODUCTION

This document has been prepared in support of a Petition by Keālia Properties, LLC to the State of Hawaiʻi Land Use Commission (LUC) to amend the Agricultural Land Use District Boundary into the Urban Land Use District (Docket No. A17-803).The Petition Area is comprised of approximately 53.4 acres of land at Keālia, Kawaihau, Puna, Island of Kauaʻi, State of Hawaiʻi. The Petition Area is identified as TMK (4) 4-7-004: por. 001.

The Petitioner, Keālia Properties, LLC proposes to develop a residential subdivision within the Petition Area, consisting of approximately 235 lots ranging in area from about 5,600 SF to 7,300 SF (Figures 1 and 2). The Proposed Action includes installation of utility infrastructure (e.g., potable water, drainage, wastewater, electrical power, and telecommunications systems) and transportation improvements to serve the new subdivision. Improved, construction-ready house lots will available for sale to the public.

The Petition Area (also referred to as the "Project Site") (Figure 3) is located adjacent to an existing 38-lot residential subdivision in Keālia. The Petition Area is agriculturally-zoned land formerly part of the Līhuʻe Plantation holdings, and was formerly utilized for sugar cane cultivation. The site and surrounding lands are currently used for cattle grazing.

1.1 PROJECT SUMMARY

Project Name:	Keālia Mauka Homesites
Location:	Keālia Ahupuaʻa, Kawaihau District, Island of Kauaʻi, Hawaiʻi
Petitioner/Owner:	Keālia Properties, LLC c/o Ms. Moana Palama Hawaii Management Services LLC P.O. Box 1630 Kōloa, HI 96756
Accepting Agency:	State of Hawaiʻi Land Use Commission (LUC) Department of Business, Economic Development & Tourism P.O. Box 2359 Honolulu, HI 96804-2359
Tax Map Key/ Coordinates:	(4) 4-7-004: por. 001 Coordinates: 22° 6' 22" N, 159° 18' 19" W
Petition Area:	53.4 acres
Existing Use:	Agriculture (cattle grazing)
Proposed Use:	Residential

<table>
<tr><td>Proposed Action:</td><td>Subdivision of 53.4 acres of grazing lands adjacent to an existing 38-lot residential subdivision, into approximately 235 single-family house lots ranging in size from about 5,600 square feet (SF) to 7,300 SF. Each house lot to be served by municipal and private utilities and infrastructure, including potable water, stormwater drainage, wastewater, electrical power, and telecommunications systems.</td></tr>
<tr><td>Land Use Designations:</td><td>State Land Use District: Agricultural (see Figure 5-1)
Kaua‘i General Plan: Residential Community (see Figure 5-2)
County Zoning: Agriculture (see Figure 5-3)
Special Management Area (SMA): Not in SMA (see Figure 5-3)</td></tr>
<tr><td>Flood Zone Designation:</td><td>Zone X, Area of minimal flood hazard, outside the 500-year flood (see Figure 3-2)</td></tr>
<tr><td>Permits Required:</td><td>State of Hawai‘i
Department of Health
• National Pollutant Discharge Elimination System (NPDES) Permit
• Construction Noise Permit
Department of Land and Natural Resources, State Historic Preservation Division
• Historic Preservation Review, Chapter 6E, HRS
Department of Transportation
• Permit to Perform Work Upon State Highway
• Private Storm Drain Connection and/or State Highways Division Storm Drain System
County of Kaua‘i
County Council
• Zoning Amendment
Planning Commission
• Subdivision Approval
Department of Public Works
• Grading, grubbing, and stockpiling permits, building permit</td></tr>
<tr><td>Chapter 343 HRS Determination:</td><td>Under the provisions of Act 172 (12), the State Land Use Commission (LUC) has determined at the outset that the proposed action requires the preparation of an environmental impact statement (EIS), based on the significance criteria set forth in Chapter 200, Title 11, State of Hawai‘i Department of Health. The proposed action may meet the criterion for “potential curtailment of the range of beneficial uses of the environment” and because it may “involve substantial secondary impacts, such as effects on public facilities” (HAR §11-200-12 [b][2] and [6]). (See discussion in Chapter 5).</td></tr>
</table>

1.2 PETITIONER

Keālia Properties, LLC is the Petitioner and Ms. Moana Palama is their authorized representative.

Contact: Keālia Properties, LLC
c/o Ms. Moana Palama
Hawaii Management Services LLC
P.O. Box 1630
Kōloa, HI 96756
Phone: (808) 742-9784
Email: moana@mskauai.com

1.3 ACCEPTING AUTHORITY

The State of Hawaiʻi Land Use Commission (LUC) is the accepting authority for EIS.

Contact: Daniel E. Orodenker, Executive Officer
State of Hawaiʻi Land Use Commission (LUC)
Department of Business, Economic Development & Tourism
P.O. Box 2359
Honolulu, HI 96804-2359
Phone: (808) 587-3822
Email: Daniel.e.orodenker@hawaii.gov

1.4 ENVIRONMENTAL PLANNING CONSULTANT

HHF Planners is the Applicant's environmental planning consultant.

Contact: Scott Ezer, Principal
HHF Planners
733 Bishop Street, Suite 2590
Honolulu, HI 96813
Phone: (808) 457-3158
Email: sezer@hhf.com

1.5 COMPLIANCE WITH HAWAIʻI ENVIRONMENTAL REVIEW LAWS

This Draft Environmental Impact Statement (DEIS) was prepared in accordance with the requirements of Hawaiʻi Revised Statutes (HRS) §343 and Chapter 200 of Title 11, Hawaiʻi Administrative Rules (HAR) in support of a State Land Use District boundary amendment to reclassify lands at Keālia, Kawaihau District, Island of Kauaʻi, Hawaiʻi from the State Agricultural District to the State Urban District. This HRS 343 environmental review is required due to the project's proposed use of State of Hawaiʻi and County of Kauaʻi lands associated with infrastructure improvements within public roadways, including Kūhiō Highway (State Route 56) and Keālia Road.

Use of State or County land is an action which triggers an environmental assessment under HRS §343-5(a)(1).

Act 172, Session Laws of Hawaiʻi (SLH) signed by the Governor on June 27, 2012 (Act 172 [12]), allows an agency to determine from the outset that the project may have a "significant impact" and an Environmental Impact Statement (EIS) is likely to be required. The applicant may then proceed directly to prepare the EIS. The determination of whether the project will likely have a significant impact is measured by the significance criteria under §11-200-12(b) of the HAR.

The Proposed Action will provide approximately 235 residential lots on approximately 53.4 acres of currently vacant land. The Proposed Action would result in the loss of the natural landscape as it currently exists, may substantially affect the economic and social welfare of the community or State, and may involve secondary impacts such as population change or effects on public facilities. (See HAR §11-200-12 (b)(1), (4) and (6), respectively).

Based on its review of the significance criteria and through its judgment and experience, the LUC, as Accepting Authority, determined on November 8, 2017 that the Proposed Action may have a significant effect on the environment and that an EIS should be prepared. An Environmental Impact Statement Preparation Notice (EISPN) was prepared and published in *The Environmental Notice*, the Office of Environmental Quality Control's (OEQC) bimonthly bulletin on November 23, 2017. The 30-day public consultation period ended on December 26, 2017.

1.6 STUDIES CONTRIBUTING TO THIS DEIS

The information in this document has been obtained from site visits, print and online reference sources, previously completed reports and technical studies, and the following technical studies that were prepared for this Proposed Action. The technical studies are included in the Appendix.

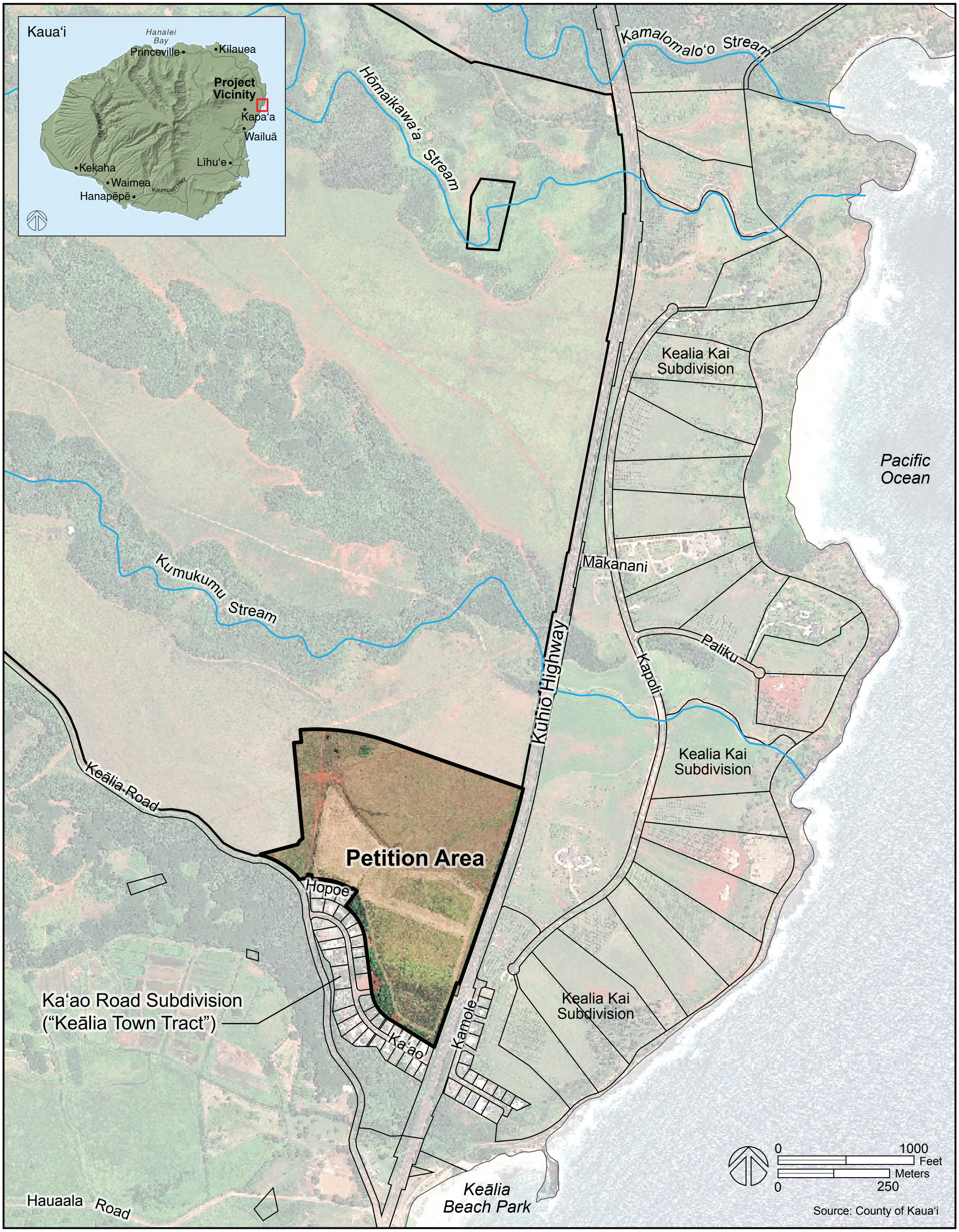
- Biological Surveys (Flora and Fauna)
- Archaeological Literature Review and Field Inspection
- Cultural Impact Assessment
- Market and Econometric Studies
- Preliminary Engineering Report
- Traffic Study
- Hydrogeological letter report

Regional Location Map **Figure 1-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC



Project Vicinity Map **Figure 1-2**

Keālia Mauka Homesites

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Tax Map Key Map **Figure 1-3**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 BACKGROUND HISTORY

The Petition Area was historically used for sugar cane cultivation, beginning with the Makee Sugar Company which was established in Kapaʻa in 1877, and later with Līhuʻe Plantation. Sugar cultivation was the first large-scale agricultural enterprise in the Keālia area. In 1934, the Makee Sugar Company was absorbed by the Līhuʻe Plantation Company, Ltd., a subsidiary of Honolulu-based Big Five company American Factors (later Amfac). As sugar became less profitable in the latter part of the twentieth century, the Līhuʻe Plantation began to phase out its operations. In 1997, the entire *ahupuaʻa* of Keālia, including the Petition Area, was sold off by Amfac. Because Keālia was the most distant from the Līhuʻe Plantation sugar mill, it was considered the least profitable. The Līhuʻe Plantation completely closed at the end of the twentieth century, and sugar cane production has since ceased throughout Kauaʻi. Since its sale, the project site and neighboring agricultural lands have been used for ranching and diversified agricultural crops, and now primarily serve as cattle grazing.

In 2010, the current landowner and Petitioner, Keālia Properties LLC, purchased a total of 2,020 acres, including the subject 53.4 acre property, from Plantation Partners. In 2007, the previous owner, Plantation Partners, proposed a project that included 199 farm lots over 2,020 acres. The proposed project, called Kealanani, was envisioned as an agricultural subdivision.

After purchase of the property from Plantation Partners in 2010, the Petitioner, Keālia Properties LLC, concluded that the previous proposal for an agricultural subdivision was not the right fit for the property. There was a lack of community support for that type of development. A decision was made to "rest" the land for three years while focusing on agricultural opportunities on the property. In late 2013, the County Planning Commission revoked its approval for the prior Agricultural Subdivision plan, via a letter to the Planning Director.

Keālia Properties and its representatives continued to meet with neighboring farmers, ranchers, community members, and government officials to investigate appropriate uses for the site, including more affordable housing options. The presence of stub-out streets behind the existing Kaʻao Road subdivision appeared to indicate that an additional phase to the subdivision was at one time considered. In July 2016, the County Planning Department made a determination that an expanded residential subdivision was consistent with the Kauaʻi General Plan Land Use Map (see Appendix A).

Given the high unmet demand for housing on Kauaʻi, a decision was made to develop the 53.4 acres adjacent to the Kaʻao Road subdivision for residential homesites. In consultations between the Applicant and the County administration, it became clear that the County's priority was to provide housing for Kauaʻi's working families. Providing smaller lot sizes would keep prices down, enabling more local residents to take advantage of the opportunity to purchase lots for construction of their own home.

Today, the project site and surrounding lands continue to be used for cattle grazing by RKL Ranch, LLC, based in Kīlauea, Kauaʻi, and several other lessees. RKL Ranch, LLC licenses a total of approximately 780 acres in the area, and employs a pasture rotation program, where cattle are rotated throughout pens on the property on a timeframe based on forage availability, weather conditions, and production outlay. Their herd consists mainly of Black Angus mixed breed cattle, with approximately 120 cows, 6 bulls, and 60 weaners, younger animals usually 6 to 7 months old. RKL's 780 acre lease includes an additional 86 acres that were recently added to compensate for the anticipated loss of 53.4 acres associated with the proposed project.

2.2 PROJECT PURPOSE, NEED AND OBJECTIVES

The purpose of the Proposed Action is to provide for-sale residential lots for Kauaʻi residents to address the current and projected shortfall of single-family housing on the island. In 2015, the State of Hawaiʻi Department of Business, Economic Development and Tourism (DBEDT) prepared a report entitled *Measuring Housing Demand in Hawaii, 2015-2025*, which projected housing demand statewide over the next decade. The analysis considered variables of projected population growth, visitor growth, and vacancy rates. Housing demand was based on the anticipated increase in number of households. This study projected that the total population for Kauaʻi County will increase by 19 percent by 2025, and forecasted a demand for 5,287 additional housing units during the 2015-2025 period (DBEDT, 2015).

The market study for the Keālia Mauka Homesites project estimated demand for 7,447 additional housing units in the Līhuʻe to Moloaʻa (East Kauaʻi) region between 2017 and 2040, of which about two thirds will be for single family households (4,928 homes) (CBRE, 2017, see Appendix F).

At the same time, housing inventory on Kauaʻi does not meet demand. The existing and planned inventory of residential units on Kauaʻi will fall short of forecasted demand for housing units, continuing the trend of increased housing pricing pressure and slowing the formation of new households. Many young families are unable to purchase their own homes, and are forced to either remain in crowded, multi-generational households or to relocate off-island. The proposed residential subdivision is intended to provide housing opportunities for Kauaʻi residents.

The purpose of the Proposed Action is to satisfy the need for housing on the island of Kauaʻi by providing improved residential lots that are:

- targeted to local Kauaʻi residents
- consistent with typical densities in the island's existing single-family residential communities
- located a reasonable distance from existing public facilities and services
- consistent with the Kauaʻi County General Plan Land Use guidance
- in compliance with the Housing Policy for the County of Kauaʻi, Ordinance No. 860, including the requirement for workforce housing

2.3 PROJECT DESCRIPTION

2.3.1 Description

The Proposed Action involves the development of a residential subdivision at Keālia, Kauaʻi, consisting of approximately 235 lots ranging in size from about 5,600 SF to 7,300 SF (Figure 2-1). The project includes installation of utility infrastructure (e.g., potable water, drainage, wastewater, electrical power, and telecommunications systems) and transportation improvements to serve each subdivided parcel. The subdivision will include two park/open space areas, totaling 5.86 acres.

These areas will provide green space for passive recreation, serve as flood detention areas, and provide a buffer with the neighboring subdivision on Kaʻao Road. Individual lot buyers could implement home construction on their parcels, a typical practice on Kauaʻi, or blocks of lots could be sold to a single purchaser to develop. Because the lots are under 10,000 square feet (SF), the County's Comprehensive Zoning Ordinance (CZO) only allows one single family dwelling unit per lot.

Access to the subdivision would be via Keālia Road from its intersection with Kūhiō Highway. A roundabout entrance to the subdivision is proposed. The lot sizes were intentionally set below 10,000 SF in order to keep prices within a manageable financial range for local residents, the intended market. The development will provide lots that will meet the workforce housing requirements of Kauaʻi County Ordinance No. 860 that established a new chapter in the Kauaʻi County Code (1987, as amended) relating to the housing policy for the County of Kauaʻi.

2.3.1.1 Estimated Development Schedule

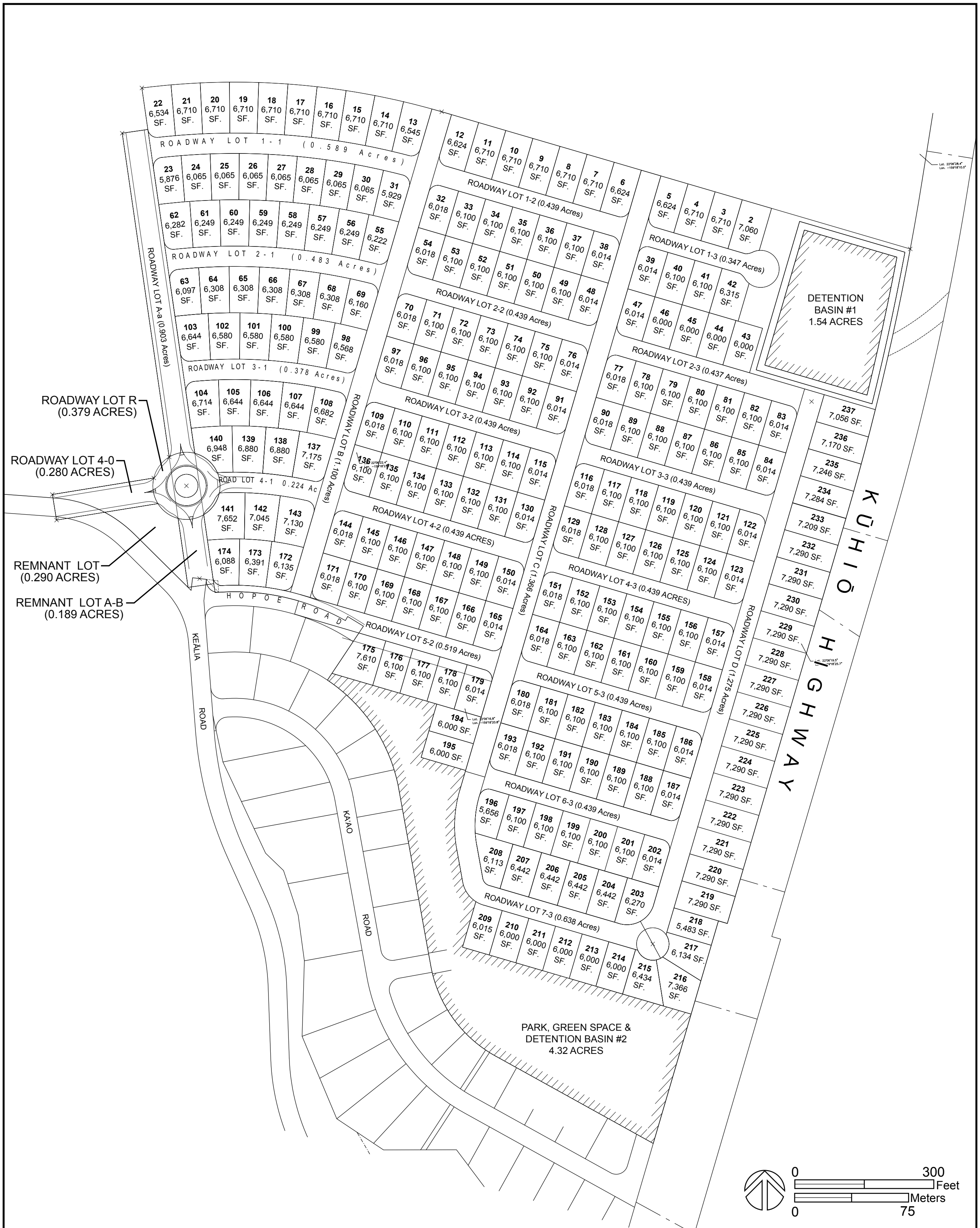
The anticipated construction of the proposed improvements is expected to take approximately 18 months. The initial mass grading work is expected to extend over the first 12 months. The County's Grading Ordinance allows a maximum of 10 acre to be disturbed at any time, therefore, the 53.4 acre site will require up to six phases of grading work (Kodani & Associates, 7/13/2017). Subsequent construction phases will include the installation of drainage structures and detention basins, installation of sewer, water, and electrical utilities, and construction of roads and sidewalks.

The finished lots will then be sold to individual buyers and/or to third party contractors buying blocks of parcels for development. The market study estimates that full absorption/sell out of the finished lots will be completed within seven years (CBRE, 2017).

2.3.1.2 Estimated Development Costs

The Proposed Action includes both on and off-site improvements. On site work includes earthwork, clearing and grubbing, mass and fine grading, construction of drainage/detention basins, and installation of utility systems (sewer, water, electrical). On site costs are estimated at about $23.0 million (Kodani & Associates, 2017).

The Proposed Action also includes off-site improvement including off-site sewer (pipeline to Kūhiō Highway, sewer lift station), construction of a 200,000 gallon water storage tank, well pumps, and overhead electrical and cable lines on Keālia Road to Kūhiō Highway. These off-site improvements are estimated at $6.1 million. It is also anticipated that improvements will be needed at the Kūhiō Highway/Keālia Road intersection to mitigate the traffic impacts of the Proposed Action. The installation of a traffic signal, reconstruction of the intersection, widening turning storage lanes, and the addition of a cross walk and sidewalks will cost an additional $1.5 million. With this traffic mitigation, total off-site costs will be approximately $7.6 million (ibid).



Source: Kodani & Associates Engineers, Inc., 2017

Conceptual Subdivision Plan **Figure 2-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

2.3.2 Project Roadways

The proposed roadways for the Keālia Mauka subdivision will be constructed in accordance with County of Kaua'i 1972, County Road Standards. It is intended that all of the proposed subdivision roads will be conveyed by the developer to the County of Kaua'i.

A roundabout entrance to the subdivision is proposed in order to provide a safe and efficient central nexus for all adjoining subdivision roads. The roundabout was proposed as a way to accommodate the angle of the intersection of Keālia Road and the main subdivision road, combined with the presence of a small side road (Ka'ao Road). A section of Keālia Road approaching the roundabout will be realigned. The roundabout would allow through traffic on Keālia Road and vehicles turning in and out of the subdivision to proceed with minimal disruption, avoiding a four-way stop condition. The roundabout would also create an opportunity to provide an attractive landscape feature at the subdivision entry.

Proposed subdivision roads connecting to the roundabout will be "Collector" roads as defined by County road standards. Collector roads have a 56-foot right of way (ROW) and 40-foot wide pavement. There are a total of two (2) Collector roads proposed for this project, totaling about 2,455 linear feet. One of the Collector roads will run in the north-south direction and the other Collector road will run in the east-west direction.

The majority of the roads within the proposed subdivision will be "Minor" roads as defined by County road standards. Minor roads have a 44-foot ROW and 20-foot wide pavement. There are a total of nine (9) Minor roads proposed for this project, totaling about 9,220 linear feet. Three (3) Minor road will traverse the north-south direction and six (6) will traverse in the east-west direction.

Currently, there is an old cane haul road entry to the property located on Kūhiō Highway. The road is currently gated and unused. This access point will be eliminated, and no direct vehicle access onto Kūhiō Highway will be allowed from the proposed subdivision.

2.4 ALTERNATIVES CONSIDERED

In addition to the proposed action, several alternatives were considered and evaluated, and are briefly presented below.

2.4.1 No Action

In this alternative, there would be no residential subdivision developed on the Petition Area, the land would be retained in agriculture, and its current use for grazing by cattle or other livestock would continue for the foreseeable future. Since no development would occur, the existing physical environment of the site would not be affected. There would be no additional demands for public services and roadway infrastructure.

Under the No Action alternative, the island of Kaua'i and the general public would not realize the social and economic benefits of the project including: 1) the availability of approximately 235 residential lots, targeted to local residents to meet current and projected housing demand; 2) direct capital investment in the local economy during the construction period; 3) income and expenditures generated by new construction and long-term jobs and wages; 4) purchases of goods and services by residents; 5) real property tax revenues; 6) net tax revenues to the County during the construction period and on an annualized basis thereafter.

Potential benefits of the No Action alternative include: 1) existing open space ambiance and views would remain unchanged; 2) existing grazing activities would be retained and the property would be available for future agricultural use; 3) no short-term construction related impacts (e.g., noise, dust, etc.); 4) no additional traffic generated during construction and operational period; and 5) no additional demand on regional recreation, public services and infrastructure.

The No Action alternative was determined to be less preferable than the proposed action because it fails to meet the Petitioner's primary objective, which is to provide housing opportunities for local Kaua'i residents. The project's benefits far outweigh the benefits of a No Action alternative.

2.4.2 Agricultural Subdivision Development

Under this alternative, the Petition Area would be subdivided into agricultural lots ranging from 2 to 10 acres, on which one dwelling would be permitted in each lot. Each owner would be required to sign an agreement that the property will comply with State land use guidelines governing lands in the State Agricultural Land Use District and submit an agriculture plan stating what the owner intends to raise on the property. This alternative would create the potential for the resumption of productive agricultural use of the land, including new diversified crops. On the other hand, an agricultural subdivision would do little to address the island's current housing shortage, especially for workforce housing.

An agricultural subdivision would involve fewer and higher priced lots than the proposed 235-unit subdivision. Under the County's agricultural zoning regulations, any residential development on the property must be "farm dwellings" and accessory to agricultural use, although a residence as large as 5,000 square feet would be allowed. Due to the larger acreage and higher sales prices, an agricultural subdivision would tend to attract a higher income buyer, including more out of state investors and second home owners, compared to the proposed project. Due to the fewer number of residential units, impacts on regional traffic and public services would be less than the proposed subdivision. There would also be less of a visual impact, since much of the site's open space character would be retained.

A previous proposal to develop a 199-lot agricultural subdivision on 2,020 acres at Keālia--including the current 53.4-acre Petition Area--was approved by Kaua'i County in 2007. This previous proposal received mixed public reaction. Proponents argued that it would promote agriculture and present an example of agricultural sustainability, creating the potential for diversified crop production. Opponents of the proposal criticized its 2,000 acre size and the potential for speculative investment, as well as its long term impact on local agriculture. The subdivision permit was subsequently rescinded by Kaua'i County, at the request of Keālia Properties, LLC.

2.4.3 Variations in Development Density

2.4.3.1 Lower Density Development

This alternative involves creating a subdivision with larger average lot sizes than the proposed action, for example, 10,000 to 20,000 SF. Overall project density would be about two to four units per acre, compared to Keālia Mauka's density of four to five units per acre. These lot sizes are more in keeping with the lots of the adjacent Ka'ao Road subdivision. Based on average price per square foot, sales prices for the lots would be higher than the current proposal. While it is likely that the majority of lot purchasers would still be Kaua'i residents, the higher prices could make them beyond the reach of many families entering the housing market. The larger lots would also make the homesites more attractive to out of state residents and speculative buyers.

In summary, this alternative meets many of the project objectives. However, due to the larger lot sizes and higher prices, it would be more difficult to meet the needs of local working families. The larger lots would also make it more difficult meet the County's desire for "workforce housing," i.e., housing affordable to families earning up to 140 percent of County median income.

2.4.3.2 Higher Density Development

Under this alternative, the Petition Area would be developed with greater density than in the proposed action, with densities of 10 units per acre and up (or average lot sizes of less than 4,400 SF), including multi-family residential development.

While the market study prepared for this EIS does project a demand for multi-family residential units in the East Kaua'i region, most of the existing multi-family units in the area have historically been vacation rentals in resort communities along the shoreline. Multi-family housing is generally less attractive to local Kaua'i residents, who have a strong preference for single family housing. This alternative would be less responsive to the market desires of local residents. A higher density, multi-family development is also less compatible with the neighboring Ka'ao subdivision and the Keālia Kai development across Kūhiō Highway.

2.4.4 Variations in Petition Area

2.4.4.1 Larger Petition Area

This alternative would create a residential subdivision on a much larger scale than the current 53-acre, 235-lot proposed Petition Area. This larger area could potentially encompass hundreds of additional acres and extend well into upland areas of the TMK parcel (4) 4-7-004:001 and adjacent agricultural lands. In July 2016, the County Planning Department determined that the proposed Keālia Mauka project is consistent with the Kaua'i County General Plan Land Use Map which indicates Residential Community development in the area. It is uncertain whether the County would determine that a larger project area extending further *mauka* would also be consistent with the intent of the General Plan.

A larger project area would result in more residential units and people. In the long term, it would create higher traffic volumes in the Keālia vicinity than the proposed action. Like the proposed action, a larger development would target local residents who are already on island. Therefore, there would be little net increase in County-wide population. However, because future residents may be relocating from one part of the island to another, there could be a noticeable impact on enrollment at Kapa'a district schools which are already near capacity. It is also likely that the conversion of more agricultural land to an urban use would encounter greater community opposition than the proposed use of 53.4 acres.

2.4.4.2 Smaller Petition Area

This alternative would involve a smaller scale residential subdivision with densities similar to the Proposed Action. A smaller project area would result in fewer total lots, with fewer residences to share the cost of required infrastructure and utility improvements. This would likely result in higher prices for the individual lots in order for the developer to recoup these relatively fixed expenses. A smaller Petition Area would not be economically feasible for the Petitioner.

2.4.5 Turnkey Homes For Sale

This alternative involves vertical construction of single-family homes on each subdivided lot in addition to infrastructure provision. Turnkey refers to the provision of a complete housing product, ready for immediate use. The house and lot would be offered for sale to buyers. While this type of development is common throughout the state, it is less typical on Kauaʻi, where it is customary to offer improved lots for sale. Purchase of vacant lots provides buyers the opportunity to build their own home according to personal preference, and at a time when it is most economically feasible. The intent of the Proposed Action is to continue this historical practice, which tends to be preferred by local residents. However, there remains the possibility that a block of lots could be sold to a single purchaser who will then construct finished homes for sale. Therefore, the sale of turnkey homes is a possibility for a portion of the Keālia Mauka subdivision, but would be up to other private developers.

3.0 NATURAL AND PHYSICAL ENVIRONMENT

3.1 CLIMATE

3.1.1 Existing Conditions

3.1.1.1 Climate

The climate on the island of Kauaʻi, as well as within the State of Hawaiʻi, is characterized as having low day-to-day and month-to-month variability. Differences in the climate of various areas are generally attributable to the island's geologic formation and topography, resulting in miniature ecosystems ranging from tropical rain forests to dryer plains, along with corresponding differences in temperature, humidity, wind, and rainfall over short distances (Dept. of Geography, 1998).

Long-term climate data for Līhuʻe, located on the island's southeast coast, shows the average daily temperature ranging from 71 and 80 degrees Fahrenheit in the year 2000 with an average annual temperature of 76.2 degrees. The range in normal temperatures from the coolest month, February, to the warmest month, August, is less than 8 degrees. The daily range in temperature is also small, less than 15 degrees. Normal annual rainfall is over 40 inches, with three-fourths of this total, on average, falling during the seven month wet season which extends from October through April (NOAA, 2017).

Tradewinds from the northeast blow across the island during most of the year, and typically dominate weather patterns from April to November. Winds from the south are infrequent, occurring only a few days a year and mostly in the winter associated with "Kona" storms. Wind speeds are normally within the 13 to 24 miles per hour range (UH Department of Geography, 1983). Air quality throughout Kauaʻi is good, meeting all state and federal air quality criteria.

3.1.1.2 Climate Change

Climate change is a long-term shift in patterns of temperature, precipitation, humidity, wind and seasons. Scientific data show that earth's climate has been warming and mostly attributable to rising levels of carbon dioxide and other "greenhouse gases" generated by human activity. These changes are already impacting Hawaiʻi and the Pacific Islands through rising sea levels, increasing ocean acidity, changing rainfall patterns, decreasing stream flows, and changing wind and wave patterns.

In 2014, the University of Hawaiʻi at Mānoa Sea Grant College Program (UH Sea Grant) prepared a *Kauaʻi Climate Change and Coastal Hazards Assessment* (KC$_3$HA) as part of the County's Kauaʻi General Plan update. The study notes that the Island of Kauaʻi is subject to a variety of coastal hazards, including coastal storms, high wave events, flooding, coastal erosion and tsunamis. Each of these may be impacted by climate change-related sea level rise (SLR).

The KC$_3$HA stated that a range of sea level rise of one foot by year 2050 and three feet by year 2100 is a reasonable, possibly even conservative planning target for Kauaʻi and the other Hawaiian Islands (UH Sea Grant, 2014). Recently, the Hawaiʻi Climate Change Mitigation and Adaptation Commission released a report stating that this magnitude of SLR could occur as early as 2060, based on recent observations and predictions. Moreover, SLR is likely to continue for centuries (Hawaiʻi Climate Change Commission, 2017). SLR is expected to increase the frequency and severity of wave inundation, erosion, and flooding. These hazards in turn can impact Kauaʻi's critical infrastructure, economy, coastal habitats, public access, and residential communities.

According to the KC_3HA, the key coastal hazard impacts to consider for Kauaʻi are1) coastal flooding and wave inundation; 2) erosion; 3) inland flooding; and 4) wind.

Coastal flooding and wave inundation is the flooding of normally dry, low-lying coastal land. It can be caused by elevated sea surfaces from static level rise or large tidal fluctuations, seasonal high waves that push water inland, and storm surge associated with low pressure systems, tropical storms, and hurricanes that cause an abnormal rise in the water level (UH Sea Grant, 2014). The Petition Area is not within a flood zone or the designated tsunami evacuation zone.

Historic studies of ***coastal erosion*** indicate that beach erosion is the dominant trend of shoreline change on Kauaʻi. The National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands (Fletcher et al, 2012) reports that 71% of beaches on Kauaʻi are eroding with nearly four miles of beach completely lost to erosion over the past century. On average, shorelines on Kauaʻi retreated over 36 feet over the past century. Beaches on the north and east coasts of Kauaʻi are undergoing the most erosion (76% and 78% of beaches, respectively) (ibid). Climate change induced SLR is expected to result in increase to historical erosion rates. The Petition Area is located approximately 1,000 feet inland from the coast, and will not directly impact or be impacted by coastal erosion.

Inland (stream) flooding on Kauaʻi may be characterized by flash floods as well as prolonged flooding associated with slowly passing rainstorms that saturate the soils. Climate change is expected to cause more extreme rain events, which could lead to impacts from inland flooding. The Petition Area is not located in a flood prone area or adjacent to streams, and is at low risk of inland flooding.

Wind related events include Kona storms tropical storms, and hurricanes. As discussed in Section 3.5, Natural Hazards, Kauaʻi has a history of damaging hurricane events, including Hurricanes Dot in August 1959, Iwa in November 1982, and Iniki in September 1992. Some studies indicate that climate change may result in an increase in tropical cyclone frequency around the Hawaiian Islands in the future.

3.1.2 Potential Impacts and Mitigation

The proposed development will have no effect on climatic conditions and no mitigation measures are needed. The Petition Area is located on the *mauka* side of Kūhiō Highway about 1,000 feet from the shoreline, at an elevation of about 100 feet. It is not vulnerable to coastal erosion or stream flooding that may occur as a result of long-term climate change. The two on-site detention areas are designed to provide areas for storm water drainage to percolate into the ground.

Like most of the island of Kauaʻi, the Petition Area is vulnerable to wind related events such as hurricanes, which may become more frequent as a result of climate change. While the likelihood of storm and hurricane damage is difficult to assess, the future residential units will comply with all applicable County building codes.

3.2 GEOLOGY AND TOPOGRAPHY

3.2.1 Existing Conditions

The Island of Kauaʻi consists of a single deeply eroded shield volcano, and the Petition Area in Keālia is located on the eastern flank of the shield. The geology of the project site includes lava flows from the Koloa Volcanic Series deposited during the Pleistocene era and recent deposits of alluvium beach and dune sand and lagoonal clays and marls (loose or crumbling earthy deposits high in calcium carbonate).

The Petition Area is located on the *mauka* slopes above Kūhiō Highway, and the topography is generally gently sloping from *mauka* to Kūhiō Highway. Near Kūhiō Highway, the elevation is about 100 feet above mean sea level (msl), and gradually rises to nearly 130 feet at the *mauka*-most areas of Keālia Road. The average slope from top to bottom is approximately three percent. The surrounding lands are largely undeveloped, with the flat lands being utilized as pasture. Valleys in the surrounding area are occupied by trees, bushes, and other greenery.

3.2.2 Potential Impacts and Mitigation

No significant modifications to site topography are planned. The Preliminary Engineering Report (PER) prepared by Kodani & Associates Engineers (2017) (Appendix G) includes a preliminary grading layout for the Petition Area. The preliminary grading plan shows the location of existing surface contours and proposed finished contours. The estimated earthwork quantity of excavation is 350,000 cubic yards (YD^3) and the total of estimated embankment is 347,000 YD^3. This results in a net excavation of 3,000 YD^3.

Best management practices (BMP) will be utilized during subdivision construction to prevent violations of State and County water quality standards due to storm water runoff. BMPs will also be implemented for long term development and operation of activities occurring on the site as part of pollution prevention measures.

3.3 SOILS

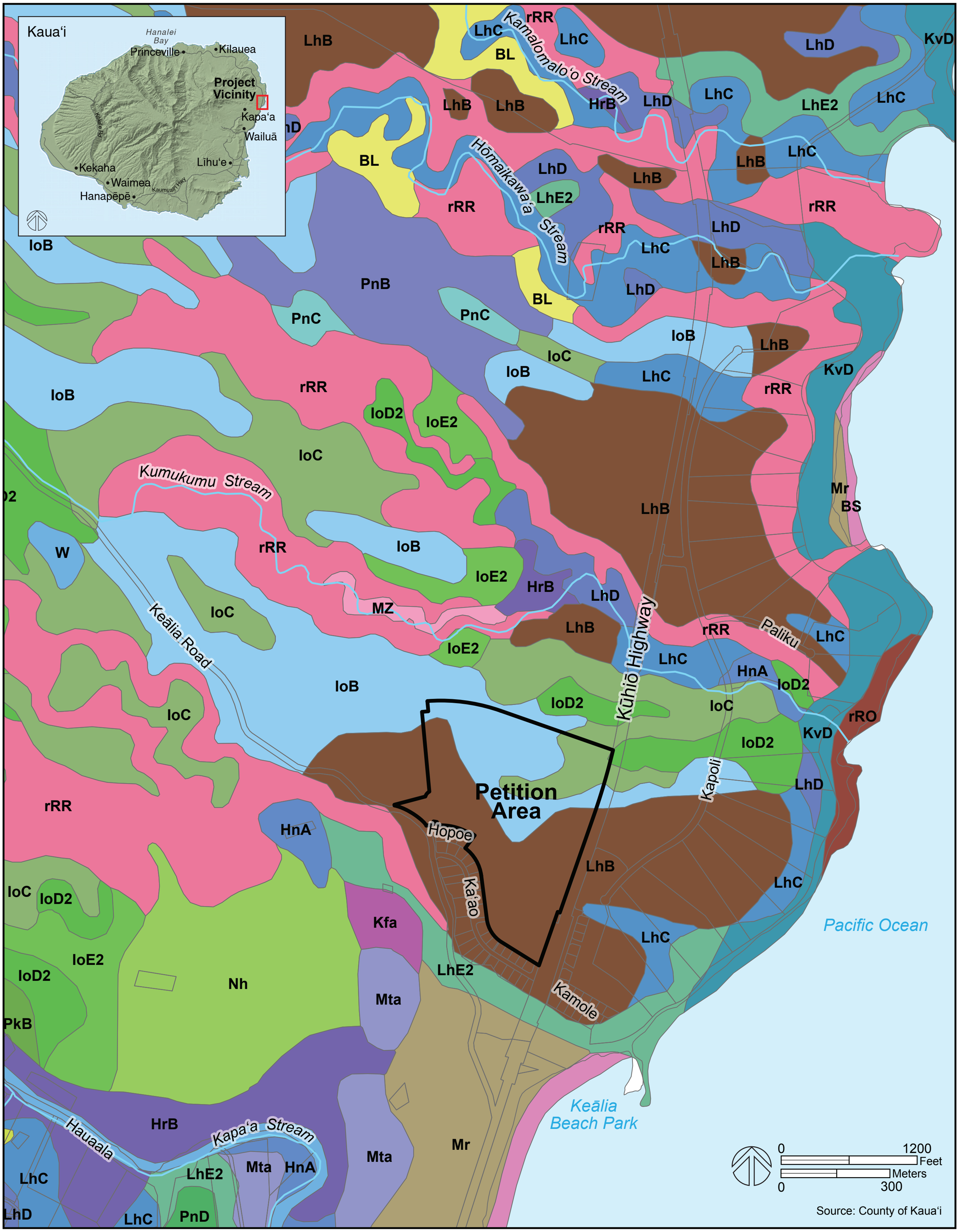
3.3.1 Existing Conditions

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil classification for the Petition Area is shown on Figure 3-1.

3.3.1.1 Soil Types

Ioleau Series. The Petition Area includes three soil types within the Ioleau soil series:

- Ioleau silty clay loam, 2 to 6% slope (IoB) in the northern half of the Petition Area
- Ioleau silty clay loam, 6 to 12% slope (IoC) in the northeastern portion
- Ioleau silty clay loam, 12 to 20% slope (IoD2) at the northeast corner.



Soils Map **Figure 3-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

The Ioleau series consists of well-drained soils on uplands on the island of Kauaʻi. These soils developed in material weathered from basic igneous rock, probably mixed with volcanic ash. They are gently sloping to steep. Elevations range from 100 to 750 feet. The annual rainfall amounts to 40 to 70 inches. The mean annual soil temperature is 72° F. Ioleau soils are geographically associated with Līhuʻe and Puhi soils.

These soils are used for irrigated sugarcane, pasture, pineapple, irrigated orchards, irrigated truck crops, wildlife habitat, and woodland. The natural vegetation consists of lantana, Koa haole, guava, and associated shrubs and grasses. [Foote et al. 1972:47]

Līhuʻe Series. The majority of the Petition Area contains Līhuʻe silty clay, 0 to 8% slope (LhB). The Līhuʻe series of soils consists of well-drained soils on uplands on Kauaʻi. These soils developed in material weathered from basic igneous rock. They are gently sloping to steep. Elevations range from nearly sea level to 800 feet. The annual rainfall amount to 40 to 60 inches. The mean annual soil temperature is 73° F. Līhuʻe soils are geographically associated with Ioleau and Puhi soils.

These soils are used for irrigated sugarcane, pineapple, pasture, truck crops, orchards, wildlife habitat, woodland, and homesites. The natural vegetation consists of lantana, guava, Koa haole, joee, Kikuyu grass, Molasses grass, Guinea grass, Bermuda grass, and Java plum. [Foote et al. 1972:82]

3.3.2 Potential Impacts and Mitigation

Appropriate erosion and sediment controls will be implemented during construction of the subdivision, and will comply with County of Kauaʻi grading ordinance and the State Department of Health National Pollutant Discharge Elimination System (NPDES) permit program. Soil erosion will increase dramatically during grading and other construction activities. When erosion occurs, sediment can be transported by wind or stormwater runoff, and has the potential to affect downstream water quality. Erosion control measures during construction may include phasing work to minimize bare areas, use of mulch, erosion blankets, and seeding bare areas to keep them vegetated. Sediment control is the capture of eroding sediments to keep them on site and away from surface waters. Examples of sediment control BMPs include silt fences, settling basins and sediment traps, and fiber rolls. BMPs will remain in working condition throughout the construction period. With the implementation of erosion and sediment control BMPs, no significant impacts to soils are anticipated.

Individual lot purchasers will be required to keep their lots vegetated until they are ready to build to minimize soil erosion. During construction, homeowners will be required to comply with the County grading ordinance and the requirements of the State Department of Health, including the NPDES permit program.

3.4 WATER RESOURCES AND HYDROLOGY

3.4.1 Existing Conditions

3.4.1.1 Watershed

A watershed unit is comprised of a drainage basin (or basins) which include both stream and overland flow, whose runoff either enters the ocean along an identified segment of coastline (coastal segment) or enters an internal landlocked drainage basin (CWRM, 2005). According to the *Atlas of Hawaiian Watersheds and their Aquatic Resources* (Hawaiʻi DAR, 2008), the island of Kauaʻi is divided into five watershed regions, with East Kauaʻi part of the Līhuʻe Region. Within the Līhuʻe region, there are 12 identified watersheds. The Keālia Mauka Project Area appears to straddle two watersheds in the Līhuʻe region--the Kapaʻa Watershed (DAR Watershed Code 22004) and the Kumukumu Watershed (DAR Watershed Code 22002).

The Kapaʻa Watershed, which is the drainage area for Kapaʻa Stream, encompasses approximately 16.5 square miles with a maximum elevation of 3,251 feet. According to the Hawaiʻi Watershed Atlas, the Kapaʻa Watershed's DAR cluster code is 5, meaning that the watershed is medium size, steep in the upper watershed and with little embayment. Approximately 53.3% of the watershed is in conservation and 43.1% in agricultural use. The State has management control of 52.3% and private entities control 47.7%.

The Kumukumu Watershed, which includes the drainage basin for Kumukumu Stream, is located to the north of the Kapaʻa Watershed. This watershed encompasses 1.2 square miles with a maximum elevation of 404 feet. Approximately 97% is in agricultural use, with 100% of the watershed under private control.

Kauaʻi's watersheds are collectively overseen by the Kauaʻi Watershed Alliance (KWA), a collaboration of 11 public and private partners. The KWA was formed in 2003 and oversees 144,004 acres of forested wetland. Ongoing management activities include controlling invasive weeds and ungulates such as feral pigs and goats. Invasive plants and animals have been identified as the two most important threats to the watershed. (Kauaʻi Watershed Alliance, 2012). The KWA partners share the common goal of the long-term protection of the island's upper watershed in order to maintain ground and surface water and healthy native ecosystems.

3.4.1.2 Surface Water

There are no wetlands or streams located within the Petition Area, although there are streams outside the Petition Area to the north and south. Kapaʻa Stream (HSA Code 2-2-04), also referred to as Keālia River, is a perennial stream located to the south. In the project vicinity, Kapaʻa Stream crosses under Kūhiō Highway, and enters the ocean at the southern end of Keālia Beach.

As is common throughout Hawaiʻi, the upper elevations of Kapaʻa Stream were diverted in the 1920's as part of the irrigation system developed by the sugar plantations. The irrigation system, consisting of tunnels, ditches and flumes, is referred to as a "ditch" system. In its *mauka* reaches, Kapaʻa Stream was diverted to the Makaleha Ditch (4 MGD) and Kapahi Ditch (5 MGD) systems (CWRM, 1990). The Petition Area and surrounding areas were at one time irrigated by water flowing through the extensive ditch system. With the closure of the sugar plantation, much of the ditch system in urbanized areas of East Kauaʻi has been abandoned, but is intact and flowing elsewhere.

Located north and outside of the Petition Area, Kumukumu Stream (HSA Code 2-2-02) is a perennial stream, flowing *mauka* to *makai* and passing through the Keālia Kai subdivision before entering the ocean. The Hawaiʻi Stream Assessment (HSA) notes that stream flows in Kumukumu Stream are year-round in the upper portions but are intermittent at lower elevations. For much of the year, Kumukumu Stream in the project vicinity is a dry gulch leading to an estuarine pool, more or less open to the ocean. Runoff flows through this gulch only during storm events (County of Kauai, 2003).

3.4.1.4 Irrigation Ditch System

The existing non-potable ditch system in the area is managed by the Keālia Irrigation Company. There are two reservoirs, Kaneha and Halaula, associated with the system. The Halaula Reservoir is located *mauka* of the Petition Area, about half-way to the Spalding Monument. The Kaneha Reservoir is located further *mauka*, just outside the Moloaa Forest Reserve. The two reservoirs are regulated by the State of Hawaiʻi Department of Land and Natural Resources (DLNR). The ditch transmission system is not State-regulated.

The Keālia Irrigation Company has an easement through the Petition Area that feeds the Keālia Kai subdivision located *makai* of Kūhiō Highway. Transmission is all underground. There are no active irrigation ditches in the Petition Area or within the larger TMK parcel.

3.4.1.3 Groundwater

In Hawaiʻi, groundwater provides about 99% of domestic water and about 50% of all freshwater used in the State. The East Kauaʻi area is within the State of Hawaiʻi Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM)'s Līhuʻe Aquifer Sector, which has a total sustainable yield of 131 million gallons per day (mgd) (CWRM, 2015) The State Water Code defines sustainable yield as "the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source…"

The Keālia Mauka Petition Area is within the Līhuʻe Aquifer Sector's Anahola Hydrologic unit (Aquifer Code 20104), which has a sustainable yield of 17 mgd (CWRM, 2015). Water users include the private Keālia Water System, the County of Kauaʻi's Water Department and agricultural users. In 2015, pumpage from the Anahola Hydrologic Unit was 2.48 mgd, about 14.5% of its sustainable yield (County of Kauaʻi and Fukunaga & Associates, 2015).

Water service for the existing Kaʻao Road subdivision and for the Keālia Kai development on the makai side of Kūhiō Highway is provided by a private domestic water system called the Keālia Water System, owned by the Keālia Water Company Holdings, LLC. Currently, the Keālia Water System provides water to approximately 60 homes on Kaʻao Road and Hopoe Road, and has 35 service connections at Keālia Kai. Water for the Keālia Water System is from a groundwater source, via two wells (Keālia 1A and 2a) on the west side of Keālia Road (Kodani & Associates, 2017).

Keālia Wells 1A and 2A are located within the area of a battery of seven wells developed and formerly used by Līhuʻe Plantation. All nine of these wells were drilled through alluvial material comprised of various clays with some land and coral to access the semi-confined groundwater which resides in the unweathered Koloa volcanics at depth below the alluvium. All nine wells are solid cased to depths between 80 to 130 feet below sea level. They draw water from the open holes below the solid casings. The open hole depths span from 80 to 235 feet below sea level. Piezometric head of the semi-confined groundwater tapped by these wells varies between eight and ten feet above sea level. When originally constructed, at least three of the seven plantation wells were free flowing under artesian pressure (Tom Nance Water Resource Engineering, 2018).

According to the CWRM, certificates of well construction and pump installation for Keālia Wells 1A and 2A were issued on 9/19/2008. The approval pump capacity is 650 gpm (936 gpd) for Keālia Well 1A (State Well No. 3-0618-009) and 540 gpm (777,600 gpd) for Keālia Well 2A (State Well No. 3-0618-010) (personal communication with Queenie Komori, 3/12/2018).

3.4.1.4 Water Quality

State waters are classified as either inland waters or marine waters. Inland waters include streams and wetlands, and marine waters are either embayments, open coastal, or oceanic waters. Inland and marine waters are classified for the purpose of applying appropriate water quality standards. Both Kapaʻa and Kumukumu Streams flow into the nearshore coastal waters, which are rated Class A by the DOH Water Quality Standards.

The federal Clean Water Act (CWA) §305(b) and §303(d) requires states to describe the overall status of water quality statewide and extent to which water quality provides for the protection and propagation of a balanced population of shellfish, fish and wildlife and allows recreational activities in and on the water. The CWA §303(d) requires states to submit a list of Water Quality Limited Segments reporting pollutants, with a priority ranking of listed waters.

The DOH's 2006 303(d) list contained a total of 93 stream segments. The 2006 list of impaired waters (*State of Hawaiʻi Water Quality Monitoring and Assessment Report,* DOH 2006) included Kapaʻa Stream (Stream Code 2-2-04) and indicated it was impaired due to turbidity. The Keālia segment of the Kapaʻa system (Stream Code 2-2-04.01) was not considered impaired. In 2016, a Draft *2016 Water Quality Monitoring and Assessment Report* (DOH, 2016) was released. The 2016 report evaluated watershed "decision units," many of them coastal watersheds. Based on new data, both the Kapaʻa Watershed (Water Body ID TBD) and the marine body at Keālia (Kapaʻa Watershed) (Water Body ID H1402035) do not meet applicable water quality standards, with turbidity the pollutant of concern.

3.4.2 Potential Impacts and Mitigation

3.4.2.1 Construction Period

Construction activity within the Petition Area has the potential to impact the water quality of nearby streams and nearshore areas due to stormwater runoff and erosion. During construction of the Keālia Mauka subdivision, the contractor will implement and maintain storm and surface water runoff Best Management practices (BMPs), subject to any applicable review and approval of the State Department of Health. The BMPs will be designed to minimize soil erosion and sedimentation during activities such as grading, grubbing, and stockpiling. The BMPs will avoid violations of State water quality standards.

Construction of homes on the individual lots will be the responsibility of future lot owners. Measures to minimize construction period impacts would also be implemented as required by the Covenants, Conditions and Restrictions (CC&Rs) for the subdivision, which will require lot owners to comply with all State and County regulatory requirements.

3.4.2.2. Operational Period

The Petitioner has a water service agreement with Keālia Water Company which allows a daily aggregate of 300,000 gallons per day (gpd) of potable water to be reserved for the proposed project. The maximum daily water demand for the 235 single family homes has been estimated at 177,250 gpd, based on an average daily demand of 500 gallons per unit per day. This maximum daily demand is within the 300,000 gpd allocation from the Keālia Water Company. The estimated maximum daily water demand is also within the CWRM's-authorized pump capacity of the two source wells (Keālia 1A and 2A). No new wells are proposed or required. An additional water storage tank will be constructed to meet fire flow and storage requirements.

At full build out of 235 homes, total pumpage from the Anahola Hydrologic Unit is estimated to be 2.98 mgd, representing less than 20% of the aquifer's sustainable yield of 17 mgd. The addition of up to 235 new single family residences will increase demand on groundwater resources, but this is within the capacity of the wells and within the aquifer's sustainable yield.

Findings of Hydrogeological Letter Report

During a Land Use Commission (LUC) meeting and in a Cultural Impact Assessment (CIA) interview (see Chapter 4, Section 4.5), one individual raised concerns about the impact of groundwater use on upgradient water users, specifically on a spring-fed *loʻi* located approximately 1.1 miles inland of the wells. A hydrogeological investigation was conducted by Tom Nance Water Resource Engineering (TNWRE) to evaluate the potential impact of additional water use from the two wells; the letter report is included as Appendix I.

The TNWRE report indicated that the Koloa volcanics, from which Keālia Wells 1A and 2A draw water, are generally moderate to poorly permeable, highly variable over short vertical and horizontal distances, and are often interbedded with nearly impermeable weathered soil layers. This results in very different water levels and hydraulic capacities in wells only short distances apart. As an example, the report compared two other wells on Hauaala Road. Well 0619-001, which was finished to a depth of 60 feet below sea level, has a water level at 66 feet above sea level. In sharp contrast, nearby Well 0619-003 has a well depth at 90 feet above sea level, and has a water level at 220 feet above sea level. The report noted that in the Koloa volcanics, such differences over short distances are more the norm than the exception.

Using Google Earth and the estimated location of the *loʻi,* the hydrogeologist estimated that the ground elevation at the *loʻi* is approximately 20 to 25 feet above sea level. The *loʻi*'s water source is not on this site, but about 200 yards away on the other side of a private dirt road, and on the order of tens of feet higher in elevation. The hydrogeologist was not able to visit the water source, which was on private property, but he talked to an individual familiar with it. It is either a spring source (as was represented by the individual in the CIA interview) or the discharge from the still active plantation irrigation system on the land immediately above.

The report stated that if it is an actual spring source at that elevation, it would be a discharge of perched groundwater with no hydrological connection to the semi-confined basal groundwater pumped by Keālia Wells 1A and 2A. The potential increase in pumpage of these wells would have no impact on the discharge rate of such a spring. If the supply is from the actively used surface water irrigation system on the land above, either as a direct connection or as a tailwater discharge, increasing pumping of the basal ground water would have no impact on its flowrate (TNWRE, 2018).

In conclusion, no adverse impacts to surface or ground water resources are expected as a result of the proposed residential use. The Proposed Action does not include any stream or surface water diversions, and will not modify any stream channels or irrigation ditches. The proposed groundwater use will not have an adverse impact on stream flow in Kapaʻa Stream, within irrigation ditches, and will not impact the water source for the taro *loʻi* mentioned during the LUC meeting and CIA interview.

3.5 NATURAL HAZARDS

3.5.1 Existing Conditions

Natural hazards include a variety of phenomena including seismic activity, hurricanes, tsunami inundation, and flood.

3.5.1.1 Seismic Activity

Seismic activity or earthquakes in the Hawaiian Islands are primarily associated with volcanic eruptions from the expansion or shrinkage of magma reservoirs, rather than shifts in the earth's crust. The island of Kauaʻi is periodically subject to episodes of seismic activity of varying intensity, but available historical data indicates that the number of major earthquakes occurring on Kauaʻi have generally been fewer and of lower intensity compared with other islands, such as Hawaiʻi Island.

Earthquakes cannot be avoided or predicted with any degree of certainty, and an earthquake of sufficient magnitude (greater than 5.0 on the Richter scale) could cause damage to roadways and structures. The Uniform Building Code (UBC) provides minimum design criteria to address potential for damages due to seismic disturbances. The UBC scale is rated from Seismic Zone 1 through Zone 4, with 1 the lowest level for potential seismic induced ground movement. Kauaʻi is designated Seismic Zone 1.

3.5.1.2 Hurricanes

Hurricanes are one subclass of a category of phenomena known to meteorologists as tropical cyclones. Hurricanes are characterized by the following life-threatening effects: high winds in excess of 74 mph; high storm surges; and heavy rains that will exceed flash flood conditions. The hurricane season in Hawaiʻi officially begins on June 1 each year and ends six months later on December 1.

Among the six most critical cyclones that approached the Hawaiian Islands between 1832 and 1949, three of the storms went toward Kauaʻi and Niʻihau. In 1959, Hurricane Dot caused $6 million in damage to Kauaʻi and was the most devastating storm up to that date in Hawaiʻi's history. In 1982, Hurricane Iwa struck Kauaʻi and Oahu and caused $234 million in property damage to both Islands. On September 11, 1992, Hurricane Iniki, a Category 4 hurricane with winds up to 150 mph (240 km/hr), resulted in an estimated $1.8 billion in damage to Kauaʻi.

The National Oceanic and Atmospheric Administration (NOAA) reported that the 2016 season included two hurricanes (Madeline and Lester), three tropical storms (Celia, Darby, and Ulika), and one tropical depression (Ivette). In addition to the six tropical cyclones, one out-of-season hurricane (Pali) occurred in January 2016 (NOAA, 2016).

3.5.1.3 Tsunami

The County of Kaua'i's tsunami evacuation zone map for Keālia to Alakukui Point shows the designated tsunami evacuation area encompassing the entire coastal area up to Kūhiʻo Highway in Kapaʻa Town. In the Keālia area, there are also some areas inland of Kūhiō Highway that require evacuation, but these are mostly south of Keālia Road. The Petition Area is located north of Keālia Road, and is not within the designed tsunami evacuation area.

3.5.1.4 Flood Zones

The Petition Area is in the Federal Emergency Management Agency (FEMA)'s flood Zone X, areas of minimal flood hazard, determined to be outside the 500-year flood (FIRM Community-Panel No. 1500020210F). Neither the Keālia Mauka site nor the adjacent Kaʻao subdivision are located within the designated FIRM flood zone (Figure 3-2). Flood prone areas are associated with Kapaʻa Stream, and mostly located to the south of Keālia Road. However, the lower section of Keālia Road closer to Kūhiō Highway is susceptible to flooding, within Zone AE and XS. This lower section of Keālia Road includes Keālia Farm, the old post office building, and an abandoned school building.

There are no FEMA flood zones associated with Kumukumu Stream or Homaikewaa Stream, both located outside the Petition Area to the north.

3.5.1.5 Dam-Related Flooding

The *mauka* lands throughout East Kauaʻi include a number of man-made reservoirs, dams, ditches and flumes that were developed in the early twentieth century as part of the sugar plantation irrigation system. Many of these structures are still in use. The Hawaiʻi Department of Land and Natural Resources (DLNR) Dam Safety Program maintains a data base of the State's reservoirs and dams, their characteristics and physical conditions. In the areas *mauka* of the Petition Area, there are two State-regulated reservoirs/dams that are owned by the Petitioner, Keālia Properties, LLC: Halaula Reservoir (State Dam ID #KA-0146) located about a half mile *mauka* of the Petition Area, off Keālia Road; and the larger Kaneha Reservoir (State Dam ID#KA-0015) located further *mauka*, about four miles from the Petition Area.

Dam "evacuation zones" represent areas where the public would be evacuated in the event of a potential or actual dam failure. The evacuation zones are designated by the Kauaʻi Emergency Management Agency (formerly Civil Defense) in the case of a potential dam break, and are much larger than the potential "inundation" area. The evacuation area includes major roads and intersections where roadblocks could be set up for traffic control.

The Petition Area is not within the dam evacuation zone. The closest dam evacuation zone, for Halaula Reservoir, is limited to lands south of Keālia Road. The evacuation area comes up to Keālia Road in the vicinity of the Petition Area, and includes some of the *makai* sections of Keālia Road near Kūhiō Highway (Evacuation Map, U.S. Army Corps of Engineers and Pacific Disaster Center, revised October 25, 2017).

As required by law, Keālia Properties, LLC, as the dam/reservoir owner, has prepared an Emergency Action Plan for the DLNR's Dam Safety Program and State and County emergency management agencies. The Emergency Action Plan is an emergency response plan and identifies proposed evacuation routes.

Flood Map **Figure 3-2**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

3.5.2 Potential Impacts and Mitigation

The proposed subdivision will not affect the occurrence of natural hazards or increase the public's vulnerability to natural hazards. Two on-site detention basins will accommodate storm water runoff from within the Petition Area and from surrounding areas. Compliance with existing County building requirements and standards during construction will avoid significant impacts associated with potential natural hazards. The Petition Area is not within a flood prone area, or within the tsunami evacuation area.

Although the Petition Area is not within the County's designated dam evacuation zone for Halaula Reservoir, the lower portion of Keālia Road is. As a result, access to Keālia Mauka subdivision could be disrupted or curtailed in the event of such an emergency. Compliance with Kaua'i Emergency Management Agency instructions and procedures will mitigate adverse impacts to residents.

3.6 BOTANICAL RESOURCES

3.6.1 Existing Conditions

A Botanical Resources Assessment (LeGrande, 2016) was completed for the Keālia Mauka Petition Area, and is included as Appendix B. The study included field studies intended to:

- inventory flora;
- provide a general description of the vegetation on the project site;
- search for threatened and endangered species as well as species of concern; and
- provide recommendations regarding potential impacts to the plant resources of the area in regards to the proposed project.

The Petition Area has historically been utilized for various agricultural activities, including sugar cane production and livestock grazing. As with many areas in the Hawaiian Islands, the natural habitat has been highly modified and is characterized by introduced plant species. The study characterizes the Petition Area as an open, alien-dominated Guinea grassland with infrequently scattered shrubs and tree species.

The field survey noted a total of 63 observed plant species. Of these, 62 are alien (introduced) and one species is indigenous (native to the Hawaiian Islands and elsewhere). No threatened or endangered species were observed during the survey. An inventory of all the plants observed within the survey area is included in the botanical resources assessment report (Appendix B).

3.6.1.1 Dominant Vegetation Types

The following is a description of the dominant vegetation divided into two main areas within the Petition Area:

Guinea Grassland

The majority of the Petition Area is dominated by a Guinea grassland (*Panicum maximum*) with scattered shrub and tree species as well as areas where smaller weedy species dominate, such as in dirt roadways and along fence lines. Besides the guinea grass that the resident cattle are grazing on, smaller weedy species growing mixed in with the grass clumps include, false ragweed (*Parthenium hysterophorus*), castor bean (*Ricinus communis*), spiny amaranth (*Amaranthus spinosus*), owi

(*Stachytarpheta australis*), lantana (*Lantana camara*), Mexican poppy (*Argemone mexicana*), and slender mimosa (*Desmanthus pernambucanus*), Tree species observed included Koa haole (*Leucaena leucocephala*), African tulip (*Spathodea campanulata*), and Christmas berry (*Schinus terebinthifolius*). Dirt roadways were dominated by weedy grass species and smaller weeds such as owi, false ragweed, and *Sida* spp.

The main water trough for the cattle was full and overflowing, causing a rivulet of water running from a higher point of elevation at the western end near the middle of the property downslope eastward. Plant species adapted to a wetter habitat were observed growing in and at the edges of the water including, primrose willow (*Ludwigia octovalvis*), mosquito fern (*Azolla filliculoides*), and sedges such as kaluha (*Kyllinga brevifolia*), *Fimbristylis littoralis*, and *Cyperus difformis*.

Both areas planned for drainage basins (1 & 2) are dominated by Guinea grass and Koa haole. Along the boundary in the southeastern corner along Kūhiō Highway, larger stands of Koa haole were observed with the non-native maunaloa vine (*Canavalia cathartica*) growing in the branches.

Java Plum/Christmas Berry Stands

This vegetation type was only observed in small stands of trees along fence lines. Java plum (*Syzygium cuminii*) trees were mixed with smaller species such as African tulip, Christmas berry and Koa haole with a few coconut (*Cocos nucifera*) palms in some locations. Understory included weedy grass species such as fimbriate paspalum (*Paspalum fimbriatum*) and radiate fingergrass (*Chloris radiata*).

Discussion

Although the field surveys represent a one-time snapshot of the plants in the survey area, when considered together with the results of historical surveys, a reasonably accurate description of the environment and vegetation can be assembled. The botanical survey confirmed that native plant habitat within the Petition Area has been highly modified by human activities over the last several hundred years. Agricultural activities, road building, residential construction, and the intentional and accidental introduction of alien species has resulted in an overwhelming abundance and prevalence of non-native plant species on the site.

3.6.2 Potential Impacts and Mitigation

The nature of the land and its present and historical disturbance by agricultural activity limit the natural botanical resources that could occur on the site. The rare frequency of native plant species appears to confirm that only those species adapted to constant disturbances (e.g., geological, vehicular, invasive plant species, feral ungulates), can survive. Uhaloa (*Waltheria indica*), was the only indigenous (native to the Hawaiian Islands and elsewhere) plant species observed, and it was found very infrequently. There is no federally delineated critical habitat for any plant species on or adjacent to the Petition Area. In summary, the construction and operation of the proposed subdivision will not have an adverse impact on threatened or endangered plant species or critical habitat. No mitigation is required.

3.7 BIOLOGICAL RESOURCES

3.7.1 Existing Conditions

Avian and terrestrial mammalian surveys were conducted for the subject property as part of the environmental disclosure process. The field work was conducted on April 1, 2017. The resulting Fauna Survey (Rana Biological Consulting, 2017) is included as Appendix C. The primary purpose of the surveys was to determine if there are any avian or terrestrial mammalian species currently listed, or proposed for listing under the federal or State of Hawaiʻi endangered species statutes within or adjacent to the study area. The study evaluated the potential impacts of the proposed development on any sensitive or protected native species, and identified appropriate mitigation measures.

3.7.1.1 Avian Survey

The avian surveys were taken from five avian point count stations sited approximately equidistance from each other within the Petition Area. A total of 250 individual birds of 15 species, representing 12 separate families, were recorded during station counts. A listing of all species identified on site is included in Table 1 of Appendix C. All 15 avian species recorded on the property are alien to the Hawaiian Islands, and none are currently proposed for listed, or listed as endangered or threatened under either federal or state of Hawaiʻi endangered species statutes.

Avian diversity was in keeping with the property location and what was described as the heavily degraded habitat on the site (i.e., existing site is dominated by alien Guinea grass (*Megathyrsus maximus*) pasture with denser woody vegetation abutting two sides). Three species, Cattle Egret (*Bubulcus ibis*), Red Junglefowl (*Gallus gallus*) and Western Meadowlark (*Sturnella neglecta*), accounted for 54% of all birds recorded during station counts. The most commonly recorded species was the Cattle Egret, which accounted for 28% of the total number of individual birds recorded.

3.7.1.2 Mammalian Survey

The survey for terrestrial mammalian species was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the Petition Area during time spent within the Petition Area.

Three species of terrestrial mammals were recorded on the site. There was a herd of cattle (*Bos taurus*) on the site including one large Black Angus bull. Tracks and scat of pigs (*Sus scrofa*) were encountered along dirt roads within and adjacent to the Petition Area. Dogs (*Canis familiaris*) were heard barking from sites to the west and south of the site, and tracks of this species were also encountered along dirt roads within the site.

No mammalian species proposed for listing, or listed as endangered or threatened under either federal or state of Hawaiʻi endangered species statutes was recorded during the survey. These findings are consistent with the location of the property and the disturbed habitat present on the site (Rana Biological Consulting, 2017).

No endangered Hawaiian hoary bats were observed overflying the site. However, Hawaiian hoary bats are widely distributed in the low to mid-elevation areas on the Island of Kaua'i, and have been documented in and around areas that still have dense vegetation.

Although no rodent species were detected during the survey, it is probable that one or more of four established alien muridae found on Kaua'i--European house mice (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*)--use various resources found within the general Petition Area. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent on them.

3.7.1.3 Protected Species

In an EISPN comment letter dated December 27, 2017 (see Chapter 9), the United States Department of the Interior, Fish and Wildlife Service (USFWS) indicates that the following listed species may occur or transit through the vicinity of the proposed Petition Area: the endangered Hawaiian stilt *(Himantopus mexicanus knudseni)*, endangered Hawaiian coot *(Fulica alai)*, endangered Hawaiian gallinule *(Gallinula galeata sandvicensis)* and endangered Hawaiian duck *(Anas wyvilliana)* (collectively referred to as Hawaiian waterbirds); the endangered Hawaiian goose *(Branta sandvicensis)*; the endangered Hawaiian petrel *(Pterodroma sandwichensis)*, threatened Newell's shearwater *(Puffinus auricularis newelli),* and endangered band-rumped storm-petrel *(Oceanodroma castro)* (collectively referred to as Hawaiian seabirds); and the endangered Hawaiian hoary bat *(Lasiurus cinereus semotus)*.

None of these listed species were observed during the 2017 Rana survey. Although not observed during the avian survey, the Rana study notes that both the endangered Hawaiian Petrel and the threatened endemic Newell's Shearwater (*Puffinus newelli*) have been recorded over-flying the general project vicinity between April and the end of November each year.

The petrel is listed as endangered and the shearwater as threatened under both Federal and State of Hawai'i endangered species statutes. The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered to be the second more significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds can become disoriented by exterior lighting such as roadway lights, and collide with man-made structures. This is especially a concern during the fledging period, when young birds are finding their way out to sea for the first time. If not killed outright, the dazed or injured birds are easy targets for feral mammals. The Save Our Shearwaters Program is a multi-agency effort that enlists the help of citizens to aid birds who have become disoriented or injured. The program has recovered birds from both species from the general Keālia area over the past three decades.

The Hawaiian goose, or Nēnē (*Branta sandvicensis*) are a species of goose endemic to the Hawaiian Islands, and are known to occur in the northeast portion of Kaua'i. Nēnē are observed in a variety of habitats, but prefer open areas, such as natural grasslands and shrublands, pastures, wetlands, golf courses, and lava flows. No Nēnē were observed during the survey.

3.7.1.4 Critical Habitat

Critical habitat is a term defined and used in the federal Endangered Species Act (ESA). It is specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection.

According to the USFWS, there is no federally designated critical habitat within the immediate vicinity of the proposed project (see letter dated December 27, 2017, Chapter 9). Therefore, the construction and operation of the proposed subdivision will not impact any federally designated critical habitat. There is no equivalent statute under State law.

3.7.2 Potential Impacts and Mitigation

3.7.2.1 Impacts

Seabirds

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

Hawaiian Hoary Bats

It is likely that Hawaiian hoary bats overfly the Petition Area on a seasonal basis. The principal impact that proposed development can pose to bats is during vegetation removal during the clearing and grubbing phases of construction. The removal of vegetation has the potential to temporarily displace individual bats, which may use the vegetation as a roosting location. Because bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled.

Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the bat pupping season. With that said, there are no suitable roost trees within the proposed Petition Area. Therefore, vegetation clearing on the site is not expected to have any impact to this listed mammalian species.

Nēnē

Although no Nēnē were recorded during the avian surveys on the property, there is the potential that they could use resources on the site on a seasonal basis, depending on how tall the grass is. The primary potential impact to Nēnē would be during clearing and grubbing phases of the project. Clearing vegetation has the potential to disturb Nēnē nests, eggs, and young. When disturbed during nesting, Nēnē may abandon their nest, eggs, and to a lesser degree, the chicks. Increased vehicular traffic associated with construction activities also increases the risk of birds being run over or hit by vehicles within the project site.

3.7.2.2 Recommended Mitigation

Construction Period

During the construction phase of the project, the following mitigation measures and training are recommended to avoid adverse impacts to listed faunal species:

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

- If Hawaiian goose (Nēnē) are observed loafing or foraging within the Petition Area during the Hawaiian goose breeding season (September through April), have a biologist familiar with nesting behavior survey for nests in and around the Petition Area prior to the start of work. Repeat surveys after any subsequent delay of work three or more days (during which time the birds may attempt to nest).

    - Cease all work immediately and contact the USFWS for further guidance if a nest is discovered within a radius of 150 feet of proposed work, or a previously undiscovered nest is found within said radius after work begins.

- In areas where Nēnē are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on site.

Operational Period

Once the subdivision is completed and occupied, the following is recommended:

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).

4.0 HUMAN ENVIRONMENT

4.1 SURROUNDING LAND USE

4.1.1 Existing Conditions

The Petition Area and its surrounding lands were once part of the Līhuʻe Plantation, and are currently owned by the Applicant, Keālia Properties LLC. The 53.4 acre Keālia Mauka site is part of an approximately 1,000-acre tax map parcel [TMK (4)4-7-004:001] that extends from Kūhiō Highway to the *mauka* lands where Keālia Road intersects with Hauaala Road near the Spalding Monument. This parcel is referred to by the Applicant as the "Kumukumu parcel." *Mauka* of the Petition Area near the Spalding Monument, Keālia Road veers northward and forms the *mauka* boundary of the Kumukumu parcel. The adjacent TMK parcel to the south is also owned by Keālia Properties and is referred to as the "Makee parcel." The Makee parcel extends from Kūhiō Highway to Hauaala Road and is also about 1,000 acres in size. The location of both parcels is shown in Chapter 1, Figure 1-3. The Kumukumu parcel is currently outleased for grazing; the Makee parcel is largely fallow, with some diversified agriculture and equestrian activity.

The Keālia Mauka Petition Area is located at the southern corner of the Kumukumu parcel, adjacent to the existing 38-lot Kaʻao Road subdivision, also known as "Keālia Town Tract." This former plantation neighborhood includes house lots ranging in size from about 7,500 square feet (SF) to about 20,000 SF. The neighborhood is characterized by low rise, plantation-style homes on both sides of Kaʻao Road. Three house lots are accessed off Hopoe Road. All of the lands surrounding the Petition Area to the north and west are former plantation lands and are currently used for cattle grazing.

The Petition Area's eastern (*makai)* boundary is the two-lane Kūhiō Highway, State Route 56. This highway is the primary thoroughfare along the east Kauaʻi shoreline. It connects Līhuʻe and Kapaʻa to Keālia, Anahola and Kīlauea, and to the north shore communities of Princeville and Hanalei.

At the base of Keālia Road near Kūhiō Highway, there remain a number of plantation-era structures. Several of these structures are still in use, including an open shed used by Keālia Farms for staging and a farmers market, the Keālia Post Office, and a rodeo ring. An old school building on the north side of Keālia Road is vacant.

Directly across Kūhiō Highway from the Petition Area is the luxury Keālia Kai subdivision, also known as "Keālia Makai." This exclusive oceanfront development encompasses 300 acres, and includes 35 homesites and 29 lots ranging in size from five to 38 acres. The development fronts Keālia Beach, one of the most popular recreational beaches on the east side.

The nearest large concentration of population is Kapaʻa, located about two miles to the south of the Petition Area. In addition to being a population center, Kapaʻa is a major commercial, industrial and visitor center. To the north of Keālia, Anahola is the next community to the north.

4.1.2 Potential Impacts and Mitigation

The Proposed Action will transform undeveloped grazing land to a visible urban, residential use once the lots are sold and homes are constructed by the owners. The subdivision will expand the existing Ka'ao Road residential area, with similar, modest single family homes. The Applicant has no plans to expand residential use beyond the proposed 235 lots. Although the Proposed Action represents a change in land use for the subject 53 acres, residential use is compatible with the existing subdivision and consistent with the County General Plan. The Petition Area represents only a small portion (5%) of the 1,000-acre tax map parcel, the remainder of which will remain in agriculture/grazing use. The Proposed Action will not impact the ongoing grazing use on the surrounding lands.

4.2 AIR QUALITY

4.2.1 Existing Conditions

Air quality at a given location can be influenced by a number of factors, including geography, climate, the quantity and type of pollutants emitted locally and regionally, and the dispersion rates of these pollutants. The dispersion of pollutants is influenced by wind speed and direction, atmospheric stability, temperature, the presence or absence of inversions, and topography. Air quality is affected by both stationary sources (e.g., industrial development) and mobile sources (e.g., motor vehicles). Ambient air quality at the site is good. Portions of the property fronting Kūhiō Highway may be more impacted by vehicle emissions, but to a relatively minor degree. There is little traffic congestion in the area fronting the Petition Area.

The federal Clean Air Act (CAA), which was last amended in 1990, requires the U.S. Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. NAAQS have been established for six principal pollutants, called "criteria" pollutants: carbon monoxide (CO), nitrogen oxides (NOx), ozone (O3), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), sulfur oxides (SOx), and lead (Pb). The State of Hawai'i has also established its own standards for these pollutants and for hydrogen sulfide. The State AAQS are more stringent than the National AAQS for certain pollutants.

The table below shows the national and State standards for these pollutants. The "primary" standards have been established to protect the public health. The "secondary" standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the general welfare. The State of Hawai'i issues its ambient air quality standards in terms of a single standard that is designated "to protect public health and welfare and to prevent the significant deterioration of air quality."

Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$).

Table 4-1: National and State Ambient Air Quality Standards

Pollutant	Standard Hawai'i State	 Federal Primary (Health)	 Federal Secondary (Welfare)
Carbon Monoxide (CO)			
1-hour average	9 ppm	35 ppm	None
8-hour average	4.4 ppm	9 ppm	None
Lead (Pb)			
3-month average	1.5 µg/m^3 (calendar quarter)	0.15 µg/m^3 (running 3-month)	Same as primary
Nitrogen Dioxide (NO_2)			
1-hour average	None	100 ppb	None
Annual average	0.04 ppm	53 ppb	Same as primary
Particulate Matter < 10 microns (PM_{10})			
24-hour block average	150 µg/m^3	150 µg/m^3	Same as primary
Annual average	50 µg/m^3	None	None
Particulate Matter < 2.5 microns ($PM_{2.5}$)			
24-hour block average	None	35 µg/m^3	Same as primary
Annual average	None	12 µg/m^3	15 µg/m^3
Ozone (O_3)			
8-hour rolling average	0.08 ppm	0.075 ppm	Same as primary
Sulfur Dioxide (SO_2)			
1-hour average	None	75 ppb	None
3-hour block average	0.5 ppm	--	0.5 ppm
24-hour block average	0.14 ppm	None	--
Annual average	0.03 ppm	None	--
Hydrogen Sulfide			
1-hour average	25 ppb	None	None

Source: State of Hawai'i, Department of Health, Clean Air Branch, NAAQS January 2013. URL= http://health.hawaii.gov/cab/files/2013/05/naaqs_jan_2013.pdf. Accessed 9/2017.

Attainment Status of Study Area

Section 107 of the 1977 Clean Air Act Amendments requires the USEPA to publish a list of geographic areas that are not in compliance with the National AAQS, and these areas are called non-attainment areas. As noted above, the State of Hawai'i is an attainment area for CO, O_3, PM_{10} and PM_{25}.

Monitored Air Quality

The State of Hawai'i Department of Health (DOH) operates a network of air quality monitoring stations at various locations around the State. Each station, however, typically does not monitor the full complement of air quality parameters. The DOH monitoring station closes to the Petition Area is located in the Niumalu residential subdivision in Līhuʻe, about 13 miles southeast of Keālia. This station is considered a Special Purpose Monitoring Station established in 2011 to monitor emissions from the cruise ships in Nawiliwili Harbor, approximately 1.0 mile upwind.

The entire Island of Kauaʻi, like the rest of the state, meets the NAAQS standards and is within an attainment area. As reported in the Annual Summary of Air Quality Data for 2014 (DOH, 2015) (the latest year for which annual data are available), the pollutants monitored at the Niumalu station were particulate matter less than 2.5 microns (PM2.5), nitrogen dioxide (NO2), and sulfur dioxide (SO2). Carbon monoxide (CO) monitoring was shut down as of April 25, 2013. The readings at this location show that criteria pollutant levels were below state and federal ambient air quality standards.

4.2.2 Potential Impacts and Mitigation

4.2.2.1 Construction Period

During construction of subdivision improvements, and to a lesser extent during construction of individual homes, there will be short-term, construction-related impacts to air quality. Fugitive dust will be generated by site grading and excavation, and by earthwork involved during construction of the individual homes. Dust control is of particular concern due to the proximity and downwind location of the Kaʻao Road subdivision.

It is anticipated that the most dust generating activities will be the initial site grading, which will be accomplished in phases and is expected to last about 12 months. The first step in the construction sequence will be the installation of erosion and dust control best management practices (BMP). Grubbing will then be conducted to remove existing vegetation and top soil, followed by mass grading.

The County's Grading Ordinance allows a maximum of 10 acres to be disturbed at any time. Therefore, the 53.4-acre Petition Area would require up to six phases of grading work. The phasing of the grading work will mitigate dust impacts on the adjacent subdivision.

The developer will comply with State DOH Administrative Rules, Title 11, Chapter 60, Air Pollution, which prohibits visible dust emissions at property boundaries. Erosion and dust control BMP will include dust fences, silt fences, mud control at construction entrances, and sediment basins. Dust levels will be monitored at the project boundary fronting the residential area to evaluate the effectiveness of the project dust control program. Other BMPs include watering active work areas, keeping adjacent paved roads clean, and covering open bed trucks.

Because the finished lots will be sold undeveloped, bare areas will be hydro-seeded or mulched to protect exposed soil from wind and water erosion. Similar BMPs will be required for individual lot owners during home construction, and included in the subdivision's Covenants, Conditions and Restrictions (CC&Rs).

The use of construction equipment and vehicles may also lead to temporary increases in airborne pollutants. Exhaust emissions from construction vehicles will be mitigated by moving construction equipment and workers during off-peak traffic hours, ensuring equipment is functioning properly. With these mitigation measures, short term impacts to air quality during construction may be annoying to neighbors, but are not expected to be significant.

4.2.2.2 Operational Period

The project will create 235 individual residential lots that will be sold and developed by their owners. This will result in more cars and trucks coming to and from the area on a regular basis. Lot purchasers may also utilize other types of equipment and machinery to maintain their property and yards, which generate emissions. As a result, there will be some increase in air pollutants over current conditions. Assuming that each residence has a minimum of two vehicles, there will be an additional 470 cars and trucks traveling to the subdivision daily. Because most of the future homeowners are expected to be local residents already living on Kauaʻi, there will not be a net increase in vehicles on the island.

An indirect impact is an increase in emissions associated with the subdivision's electrical power demand and solid waste disposal requirements. However, even under a maximum build out and a worst case scenario, air quality is expected to remain well within both Hawaiʻi state and national ambient air quality standards. Long-term impacts to air quality would be less than significant.

Various energy saving features could be implemented to reduce energy consumption, including the use of solar water heaters, energy efficient lighting systems, and designing homes to maximize natural light and ventilation. Landscaping can also be used to provide shade and reduce the use of air conditioning.

4.3 NOISE

4.3.1 Existing Conditions

The Petition Area is currently used for cattle grazing, and the ambient noise environment consists of the sounds of the wind, ocean, and birds, and depending on proximity to major roadways, vehicle traffic from Kaʻao Road, Keālia Road and Kūhiō Highway. In the *mauka*-most areas of the site which are further from existing roadways, ambient noise is low. The eastern boundary of the Petition Area is located adjacent to Kūhiō Highway, and noise levels are higher in this area.

Although no noise measurements were taken at the Petition Area, a 2014 noise assessment for another proposed residential project provides comparable data on ambient highway noise. The Lima Ola Workforce Housing Development is proposed on a 75-acre site in ʻEleʻele, in west Kauaʻi. The site is bordered on one side by Kaumualiʻi Highway, and surrounded by agricultural fields to the south and west. A 2014 *Environmental Noise Assessment Report for the Lima Ola Workforce Housing Development* in ʻEleʻele, Kauaʻi (D.L. Adams Associates, Ltd., 2014) found that project areas adjacent to Kaumualiʻi Highway had high ambient noise levels during peak traffic hours, ranging from 50 to 68 dBA (dBA is an "A"-weighted decibel, expressing the relatively loudness of sounds in air as perceived by the human ear). In areas of the site far from major roadways, ambient noise levels were relatively low, ranging from 44 to 70 dBA. (D.L. Adams, 2014). It is expected that similar noise conditions exist along the Petition Area's Kūhiō Highway frontage, with lower noise levels further from the highway.

4.3.1.1 Noise Standards

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts, and have set noise limits as a function of land use. The State of Hawaiʻi's Community Noise Control Rule (HAR §11-46) identifies three classes of zoning districts and specifies maximum permissible sound levels due to stationary noise sources. The Community

Noise Control Rule also regulates noise related to construction activities. For Class A zoning districts, which include residential uses, maximum levels are 55 dBA (exterior) for day hours (7 AM to 10 PM), and 45 dBA (exterior) for night hours (10 PM to 7 AM).

The eastern boundary of the Petition Area borders Kūhiō Highway, which is a source of traffic noise. The Federal Highway Administration (FHWA) regulation 23 CFR 772 contains highway traffic noise abatement criteria (NAC) for seven land use activity categories and assigns corresponding maximum hourly equivalent sound levels ($L_{eq(h)}$) for traffic noise exposure. The Keālia Mauka subdivision would fall under "Category B," defined as residential and has a corresponding maximum $L_{eq(h)}$ of 67 dBA. These limits are viewed as design goals and all projects meeting these limits are deemed in conformance with FHWA noise standards. Under 23 CFR 772, if the predicted noise level approaches or exceeds the NAC, there is considered to be a "traffic noise impact" (FHWA, 2017).

The State of Hawaiʻi Department of Transportation (HDOT) has implemented the requirements of the FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy. According to the HDOT policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's NAC or when the predicted traffic noise levels "substantially exceed the existing noise levels." "Approach" is defined as 1 dB less than FHWA's NAC and "substantially exceed" is defined as an increase of at least 15 dB.

The U.S. Environmental Protection Agency (USEPA) has identified a range of yearly day-night equivalent sound levels (Ldn) sufficient to protect public health and welfare from the effects of environmental noise. Ldn is the average equivalent sound level over a 24-hour period, with a penalty added for noise during the night time period. The EPA has established a goal to reduce exterior environmental noise to an Ldn not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an Ldn not exceeding 55 dBA. These goals are not intended as regulations, but are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

The U.S. Department of Housing and Urban Development (HUD) has noise standards for new residential construction in high noise areas. All sites whose environmental or community noise exposure exceeds the day night average sound level (Ldn) of 65 Ldn are considered noise-impacted areas. The interior noise standard is 45 Ldn. According to HUD standards, locations with day-night average noise levels above 75 Ldn have "Unacceptable" noise exposure.

4.3.2 Potential Impacts and Mitigation

4.3.2.1 Construction Period

The Proposed Action will result in both short-term and long-term noise impacts. Short-term impacts will be associated with the development of subdivision infrastructure including excavation, grading, and construction of roadways, utilities, drainage, etc. These activities will generate construction-related noise that may affect surrounding land uses. Actual noise levels will depend on the methods employed during each stage of the construction process. The surrounding use most impacted by construction noise will be the adjacent Kaʻao Road subdivision. In particular, the three homes along Hopoe Road which face the Petition Area will be most impacted.

As noted above, the County's Grading Ordinance allows a maximum of 10 acres to be disturbed at any time. The phasing of construction will mitigate noise impacts on the adjacent subdivision.

During construction, earth moving equipment, e.g., bulldozers and diesel powered trucks, will likely be the loudest equipment used. In cases where construction noise is expected to exceed the Department of Health (DOH) "maximum permissible" levels at the property line, a permit will be obtained from the DOH to allow the operation of construction equipment. Additional noise mitigation such as temporary noise barriers, and limitations on work hours/days will be employed as required by DOH.

Once the roads and utilities are complete, the lots will be sold and built out by the individual lot owners. Build out of the subdivision is expected to continue over a number of years, and noise will not be continuous at any one location. However, it is difficult to predict exactly when construction noise will occur. Noise impacts on the Ka'ao Road homeowners will be mitigated by the presence of the detention basin/green space buffer located along the back of the Ka'ao Road lots. There will be no green space buffer for the residences on Hopoe Road, therefore they will be impacted more when homes are constructed near them. Early occupants of the subdivision may be impacted by noise as their future neighbors build their homes. In general, residents will be most affected when construction is occurring on adjacent or nearby lots, particularly upwind.

4.3.2.2 Operational Period

Noise Generated by Residential Use

In the long-term, noise will be generated by the residential uses, people, outdoor mechanical equipment, and by vehicles coming to and from the subdivision. All project activities will comply with the DOH Administrative Rules, Chapter 11-46, Community Noise Control. Noise from stationary mechanical equipment such as air handling equipment and condensing units will be required to meet the maximum permissible noise limits of 55 dBA during the daytime hours and 45 dBA during nighttime hours for single family residential areas.

Impacts of Highway Noise on Residential Use

There is the potential for noise impacts from Kūhiō Highway on some subdivision residents. The Petition Area property line abuts the highway right-of-way (ROW) and the subdivision plan includes a row of 22 lots adjacent to the *mauka* edge of the highway right of way. In the area immediately fronting the Petition Area, the Kūhiō Highway ROW narrows from 140 feet to 100 feet in width. Per County Comprehensive Zoning Ordinance, residential structures must be set back ten feet from a rear property line. With a 100-foot highway ROW, residential structures on these 22 lots would be located 60 feet from the centerline of Kūhiō Highway. If the ROW were widened to 140 feet (as it is for other portions of the highway), structures would be 80 feet from the highway centerline.

Highway noise impact on the 22 residential lots was estimated using HUD's Day/Night Noise Level Electronic Assessment Tool provided by the HUD Environmental Planning Division. This on-line tool calculates Ldn, or noise exposure over a 24-hour period, at an effective distance. The effective distance was set for 80 feet (from the highway centerline), which assumes a "best case" 140-foot highway ROW. Traffic counts were taken from the State of Hawai'i Department of Transportation's 2015 data for the Anahola traffic station on Kūhiō Highway. The HUD model indicated that even at a distance of 80 feet, the day-night average sound level for Kūhiō Highway will exceed 65 Ldn, and be considered a noise-impacted area, requiring attenuation/mitigation. However, the projected day/night noise level is expected to be less than HUD's "unacceptable" level of 75 Ldn.

Potential Highway Noise Mitigation

Noise mitigation is required for the 22 impacted lots along Kūhiō Highway. Even with a 140-foot ROW, these homes will be adversely affected by highway noise. Some areas along the property boundary have existing vegetation and berms, which could provide some degree of noise mitigation, but not enough to reduce noise to acceptable levels. Potential noise mitigation may include:

- Highway sound barriers/walls along Kūhiō Highway

Effective mitigation to reduce interior noise includes:

- air conditioning instead of natural ventilation
- double glazed windows and sound proofed exterior walls
- acoustically softening interior spaces by thick carpeting with padding, acoustical tile ceiling, louvered closet doors, etc.

Other mitigation that may be considered could be to set back the 22 lots further from the highway, or completely relocate these lots to a less impacted area.

4.4 ARCHAEOLOGICAL AND HISTORIC RESOURCES

An archaeological Literature Review and Field Inspection (LRFI) for the proposed Keālia subdivision has been prepared by Cultural Surveys Hawaiʻi (CSH) (Appendix D). The Area of Potential Effect (APE) and inspection area encompassed the entire Petition Area. The LRFI included historical, cultural and archaeological background research and a field inspection to identify existing resources in the Petition Area and determine the likelihood that they may be affected by the project.

The LRFI summarized all previous archeological research and historic properties identified in the Keālia *ahupuaʻa*. The studies included several investigations conducted in 2007 (Drennan and Dega) of a 2,008-acre property that included the current Petition Area. A summary of all previous archeological investigations is provided in the LRFI. The following provides an overview of the LRFI findings and recommendations.

4.4.1 Existing Conditions

4.4.1.1 Background Summary and Predictive Model

The Keālia Mauka Petition Area is located in the *ahupuaʻa* of Keālia in the ancient district of Puna, one of five ancient districts on Kauaʻi. Legends, traditional accounts and *wahi pana* (celebrated places) point to an area rich in pre-Contact history, although much less than that of nearby Wailua. Historic records list a number of *heiau* (temples, non-Christian places of worship) in Keālia. This suggests that Keālia, as well as the Kapaʻa *ahupuaʻa*, were probably more politically significant in ancient times. The specific locations of most of these *heiau* are unknown. According to historic documents, the plateau areas north of Keālia Valley were sparsely inhabited with areas bordering Kumukumu and Hōmaikawaʻa Streams hosting the largest settlements.

The earliest successful economic enterprise by a Westerner in the *ahupuaʻa* was the Krull Ranch and Dairy, which operated in the Kumukumu area in the 1860s. In 1877, the Makee Sugar

Plantation was established. The Makee Plantation built a mill and landing at Kapaʻa as part of the plantation infrastructure. Following the move of the Kapaʻa mill to Keālia in 1885, a railroad was built from Makee Landing to Keālia with another railroad arm leading into the *mauka* regions of Kapaʻa.

The Makee Sugar Plantation, operating out of Keālia, attracted hundreds of immigrant workers, first the Portuguese and Japanese and later, Filipinos. Keālia town sprang up around these immigrant groups. In addition, there were several plantation camps in Keālia, including in the plateau lands of Kumukumu and Hōmaikawaʻa. Commercial sugarcane cultivation and milling initiated in the mid- to late 1800s was a primary factor in the changes in settlement patterns in the Keālia area. Housing patterns were based on plantation camps of mainly immigrant laborers. A pre-contact subsistence economy was replaced by the market-based economy. Transportation became mechanized, with rail lines from the fields to the mills, and to new landings.

The demise of sugar in the late 20th century occurred concurrently with an increase in tourism and a service-oriented economy. Plantation-era transportation routes were abandoned or were incorporated into present transportation infrastructure. The LRFI notes that modern construction activities in coastal Keālia, however, continue to unearth evidence of pre-Contact, early historic, and plantation era activities (Cultural Surveys Hawaiʻi, 2017).

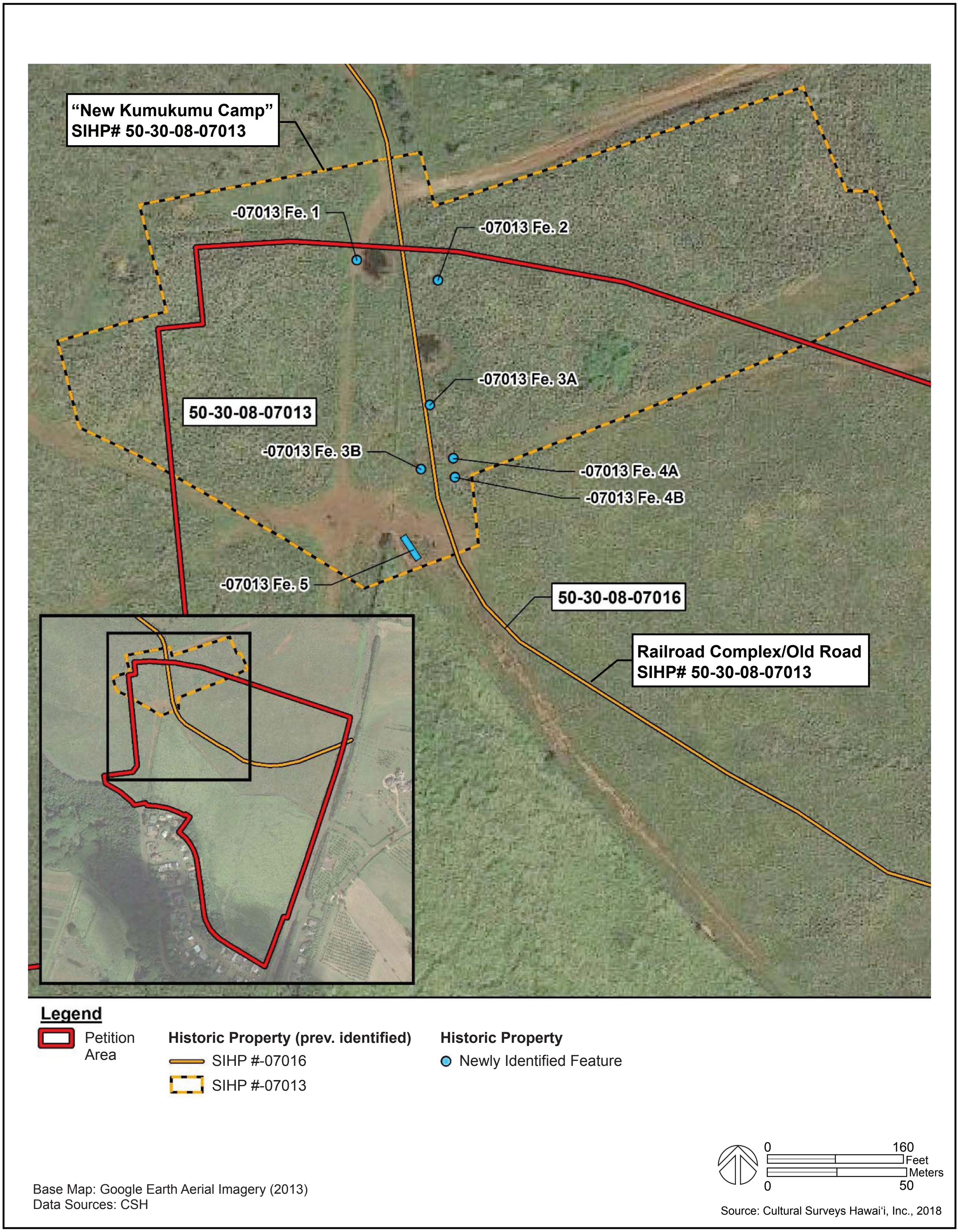
4.4.1.2 Previously Identified Historic Sites

The LRFI noted that based on background research, the Keālia Mauka Petition Area was part of an area under sugarcane cultivation between the late nineteenth century and 2000. Previous archaeological studies in the *ahupuaʻa* have identified numerous archaeological sites around the Petition Area, many associated with post-contact agricultural use. Within the current Petition Area, there are two previously identified historic sites: "New Kumukumu Camp" (State Inventory of Historic Places (SIHP) # 50-30-08-07013) and an old road/railroad complex (SIHP #50-30-08-07016). The locations of these sites is shown in Figure 4-1. The two sites were evaluated during Phase I of a four phase *Archaeological Inventory Survey (AIS) in the Keālia Ahupuaʻa* (Drennan et al. 2006).

The Drennan et al. AIS recommended no further archaeological work for the two historic properties (-07013 and -07016). That AIS was reviewed and accepted by the State Historic Preservation Division (SHPD) in an April 12, 2007 review. The recommendation for no further work may also be reasonably understood to be accepted by the SHPD.

4.4.1.3 Results of 2017 Field Work

The 2017 CSH field inspection focused on the area of the proposed subdivision. The study characterized the Petition Area as consisting of relatively level areas along the western portion and gentle to moderate slope areas to the east. The pedestrian survey was accomplished through systematic sweeps spaced 10 to 15 meters apart due to the low vegetation.



Historic Features Within The Petition Area **Figure 4-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

Historic properties observed within the northwest corner of the project area are features associated with the “New Kumukumu Camp” (SIHP # 50-30-08-07013). A total of five newly identified features within the Petition Area were given feature numbers (SIHP # 50-30-08-07013 Features 1 through 5) The features are associated with the plantation as seen in previous archaeological studies as well as the similar style of construction associated with water control in sugar plantation systems on Kauaʻi.

The 1950 aerial photograph in Figure 4-2 shows a portion of the New Kumukumu Camp with the location of the newly identified features. During the current inspection, SIHP #-07016 could not be re-identified.

Table 4-2. Historic Features Within the Petition Area

SIHP #	Feature Type	Function	Age	Notes
50-30-08-07013 Feature 1	Alignment	Transportation	Plantation era	Abandoned
50-30-08-07013 Feature 2	Concrete slab	Indeterminate	Plantation era	Abandoned
50-30-08-07013 Features 3A and 3B	Concrete posts	Communication	Plantation era	Abandoned
50-30-08-07013 Features 4A and 4B	Culverts	Water Control	Plantation era	Abandoned
50-30-08-07013 Feature 5	Concrete	Indeterminate	Plantation era	Abandoned

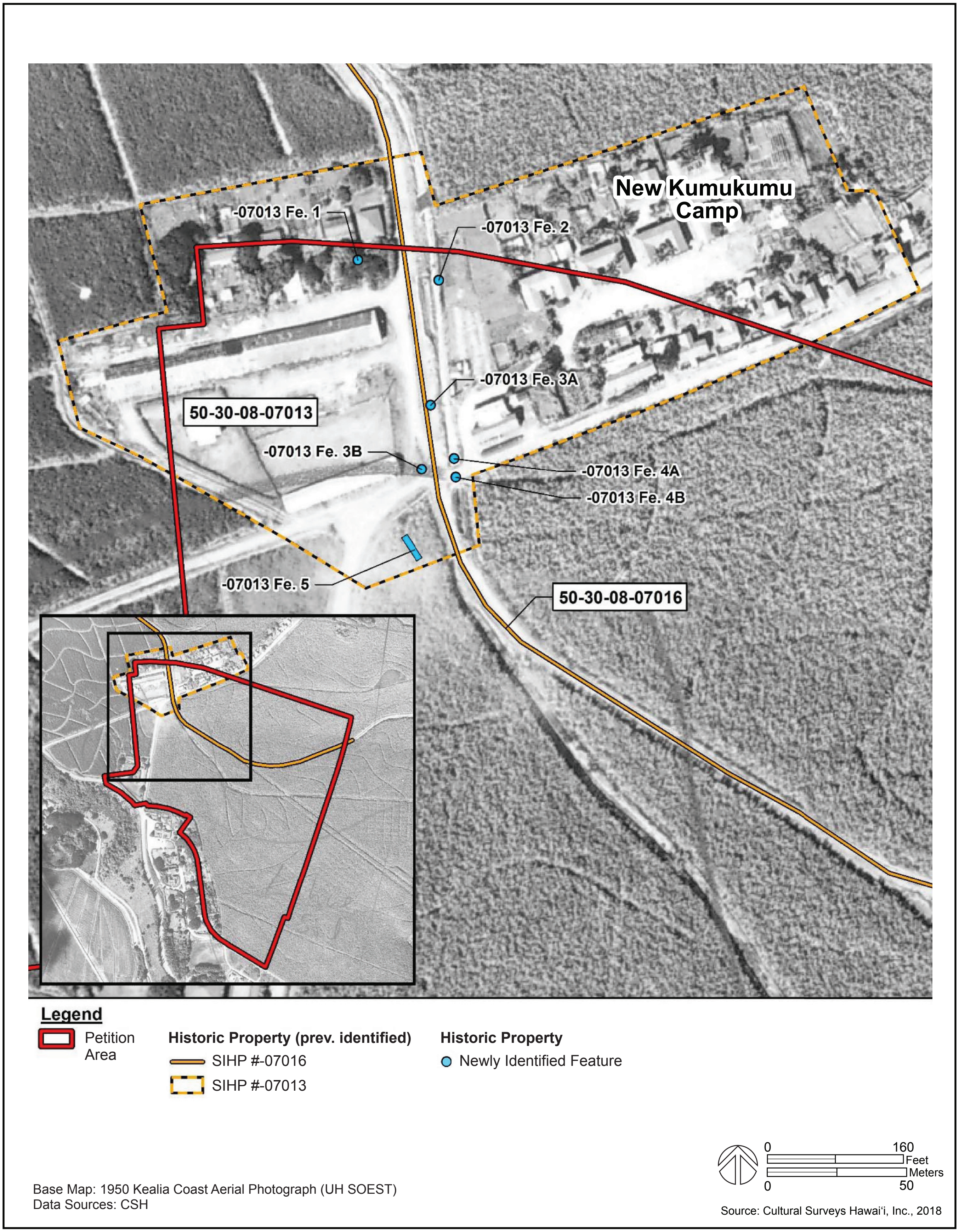
Source: Cultural Surveys Hawaiʻi, 2018

The following are descriptions of the newly identified features, which are thought to be features of the New Kumukumu Camp’s irrigation, communication and transport system. Photographs of the features are included in the LRFI (Appendix D).

SIHP #50-30-08-07013, Feature 1, Alignment. This feature is a remnant alignment of concrete, brick, and metal that measures 2.1 m in length by 0.30 m in width and runs in a rough north/south direction. The alignment is in extremely poor condition and the function of the historic property could not be determined. It parallels a dirt road currently in use.

SIHP #50-30-08-07013, Feature 2, Unknown. This feature is a concrete slab measuring 1.49 m in length by 0.42 m in width with a thickness of 0.36 m. The concrete slab was observed along a gently sloping area. Due to its present condition and lack of other information including figures, the formal type and function of this slab is unknown.

SIHP #50-30-08-07013, Feature 3, Posts. This feature consists of two concrete posts (Features 3A and 3B) measuring approximately 30 feet high. Feature 3A is square-shaped and measures 0.20 cm by 0.20 m. The base of the post is thicker at the bottom and tapers at the top. Feature 3B is an octagon-shaped concrete post measuring 0.25 m in radius.



1950 Aerial Photo Showing Historic Features **Figure 4-2**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

SIHP #50-30-08-07013, Feature-4, Culverts. This feature consists of two remnant culverts (Features 4A and 4B) constructed of basalt and mortar. Feature 3A is located to the north and measures 3.5 m by 3.5 m with a depth of 0.83 m along the north face. Feature 4A is in extremely poor condition. Feature 4B measures 4.1 m in length (in an east/west direction) by 3.2 m in width (in a north/south direction) and walls measuring from 0.22 m to 0.37 m thick. Feature 4B appears to have been at one time a four-way culvert. Sluice gate slots were observed as well as a single culvert opening on the west side. The opening measures 0.43 m wide by 0.26 m high.

SIHP #50-30-08-07013, Feature 5, Foundation. This feature consists of a large rectangular-shaped concrete slab measuring 10.0 m by 2.45 m with heights from 0.0 m at the northwest corner to 0.43 m at the central-east area. The thickness of the slab varies from 0.12 m to 0.20 m. On the southeast corner of CSH-5, the name "GOMES" was observed. The function of the slab is indeterminate but is understood as related to plantation activities.

4.4.2 Potential Impacts and Mitigation

4.4.2.1 Significance Assessment

The five features of a previously designated historic property, "New Kumukumu Camp" (SIHP #50-30-08-07013), were identified within the current Petition Area and were evaluated for significance according to the broad criteria established by HAR §13-284-6. The five significance criteria are:

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;

d. Have yielded, or is likely to yield information important for research on prehistory or history;

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

SIHP #50-30-08-07013, remnants of a former plantation camp, is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history). This reflects its value to our understanding of plantation era infrastructure. Water control was essential for sugarcane cultivation, as evidenced by the fact that water was transferred from as far away as Hanalei (Wilcox 1996:70). Communication within the plantation was also important. This is consistent with the significance assessment in Drennan and Dega (2007:110-111) that concluded that SIHP # -07013 was significant under Criterion D (only) of the Hawaiʻi State Register of Historic Places.

4.4.2.2 Summary and Recommendations

The recent CSH inspection of the Petition Area identified five historic features that are associated with previously designated SIHP # 50-30-08-07013. The newly identified features consist of basalt and mortar culverts, concrete posts, and concrete slabs. Due to its inclusion in, or close proximity to previous archaeological studies, the features identified during the current investigation most likely date to the early twentieth century and are part of the Keālia and Līhuʻe Plantations' irrigation, communication, and transport system.

The Proposed Action, development of the Keālia Mauka Homesites, will require demolition of the five newly identified site features. As such, the Proposed Action may have an adverse effect on the plantation era infrastructure features of SIHP # 50-30-08-07013. The LRFI supports the recommendation of Drennan and Dega 2007 for no additional archaeological work at this historic property. No additional archaeological work is recommended for the Petition Area (CSH, 2008). The LRFI recommended consultation with SHPD to gain clarity regarding State requirements prior to the Proposed Action.

In a letter dated February 27, 2018, the State of Hawaiʻi Land Use Commission, the EIS accepting agency, notified the SHPD of the Proposed Action and the Petitioner's request for a Land Use District Boundary Amendment. The LUC requested confirmation from SHPD that the entire Petition Area has been reasonably addressed in the prior AIS which recommended no further work or mitigation. A response from SHPD is pending.

4.5 CULTURAL RESOURCES

4.5.1 Existing Conditions

4.5.1.1 Document Purpose and Background

A Cultural Impact Assessment (CIA) for the project was conducted by Cultural Surveys Hawaiʻi (CSH) (CSH, 2018) and is included as Appendix E. The CIA was prepared to comply with the State of Hawaiʻi's environmental review process under Hawaiʻi Revised Statutes (HRS) §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. Act 50, Sessions Laws of Hawaiʻi 2000, amended Chapter 343 HRS to require that environmental impact statements assess the effects of a proposed action on the cultural practices of the community and State, and acknowledged the State's responsibility to protect native Hawaiian cultural practices.

Through document research and ongoing cultural consultation efforts, this report provides information pertinent to the assessment of the Proposed Action's impacts to cultural practices and resources (per the *Office of Environmental Quality Control's Guidelines for Assessing Cultural Impacts*), which may include Traditional Cultural Properties (TCP) of ongoing cultural significance that may be eligible for inclusion on the State Register of Historic Places. The document is intended to support the project's environmental review and may also serve to support the project's historic preservation review under HRS §6E-42 and I Administrative Rules (HAR) §13–284.

Native Hawaiian Rights

In Ka Paʻakai O Ka ʻAina v. Land Use Commission, 94 Hawaiʻi 31, 74, 7 P.3d 1068, 1084 (2000), the Hawaiʻi Supreme Court held the following analysis be conducted:

(1) The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;

(2) The extent to which those resources – including traditional and customary native Hawaiian rights – will be affected or impaired by the proposed action; and

(3) The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist.

Under the Ka Paʻakai case, the required analysis shall end upon the determination that there are no known traditional and customary Native Hawaiian rights exercised in the 53.4-acre project area. The CIA makes a good faith effort to identify the nature and scope of valued cultural, historical, or natural resources in the project area; determine the extent to which these resources will be affected or impaired by the proposed action; and recommend feasible action, if any, to be taken by the Land Use Commission (LUC) to reasonably protect Native Hawaiian rights if they are found to exist.

Community Consultations

As part of the CIA, Hawaiian organizations, agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Petition Area and the vicinity. Outreach was initiated in April 2017 through letters, email, telephone calls and in-person contact. CSH attempted to contact 41 individuals and agencies. The organizations consulted included the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the Kauaʻi/Niʻihau Island Burial Council (KNIBC), Kauaʻi Historic Preservation Review Commission, Kapule Hawaiian Civic Club, and Kauaʻi Council of Hawaiian Civic Clubs, and community members in the Kawaihau District. Four individuals agreed to be interviewed and share their *manaʻo* (thoughts, opinions) and *ʻike* (knowledge) about the Petition Area and the Keālia *ahupuaʻa*. Appendix E includes a summary of all consultations and interviews.

4.5.1.2 Results of Background Research and Community Consultation

The background research for the CIA summarized both pre- and post-contact land uses within the Keālia *ahupuaʻa,* as described previously in Section 4.4. The explosive growth of the sugar industry within Keālia (as well as the rest of East Kauaʻi) starting in the mid to late 1800's, led to the development of a small town comprised mainly of sugar plantation workers, many of whom were immigrants from Portugal, Puerto Rico, the Philippines, Japan, and China (Kauaʻi Historical Society n.d.). However, the decline of sugar also marked the end of Keālia Town. The town slowly dispersed after the incorporation of the Makee Sugar Company into the Lihue Plantation in the 1930s. Many of the plantation workers bought property of their own and moved out of plantation camps. The plantation camps that bordered Kūhiō Highway were disbanded in the 1980s. In 1997, the entire *ahupuaʻa* of Keālia was sold off as an effort to downsize Amfac's landholdings and because Keālia is the most distant from the Lihue Plantation sugar mill, it was considered the least profitable (Honolulu Advertiser, 7 July 1997).

As discussed in Section 4.4 above, previous archaeological studies identified two historic properties within the boundaries of the current Petition Area: "New Kumukumu Camp" (State Inventory of Historic Places (SIHP) # 50-30-08-07013) and an old road/railroad complex (SIHP #50-30-08-07016). Five new features were identified during a 2017 archaeological field inventory.

4.5.2 Potential Impacts and Mitigation

4.5.2.1 Ka Paʻakai v. Land Use Commission Analysis

Based on its findings, the CIA evaluated the Proposed Action using the three required components of the Hawaiʻi Supreme Court's Ka Paʻakai v. Land Use Commission ruling. In evaluating the first criteria of the Ka Paʻakai analysis ("*the identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area"*) the CIA found there are no known traditional and customary Native Hawaiian rights exercised in the Petition Area. Under Ka Paʻakai, the required analysis ends after the determination that there are no known traditional and customary Native Hawaiian rights in the Petition Area.

Although the Ka Paʻakai analysis is complete, the CIA's community consultations revealed concerns about cultural and non-cultural impacts outside of the Petition Area. The CIA categorized these into "non-culturally relevant" and "culturally relevant" community concerns. They are discussed further in the CIA and summarized below.

4.5.2.2 Non-Culturally Relevant Community Concerns and Recommendations

Integrity of Halaʻula Reservoir

A concern expressed during the CIA consultation was the integrity of the Halaʻula Reservoir located *mauka* of the current Petition Area. Comparisons were drawn to the Kaloko Dam catastrophe, and a request was made by one informant that efforts be made to prevent a similar tragedy from occurring within Keālia.

Discussion: As discussed in Section 3.5.1.5 of this Draft EIS, the privately-owned Halaʻula Reservoir, as well as other *mauka* dams, are regulated by the State Department of Land and Natural Resources Dam Safety Program. The Dam Safety Program maintains a data base of the dam characteristics and physical conditions. The Petition Area is not within the State-designated dam evacuation zone, the area where the public would be evacuated in the event of a potential or actual dam failure. The Petition Area is not in an at risk area in the event of a potential dam breach. As required by law, Keālia Properties LLC, as the dam/reservoir owner, maintains the dam structures to required standards and has prepared an emergency response plan for use by State and County emergency management agencies.

Chemicals and Pesticides in Petition Area Soils

One CIA informant expressed a concern about the presence of chemical fertilizers and pesticides within the soil. As former sugar cane lands, chemicals once utilized for this industry may be present within Petition Area soils.

Discussion: As discussed in Section 4.8 of this Draft EIS, prior agricultural activity in the Petition Area creates the potential for the presence of hazardous substances in the soil which present unacceptable health risks to future residents, especially children. As recommended by the Hawaiʻi Department of Health and in accordance with State policies, soil testing will be conducted in areas of the Petition Area proposed for residential or recreational use. If identified, contaminated soils and materials will be handled, transported, stored, disposed of and/or remediated in place to levels appropriate for residential use.

4.5.2.3 Culturally Relevant Community Concerns and Recommendations

Potential for Subsurface Cultural Deposits, Including *Iwi Kūpuna*

Despite the lack of ongoing traditional cultural practices and above ground cultural sites, several individuals expressed concerns that subsurface cultural deposits (i.e., *iwi kūpuna, imu, pōhaku*) may be impacted by the Proposed Action.

Discussion: The CIA notes that although the Keālia *Ahupuaʻa* has a rich cultural history, evidence of pre-contact settlement and land use has largely been obliterated by historic era sugar planting activities. The Petition Area has been highly disturbed through decades of mechanized and intensive agriculture-related activity. Background research indicates that the area was heavily plowed in the historic era, typically to depths of 18 to 24 inches. Due to this disturbance, the likelihood of encountering subsurface cultural deposits (i.e., *iwi kūpuna, imu, pōhaku*) remains low. No burials or traditional cultural material have yet been encountered within the Petition Area.

Although the likelihood of finds remains low, project construction workers will be informed of the possibility of inadvertent cultural finds, including human remains during a preconstruction meeting. Personnel will be educated on the types of cultural materials that may be encountered during ground disturbance. In the event that any potential historic properties are identified, all activity in the area will cease and the State Historic Preservation Division will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. Remains will be reinterred in accordance with an agreed upon burial treatment plan.

Potential Impact to Groundwater Resources

One individual interviewed for the CIA expressed concern about the potential impacts to groundwater resources and the aquifer. Specifically, this individual suggested that the Proposed Action could impact a natural spring feeding his taro *loʻi*, which is located in Keahapana Valley, approximately one mile southeast of the Petition Area.

Discussion: During the preparation of the CIA, the cultural researcher was not able to gain access to the property to verify the location of the *loʻi* or its water source. Subsequently a hydrogeologist was hired to further evaluate this issue. The findings were discussed in Section 3.4 (Water Resources) of this Draft EIS, and the hydrogeologist's letter report is included as Appendix I. The report states that the source of water for this particular *loʻi* is estimated to be about 200 yards from the *loʻi* at a higher elevation. It is either a spring source, as represented by the cultural informant, or is the discharge from the still active plantation irrigation system on the land immediately above.

If the water source is an actual spring at that elevation, it would be a discharge of perched groundwater with no hydrologic connection to the groundwater pumped by the wells supplying Keālia Mauka. The water use by the proposed subdivision would have no impact on the discharge rate of such a spring. If the *lo ʻi*'s water supply is from the plantation irrigation system, it is a surface water source, and increased pumping of groundwater for Keālia Mauka would have no impact on its flowrate (TNWRE, 2018, see Appendix I). In either case, the Proposed Action will have no impact on the water source used by the cultural informant.

Finally, as discussed in Section 3.4, the Applicant's water service agreement with Keālia Water Company allocates more than enough water to accommodate the subdivision's needs. The project's water demand is also well below the State-approved pump capacity for these two wells. No adverse impacts to the groundwater aquifer is anticipated.

4.6 VISUAL AND SCENIC RESOURCES

4.6.1 Existing Conditions

In the Petition Area vicinity, public views from Kūhiō Highway include the open pasture lands in the *mauka* areas to the northwest and southwest. In the far distance, there are views of Mt. Kalalea and the Nounou mountain range to the southwest, and the Keālia Forest Reserve to the northwest. Although Kūhiō Highway closely parallels the coastline north of Kapaʻa Town, offering shoreline views, past Keālia Road, the shoreline jogs to the east, and Kūhiō Highway continues its northerly route.

The Petition Area is located on the west (*mauka*) side of Kūhiō Highway, just north of the intersection with Keālia Road. The Petition Area is at an elevation of about 100 feet, slightly above the elevation of the highway. In this area, there are no coastal views. The view looking *makai* from the highway is of the manicured landscape of the oceanfront Keālia Kai subdivision.

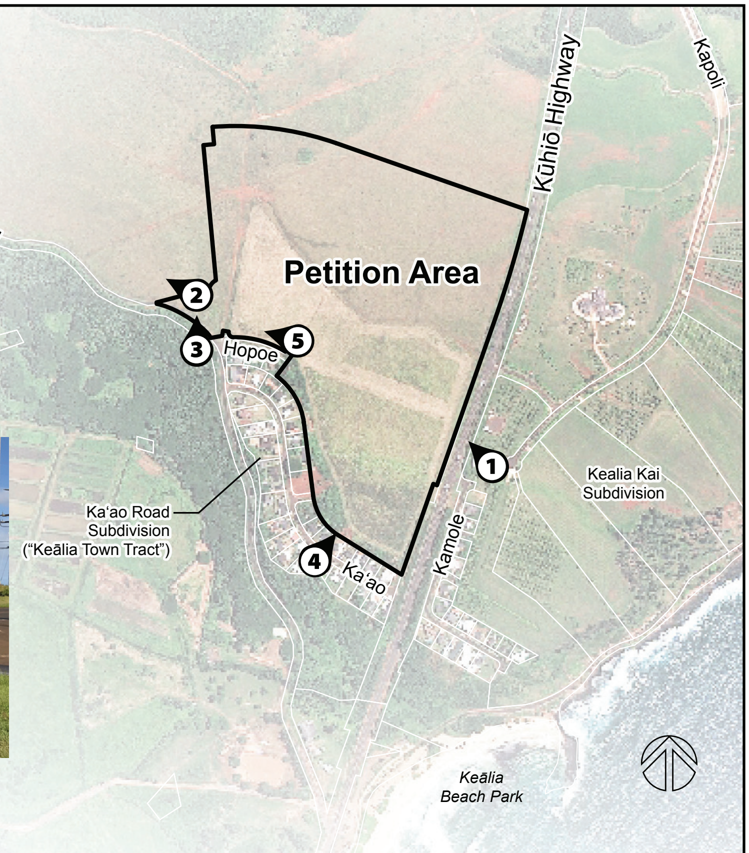
The Keālia Mauka Petition Area slopes gently upward from Kūhiō Highway toward the mountains, reaching an elevation of about 125 feet at its *mauka* boundary. From Kūhiō Highway, views of the Petition Area are limited due to the presence of thick, overgrown vegetation alongside much of the highway. However, there are several sections without this vegetation with unobstructed views of vast pasture lands and the Kaʻao Road subdivision, located about a half mile up Keālia Road.

From Keālia Road, there are expansive views of vacant pasture land beyond the Kaʻao Road subdivision, including the Petition Area. Grazing cattle, fencing, water tanks and gently rolling terrain are clearly visible, with the mountain ranges in the *mauka* areas. Residents on Kaʻao Road and the shorter Hopoe Road currently have an unobstructed view of these *mauka* pasture lands, which include the future subdivision. The photos in Figure 4-3 show the view of the Petition Area from public roads.

The Petition Area is not visible from the Keālia Kai subdivision or from the coastal multi-use path which is at a lower elevation along the shoreline. Scenic views up and down the coast, as well as the distant mountains are available to the public from the County's Ke Ala Hele Makalae multi-use path.

4.6.2 Potential Impacts and Mitigation

The subdivision will include 22 house lots that will back onto a 1,400-foot stretch of Kūhiō Highway. The eastern boundary of the Petition Area is located about 70 feet from the centerline of Kūhiō Highway, which has a 140-foot right-of-way. The County Zoning Ordinance requires structures to be setback a minimum of 10 feet from this (rear) property line. The future homes will be visible when looking *mauka* from the highway. Because there are no sidewalks or pedestrian paths along this stretch of Kūhio Highway, the visual impact will be to individuals driving by. Where new homes are built along the highway frontage, the distant mountains will no longer be visible. Although the change in the *mauka* view will be noticeable, existing terrain and vegetation intermittently obscure the view. The impact to *mauka* views from Kūhiō Highway will only be experienced for a few seconds from a moving car. Posted speeds along this segment of Kūhiō



1: Petition Area, looking *mauka* (north west) from Kūhiō Highway near Kamole Street.

2: Petition Area (right) as seen heading *mauka* on Keālia Road.

3: Petition area with Kalalea Mountain Range in background.

4: Petition Area (in the background), as seen from Ka'ao Road homes. A park/green space buffer will be located between the existing homes and the new lots.

5: Hopoe Road looking west toward Keālia Road. Several lots are proposed directly across three existing homes on Hopoe Road.

Views of the Petition Area **Figure 4-3**

Highway are 50 mph in the northbound direction and 40 mph in the southbound direction. A vehicle moving at 40 mph will take about 23 seconds to drive past the entire 1,400 foot frontage of the site.

From Keālia Road, the transformation of an undeveloped grazing area into a residential subdivision will have a very noticeable impact. The future subdivision will be clearly visible to residents living on Kaʻao Road, particularly from the backyards of homes on the north side. The visual impact will be most profound for the residents of the three lots on Hopoe Road, whose front yards will directly face the subdivision. To mitigate the visual impact to residents along Kaʻao Road, the subdivision will be separated by a 4.3-acre detention basin and green space that will serve as an open space buffer. The visual buffer does not extend to the three lots on Hopoe Road.

The proposed subdivision will have no impact on *mauka* views from the Keālia Kai residences, from Keālia Beach or the Ke Ala Hele Makalae multi-use path. The Petition Area is not visible from these areas due to the existing topography, elevations and vegetation.

The visual impact of the development from Keālia Road and Kūhiō Highway can be mitigated through the use of landscaping and screening vegetation. A landscape plan should be prepared and include vegetation adjacent to the subdivision's major entry point (roundabout); along public road frontages; and on major roads within the subdivision. The landscaping should also include screening vegetation in the detention basin/park to minimize impact to Kaʻao Road residents. The landscape plan should be submitted to the County as part of the subdivision application.

4.7 AGRICULTURE

Consideration of the Petition Area as an agricultural resource is complex. Issues relating to agricultural rating systems, the State's effort to identify Important Agricultural Lands (IAL), productivity, and food security are important considerations when discussing the potential impacts of the Proposed Action.

4.7.1 Existing Conditions

4.7.1.1 Historic Agriculture Use

Little is little known about land use in the Keālia *ahupuaʻa* prior to western contact in the late eighteenth century. A twentieth century description of the *ahupuaʻa* described it as being:

> …rather dry, with small streams and gulches and only a few *loʻi* areas. Where Keālia and Kapaʻa Streams join inland there are wide flats that were terraced. Seaward there were formerly many terraced areas. There are clumps of coconut and mango trees where formerly were *kuleana* with their *loʻi*. Inland there were a number of small streams which doubtless once had small *loʻi* developments. (Handy and Handy, 1972).

The Petition Area and surrounding Keālia lands were under active sugar cultivation from the late 1800's, when the Makee Sugar Company began operations in Kapaʻa in 1877. The Makee Sugar Company was later absorbed by Līhuʻe Sugar Company, which then closed in 2000. As far back as the 1930's the project vicinity has been used for housing for sugar company employees. Since the closure of Līhuʻe Sugar Company, the Petition Area has been used for cattle grazing.

4.7.1.2 Important Agricultural Lands

Background

In the years following World War II, Hawaiʻi experienced a shift from a plantation-dominated economy to one of tourism and federal spending. In response to this economic shift, plus growing public concern about maintaining the viability of agriculture and protecting the State's agricultural lands, the 1978 State Constitutional Convention proposed the identification and designation of Important Agricultural Lands (IAL).

Article XI, Section 3 of the Constitution of the State of Hawaiʻi sets out the framework for state policies to promote agriculture and the conservation of productive agricultural lands in the State:

> *"The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands. The legislature shall provide standards and criteria to accomplish the foregoing.*
>
> *Lands identified by the State as important agricultural lands needed to fulfill the purposes above shall not be reclassified by the State or rezoned by its political subdivisions without meeting the standards and criteria established by the legislature and approved by a two-thirds vote of the body responsible for the reclassification or rezoning action."*

Nearly 30 years after Hawaiʻi's voters ratified this 1978 constitutional amendments, the State Legislature adopted legislation to fulfill its intent and purpose. With the passage of Act 183 (Session Laws of Hawaiʻi (SLH) 2005) and Act 233 (SLH 2008), Hawaiʻi Revised Statutes (HRS) Chapter 205 was amended to describe the framework for the identification and designation of IAL, and the associated landowner incentives. Pursuant to Chapter 205, each county is required to identify and map lands within its jurisdiction that have the potential for designation as IAL.

Definition of IAL

Important agricultural lands have been defined as those that:

- are capable of producing sustained high agricultural yields when treated and managed according to accepted farming methods and technology;
- contribute to the State's economic base and produce agricultural commodities for export or local consumption; or
- are needed to promote the expansion of agricultural activities and income for the future, even if currently not in production.

IAL Designation Process

The purposes of the IAL process are to identify the best agricultural land in the State; provide incentives for landowners to keep their land in agricultural use; increase the availability of locally-produced food crops; and discourage the urbanization of our best agricultural land.

There are two processes in which important agricultural lands can be designated. A landowner or farmer has the opportunity to voluntarily petition the State Land Use Commission (LUC) directly to designate agricultural lands. The counties can also recommend land for IAL designation to the LUC.

Each County is to develop maps of potential lands to be considered for IAL, to be adopted by a county council resolution and submitted to the LUC.

In 2009, the County of Kauaʻi initiated an *Important Agricultural Land Study*, which was finalized in July 2015. As a primary goal of the County's IAL initiative, the study recommended an initial designation goal of a minimum of 21,158 acres to establish self-sufficiency, based on what it estimated was needed to feed a population of approximately 70,000 people (County of Kauaʻi, 2015).Although the final study was completed in July 2015, it has yet to be transmitted to the Kauaʻi County Council.

As of February 2017, four major landowners on Kauaʻi have received approval from the LUC for IAL designation of nearly 36,000 acres of land, exceeding the minimum of 21,158 acres identified in the County's 2015 IAL study. The subject Keālia Mauka site is not currently designated IAL. There are no lands in the Keālia area that are designated IAL.

4.7.1.3 Soil Classification Systems

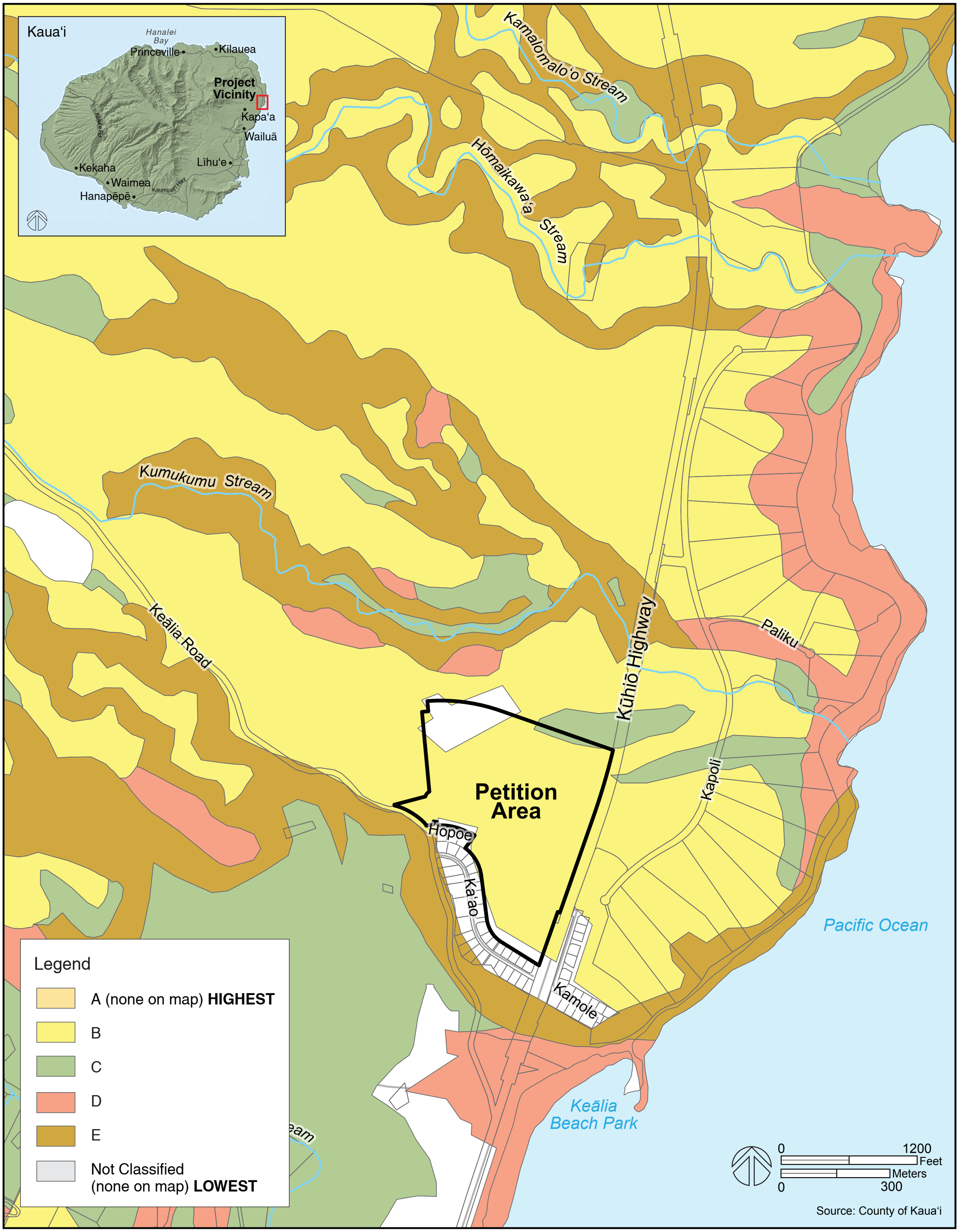
Land Study Bureau (LSB) Soil Productivity

The University of Hawaiʻi Land Study Bureau (LSB)'s 1967 *Detailed Land Classification* provided an inventory and evaluation of the State's land resources. All lands in the State were grouped into similar units of land types, except those in the State Urban District. The LSB also described their condition and environment; rated the overall quality of the land in terms of agricultural productivity; assessed its capabilities for selected alternative crops; and defined land types and groupings based on their soil properties and productive capabilities. A five-tier productivity rating system was developed with "A" representing the highest level of productivity and "E" the lowest. As shown in Figure 4-4, the lands within the Project Area have a productivity rating of B, a fairly high level of productivity.

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

The Agricultural Lands of Importance to the State of Hawaiʻi (ALISH) Classification System was developed and compiled in 1977 by the State Department of Agriculture with assistance from the Natural Resources Conservation Service, U.S. Department of Agriculture (formerly the Soil Conservation Service) and the College of Tropical Agriculture, University of Hawaiʻi. This classification system was developed to identify three classes of agriculturally important lands for Hawaiʻi as part of a national effort to inventory important farmlands. The Hawaiʻi classification system established three classes of agricultural lands that are important to the State: "Prime," "Unique," and "Other." Residual lands that are less suitable for agriculture are "Unclassified."

As shown in Figure 4-5, the ALISH system classifies the entire Project Area as Prime agricultural land, defined as "land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods" (NRCS, 2008).

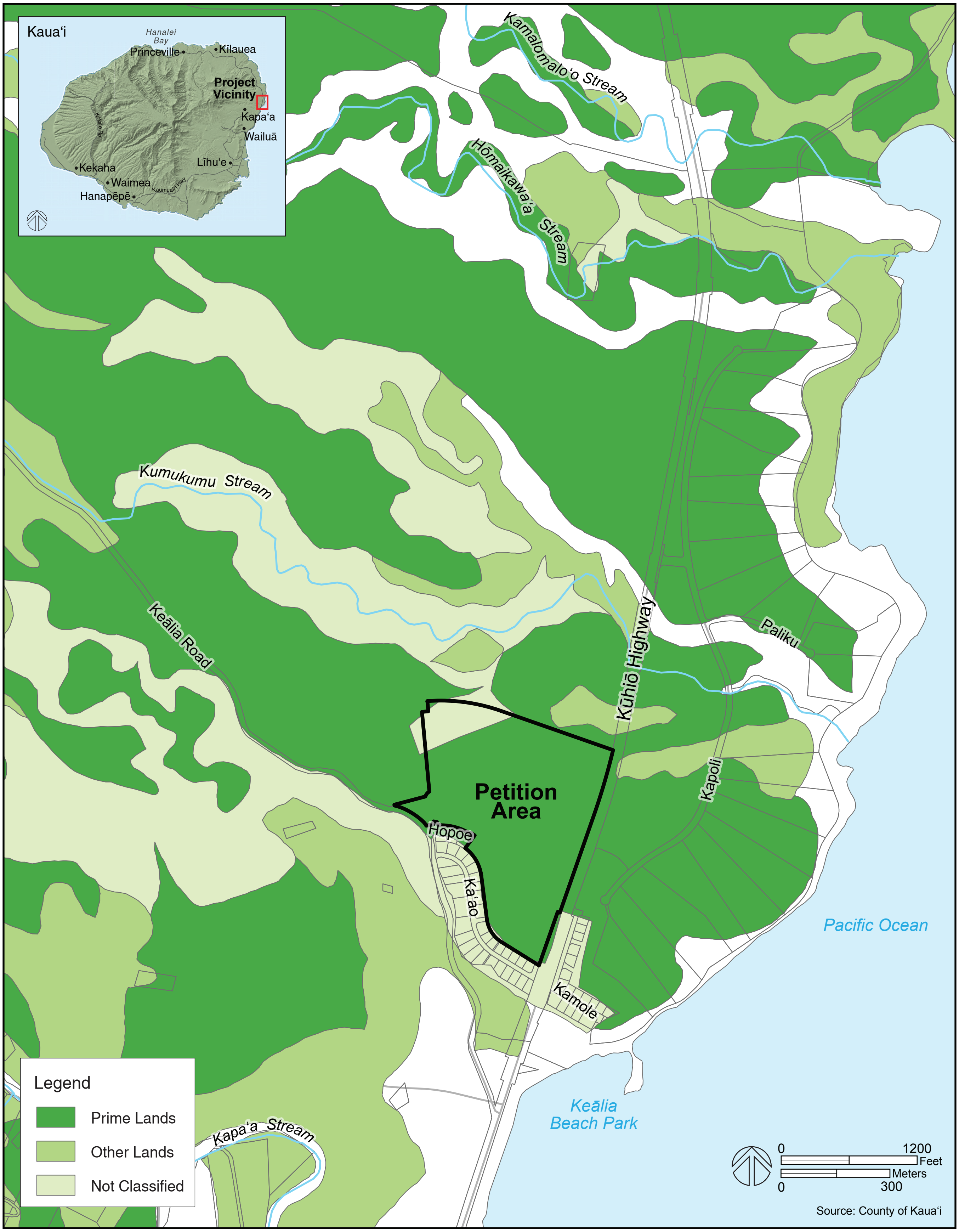


Land Study Bureau Agricultural Productivity Ratings **Figure 4-4**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC



Agricultural Lands of Importance to the State of Hawai'i **Figure 4-5**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

4.7.1.4 Food Security

The State of Hawai'i is placing an increased emphasis on the concept of food security and food self-sufficiency, with the goal of increasing the amount of locally grown food consumed by Hawai'i residents. Currently, about 85 to 90 percent of Hawai'i's food is imported, making the state particularly vulnerable to natural disasters and global events that disrupt shipping and the food supply. The State Department of Business, Economic Development and Tourism, in conjunction with the State Department of Agriculture, has prepared the *Increased Food Security and Food Self-Sufficiency Strategy* (DBEDT, 2012), a State strategic functional plan focusing on increasing food security and food self-sufficiency. The strategy emphases increasing production by strengthening agricultural infrastructure and actions to provide for food safety, pest prevention and control, workforce training, research and extension services, and policy and organizational support. Among its objectives are to increase demand for and access to locally grown foods, and increase production of locally grown foods. The strategy is intended to set an overall direction toward food self-sufficiency, but does not address the issue of how much land is necessary for self-sufficiency. The strategy identifies action and projects that will provide more land for food commodities.

4.7.2 Potential Impacts and Mitigation

The use of the Petition Area for residential use will remove 53.4 acres of agricultural land from active cattle grazing. While the Petition Area meets several of the eight criteria for Important Agricultural Lands, it represents only a small percentage of the suitable agricultural land available in the East Kaua'i region. The Petition Area is a portion of a 1,000-acre TMK parcel ((4)4-7-004:001) that is currently leased to three private entities for agricultural/grazing purposes. In order to accommodate the loss of project acreage, an additional 86 acres has been added to one of the leases.

The Petition Area is adjacent to an existing residential subdivision. Although the Petition Area is in the State Agricultural District, the County has determined that residential use is consistent with the County of Kaua'i General Plan. The County Planning Department has made a written determination (Departmental Determination DD-2016-70) that the Petition Area is located within the area earmarked on the General Plan Land Use Plan for "Residential Community." Since the closure of Līhu'e Plantation, there is more than adequate agricultural land available in the East Kaua'i region for current and foreseeable future agricultural activity. The loss of 53 acres will not have an adverse impact on the region's agricultural resources.

The conversion of the land to residential use will not negatively affect the County and State efforts toward food self-sufficiency. Private landowners on the island have already completed designation of nearly 36,000 acres for IAL, exceeding the goal set by the County's 2015 IAL study. In addition, Keālia Mauka lot purchasers will always have the option to grow backyard crops and establish family gardens. In a small way, these actions can contribute to food security.

4.8 HAZARDOUS AND REGULATED MATERIALS AND WASTE

4.8.1 Existing Conditions

A Phase I Environmental Site Assessment (ESA) was prepared for the previous landowners as part of due diligence activities prior to their purchase of some 2,000 acres of land (Belt Collins Hawai'i Ltd., 2005). The 2,000 acre study area included several TMK parcels, including TMK (4) 4-7-004, which includes the subject 53.4-acre Petition Area. The purpose of the Phase I ESA was to identify "recognized environmental conditions" (REC), meaning the presence or likely presence of hazardous substances or petroleum products on a property under conditions that indicate an existing release, past release, or material threat of a release.

The Phase I ESA included a review of historic property uses, review of regulatory data bases, site reconnaissance, and interviews with persons associated with the property. The 2,000-acre ESA study area has a history of use throughout the twentieth century for commercial agricultural activities. These activities included the use of fertilizers, herbicides and pesticides (Belt Collins Hawaiʻi Ltd., 2005). There is a possibility that waste products have been disposed or stored on site, and that the operation of machinery resulted in released fuel, oil, or solvents into the environment. The ESA revealed previous land uses within the 2,000-acre study area included a sugar mill, vehicle storage and maintenance, service station, and rodeo ring. The ESA study area included above and underground storage tanks. According to maps provided in the document, the sugar mill, vehicle maintenance activities and other activities were unlikely to have been conducted within the current Petition Area, which appears to have been limited to sugar cultivation and plantation housing.

4.8.2 Potential Impacts and Mitigation

Although the Phase I ESA was conducted for an area much larger than the current Petition Area, the general conclusions of the ESA are applicable. During construction of the subdivision improvements, there is the potential for ground disturbing activities to encounter areas with existing environmental contamination. Historic herbicide application practices also create the potential for heavy metals (specifically arsenic) in the soil. In its EISPN comment letter (see Chapter 9), the State of Hawaiʻi Department of Health (DOH), Hazard Evaluation and Emergency Response (HEER) office noted that "agricultural lands, especially those that were in production after about 1912, may include arsenic and pentachlorophenol (with dioxin contaminants) and possibly organochlorine pesticides which were used for weed or insect control." These chemicals are now generally banned due to unacceptable human or environmental health risks, but may persist in the environment for decades at levels that present unacceptable health risks, especially for children. The potential presence of these hazardous substances could pose health concerns for future residential and recreational use.

As recommended by the DOH HEER office, and in accordance with current State policies, soil testing will be conducted in the Petition Areas proposed for residential or recreational use. A soil sampling plan identifying chemicals of potential concern and the proposed testing methodology will be developed based on guidance in the DOH HEER Office's Technical Guidance Manual. The sampling plan will be submitted to the DOH HEER office for review and approval. Test results and recommendations will be submitted to the DOH HEER office for review and approval.

If identified, contaminated soils and materials will be handled, transported, stored, disposed of and/or remediated in place to levels appropriate for residential use, and a "No Further Action Letter" will be obtained from the DOH. All removal and remedial actions to clean up hazardous substance or oil releases will comply with Chapter 128D, Environmental Response Law, HRS, and Title 11, Chapter 451, HAR, State Contingency Plan. With this mitigation, there is unlikely to be an adverse effect on construction workers, project residents or other members of the public from residual soil contamination.

During construction of the subdivision improvements, there is also a potential for release of petroleum products by construction vehicles and equipment. This will be mitigated by implementing best management practices such as proper maintenance of construction vehicles, and regular inspection for leaks. During occupancy of the subdivision, there is also potential for environmental contamination caused by future residents (e.g., vehicle leaks and improper disposal of hazardous materials). These potential impacts would be reduced by following applicable county and state regulations. Development and occupancy of the proposed subdivision is not expected to have a significant impacts associated with hazardous materials and wastes.

4.9 SOCIAL AND ECONOMIC FACTORS

4.9.1 Population

4.9.1.1 Existing Conditions

According to the 2010 U.S. Census, the population of the State of Hawaiʻi was 1,360,301, with the population of the County of Kauaʻi accounting for approximately 67,091 (4.9%) of those residents. The population on Kauaʻi in 2010 was almost 15% more than that in 2000 (U.S. Census Bureau, 2016).

The Keālia area is within the Census Bureau's Wailua-Anahola Census County Division (CCD). A CCD is a census subdivision of a county used to present statistical data, and may consist of multiple census tracts. In 2010, the total population of the Wailua-Anahola CCD was 12,607 persons, with a median age of 42.5 years. Racial make-up of the CCD was 39.6% white, 38.6% Asian, 13.0% Native Hawaiian and other Pacific Islander, and 27.3% of two or more races. The average household size was 2.7 persons, and median household income (in 2009 inflation-adjusted dollars) was $70,408. Of the housing stock within the CCD, 61.4% was owner-occupied.

Market and Econometric Studies of the Proposed Action were conducted by CBRE in 2017 (Appendix F). The study area for the market study extended beyond the Wailua-Anahola CCD, and encompassed a 16-mile near-coastal and lower elevation corridor along the eastern shore of Kauaʻi, stretching from Līhuʻe to Moloaʻa. In addition to the Wailua-Anahola CCD, this larger "market study area" included the CCDs of Wailua Homesteads, Līhuʻe, Kapaʻa, and Wailua.

Within this East Kauaʻi market study area, there were 34,467 residents in 2010, representing 51.4% of the County total. By the first quarter of 2017, the estimated population of this region had grown to 38,101 persons, or 51.8% of the island. The market study notes that population growth was limited by lack of available housing supply more so than demand. The market study forecast the resident population in this Līhuʻe to Moloaʻa corridor (or greater East Kauaʻi) will increase by 2040 to between 51,650 persons (a gain of 35.6% over 2017 estimate) and 53,554 persons (up 40.6%) (CBRE, 2017).

The current average resident household size in the Līhuʻe to Moloaʻa Corridor is about 2.94 persons (among the largest for the island). Average household size is forecast to decline in coming decades as a result of evolving family/household trends and an increasingly diverse mix of unit types from new development. By 2040, the average household size in the study area is anticipated to lower to 2.85 persons (CBRE, 2017).

4.9.1.2 Potential Impacts

The Proposed Action is expected to have a negligible direct and indirect effect on the population and population growth within the County of Kauaʻi and the State. CBRE market study projections indicate that over the next 20 years, the population of the East Kauaʻi area is expected to increase between 35 and 40 percent, even without the Proposed Action.

The Keālia Mauka residential lots are targeted primarily toward Kauaʻi residents. The market study estimated that approximately 82% of the single family homes at Keālia Mauka (194) will be occupied by full-time Kauaʻi resident families with an average household size of 3.4 persons, totaling 658 full-time residents at buildout and full occupancy.

Because sale of the lots cannot be restricted to Kauaʻi residents, there will inevitably be some non-resident, second home purchasers. This group of part-time, second/vacation homeowners was estimated at 18 percent (42 lots). They are expected to occupy their residential unit 30 percent of the year, and have an average household size of 3.6 persons. This equates to an average of 42 persons daily. Together, the full time resident and non-resident groups will result in an average daily “de facto” population at build-out of 700 persons (658 full time residents and 42 vacationers).

Although it responds to the existing and future market demand for housing, the project will not generate or cause population growth in East Kauaʻi. It is expected that the house lots will respond to the demand for new housing product generated by 1) on-island population growth and 2) new household formation. The Proposed Action is not expected to have an impact on the in-migration of individuals from out of state.

4.9.2 Housing

4.9.2.1 Existing Conditions

The CBRE Market Study evaluated housing conditions within the 16-mile Līhuʻe to Moloaʻa corridor. Within this region, there are an estimated 19,428 single and multifamily housing units, of which 3,428 (or 17.6%) are registered as vacation rentals. Many of these vacation rentals are within the Coconut Plantation community, located about two miles south of Kapaʻa Town. The remaining 16,000 housing units in the study area are considered to be standard residential (non-resort) use. Of these units, 13,120 (82%) house full-time Kauaʻi resident households, with the remaining 2,880 units (18%) used by non-resident second/vacation home owners.

In the first quarter of 2017, the median sales price for a single family residential unit in the East Kauaʻi area was $574,000, a 5.6% increase from the previous year. This compares to a median sales price of $500,000 in Līhuʻe. The CBRE market study indicates that median sale prices are expected to continue to increase into the long-term.

4.9.2.2 Potential Impacts and Mitigation

The Proposed Action will create 235 improved residential lots which will be available for sale to Kauaʻi residents. The Petition Area is appropriate for this use based on its physical conditions, location adjacent to an existing subdivision, proximity to supporting services, and its designation for residential use in the County General Plan.

4.9.3 Economy and Employment

The CBRE Market and Econometric Studies in Appendix F includes three elements: 1) market study; 2) economic impact analysis; and 3) public cost/benefit assessment. The following sections are based on the economic impact analysis and public cost/benefit assessment.

4.9.3.1 Existing Conditions

The Līhuʻe/East Kauaʻi area is one of the three centers of the island's tourism industry, called "the Coconut Coast." Along with Poipu/South Kauaʻi and the North Shore (Princeville/Hanalei), East Kauaʻi has evolved into a primary region for economic activity and employment; attracting significant development and capital investment over the past four-plus decades. This trend is anticipated to continue over the long-term, increasing in cumulative attraction as the economy strengthens further. East Kauaʻi is also the region with most of the commercial and industrial space on the island, the most businesses, and most employment opportunities. It is currently Kauaʻi's focus of economic activity and will continue to be an expanding, increasingly diversified market.

The unemployment rate on Kauaʻi is about 2.4% (approaching effective full employment), down from a high of some nine percent during the depths of the 2008-2009 recession. Median household income has grown at a rate approaching 4.0% compounded annually since 2014; there has been major positive absorption of retail and industrial space since the beginning of 2016 (with some 200,000 square feet absorbed in the first half of 2017), increasing velocity of commercial space development; and, record growth in tourism. Total visitor days and visitor spending have grown at compounded annual rates above five percent and eight percent respectively since 2009.

Though not issued on a County-basis, the most recent State of Hawaiʻi Department of Business, Economic Development & Tourism (DBEDT) *Quarterly Outlook for the Economy* (2nd Quarter 2017) statewide forecasts show continuing gains in 12 economic indicators[1] through 2020. The projections are more optimistic than their prior forecasts, and have been gaining upward momentum for the past several years (CBRE, 2017).

The Petition Area is a former agricultural parcel that is currently leased out for grazing. There is no other revenue generated by the property.

4.9.3.2 Potential Impacts and Mitigation

CBRE developed a computer model to estimate the economic impact of the Keālia Mauka project on the Kauaʻi and Statewide community during its "lifespan," from commencement of site work and infrastructure emplacement through absorption/sell out of the finished lots. The findings are briefly summarized here, with further details and tables provided in the study. No mitigation is required for impacts on employment or the economy.

Economic Impacts

Direct and Indirect Expenditures. The development of the proposed subdivision will generate significant expenditures that will have a positive direct and indirect impact on the Kauaʻi economy.

[1] DBEDT economic indicators include 1) total population; 2) visitor arrivals; 3) visitor days; 4) visitor expenditure; 5) Honolulu Consumer Price Index; 6) personal income; 7) real personal income; 8) non-agricultural wage and salary jobs; 9) civilian unemployment rate; 10) gross domestic product; 11) real gross domestic product, and 12) gross domestic product deflator.

These expenditures will increase the level of capital investment and capital flow in the region, which will in turn create employment and widen the tax base.

Direct expenditures will be associated with the creation of the 235 house lots as well as the eventual construction of homes on the lots. These expenditures include building materials and supplies and construction services. CBRE has estimated that over the project build-out period (estimated to extend to year 2030), the Proposed Action will bring approximately $121 million in new, direct development capital into the Kauaʻi economy, along with significant unquantified indirect expenditures. The Proposed Action will generate an estimated $226 million in total new economic activity islandwide during its build out. Following build out, Keālia Mauka will contribute some $13.7 million in annual economic activity on a stabilized basis, due largely to the discretionary spending by full and part-time residents.

Employment. The project's economic impact includes the creation of employment opportunities by the installation of project infrastructure, the construction of the homes, and in the long term, the provision of continuing services to the community and occupied residences. These jobs will include construction, equipment operators, and specialty trade jobs on- and off-site, directly and indirectly.

CBRE estimated that the construction of project infrastructure and finished single family homes will directly create an estimated 1,048 "worker-years" of employment (the equivalent of 52 work weeks at 40 hours per week) in the trades and supply businesses during build-out, averaging about 81 worker-years annually, with an estimated $55 million in wages (averaging about $4.2 million per year).

Once infrastructure is installed and the individual house lots are developed, there will be some limited permanent jobs associated with the operation of the homeowners association, and related to the upkeep, maintenance, and renovations of the homes. CBRE has estimated that the community homeowners association and the upkeep, maintenance, and renovations of the 235 homes will create 59 worker-years of employment from 2021 through 2030 and associated wages of $3 million. Once stabilized, the project will support 15 full time equivalent (FTE) positions (most made up of many short-term workers) and annual wages of $492,000 (CBRE, 2017).

Associated secondary/off-site employment during the overall development and absorption time frame (estimated through year 2030) will total 262 worker-years with wages of $14.2 million and a stabilized FTE job-count of 5, with total wages of $267,000 per year.

Islandwide Economic Impact. The general island economy also will benefit from the Proposed Action, as Keālia Mauka's full and part-time residents will spend discretionary income on goods and services and in shops, restaurants, and service establishments. It should be noted that because most future subdivision residents are expected to be current Kauaʻi residents, much of this discretionary spending is not "new," but rather continued spending from existing households. The only "new" spending will come from non-resident second-home owners. The market study estimated that about 42 of the expected population of 700 will be new non-resident second-home owners and their guests.

Islandwide economic impacts will result as wages, profits and expenditures associated with the project move through the regional economy, having a ripple or multiplier effect which increases the amount of capital flowing to the entire community.

Secondary Impacts. The Proposed Action will have nominal to minor impacts on the real estate market and on home prices in the region. The subdivision lots are sized to appeal primarily to local buyers, and the project is located adjacent to an existing subdivision of comparable density and moderate price. The new subdivision is not expected to contribute to upward pricing pressures in the region. The Keālia Mauka Homesites will not itself drive regional market values or real property assessments of nearby real estate. The Proposed Action is not expected to cause in-migration to Kaua'i, as it is intended to provide housing for existing island residents.

Public Fiscal Impacts

Public fiscal impacts looks at the public costs and benefits of the proposed development. Many of the government costs associated with the projected 658 current Kaua'i residents will not be "new," but are already factored into existing County and State budgets. The only new fiscal contributions from the full-time resident households will be:

- Additional assessments to the County real property tax rolls; and,
- Maintenance/renovations associated with the houses, which will expand general economic activity.

The fiscal impacts associated with the estimated 42 non-resident, second home owners and their guests do represent "new" costs and benefits for the State and County. CBRE applied the Hawai'i State Input-Output model which estimates primary tax receipts generated during the project life. The model used a conservative assumption that each new person added to the Kauai community is "responsible for" a similar tax cost/obligation as every other person on the island. CBRE noted the actual additional costs and impact on services from the estimated 42 part-time residents will be minimal. Typically, part-time residents place limited demands on schools, administrative infrastructure, most governmental services and facilities, and are unlikely to push emergency services beyond an expansion-requiring threshold. The conclusions of the analysis are:

- The County of Kaua'i will realize "new" real property taxes ($5.4 million), and other secondary receipts and development fee totaling $9 million during the build-out projection period (estimated at 2018-2030), and $1.3 million annually on a stabilized basis thereafter. These figures incorporate exemptions for real property tax resident owner-occupants.

- The State of Hawai'i will receive "new" gross excise and income taxes and secondary revenues, of $12.7 million during the 2018-2030 modeling period, and $276,000 per year thereafter.

4.9.4 Market Assessment

The purpose of the market assessment was to determine whether there will be sufficient demand in the (Līhu'e to Moloa'a) study corridor single family residential real estate market sector to absorb the finished vacant house lots in a timely manner. The time frame for the market study was to 2040, although it is anticipated that the 235 subject lots will be absorbed by the market in a much shorter period.

4.9.4.1 Existing Conditions

Housing Market

The State of Hawaiʻi has steadily rebounded from the 2008-09 recession and associated down-cycle in the real estate market. On Kauaʻi, favorable economic indicators and trends include a decrease in the unemployment rate, the growth in median household income, and positive absorption of retail and industrial space since the beginning of 2016. Tourism continues to reach all-time records with increases in total visitor days and visitor spending.

Although experiencing some instability in the first quarter of 2017, the Kauaʻi residential real estate market has also shown post-recession recovery and growth. Island-wide, the single family residential, condominium and vacant lot sectors are experiencing the highest level of sales activity since 2004-07. In the Līhuʻe/East Kauaʻi area, median single-family home prices in Kapaʻa were up by nearly six percent in 2016 (over 2015) and are continuing to rise. General indicators point to continued increase in demand, sales velocity, and prices, particularly given the limited supply of new residential inventory.

Residential Demand

The market study estimated that the demand for new residential (non-vacation rental) units in the Lihue/East Kauaʻi region through 2040 will be between 6,654 and 8,240 units (mid-point of 7,447 units). The demand projection was based on the County's regional population projections to 2040. It also considered recent trends, including a declining average household size, and an increasing share of units being used by non-residents and visitors.

The CBRE study estimated that about 66% of the total future demand will be for single family homes and lots, with about 34% for condominium units. CBRE estimated that approximately 72% of the demand for finished single family homes in the primary study area over the next 24 years will be for houses with a current price of $539,000 or less. This price is approximately the upper-price threshold that will meet County affordability standards (i.e., affordable to those earning 140% of median household income). For multifamily units, CBRE estimated that 76% will need to be priced at $480,000 or less (consistent with household incomes at 140% or below of median).

Existing and Projected Inventory

As discussed in Section 4.9.2 (Housing) above, of the 19,428 housing units in the study area, 17.6% (3,428 units) are registered as transient vacation rentals (TVR) and unavailable for meeting standard residential housing needs. Of the remaining 16,000 non-resort units, 18 percent (2,880 units) are used by non-resident second/vacation home owners.

According to the County Planning Department, there are there are up to 5,197 single and multi-family residential units proposed for the Lihue/East Kauai study region, not including the Keālia Mauka lots. Approximately 30% of these proposed units are resort residential and oriented toward visitors and vacation/second home buyers.

Even if all 5,197 proposed residential units were offered as non-resort product and constructed in a timely manner, the supply would still be insufficient to meet anticipated demand, with a shortfall of approximately 2,250 units (5,197 unit proposed vs. 7,447 unit demand). In reality, many proposed units will not be completed within the projection period, and others will be priced at levels that are unaffordable to virtually all Kauaʻi resident households. The market study forecast a shortfall of more than 3,500 single and multi-family residential units in the study corridor through 2040. The shortfall in the single-family sector will be more than 2,000 home/lots.

4.9.4.2 Potential Impacts and Mitigation

The Proposed Action will create 235 finished house lots. Although this offering will not come close to meeting the anticipated shortfall of single family homes/lots, it will have a beneficial impact on the supply of residential housing in the Līhuʻe/East Kauaʻi region.

Residential development in the East Kauaʻi region is appropriate due to the area's desirable climate, expanding population, and a favorable economic outlook. Residential development on the Petition Area is compatible with adjacent residential use, and consistent with County of Kauaʻi General Plan land use guidance. The Petition Area provides convenient access to Kūhiō Highway, Kapaʻa Town, schools and other supporting services. The subdivision will provide homeownership opportunity for large numbers of Kauaʻi residents and households. The market study indicates that the subdivision will have the attributes necessary to be competitive in the workforce and market single family housing product sectors, and will capture a reasonable market share during its offering period. Although the home sites will be somewhat desirable for non-resident second-home purchasers, it will be less so than other projects with large lots, ocean views or in resort communities (CBRE, 2017). No mitigation is required.

4.10 INFRASTRUCTURE AND UTILITIES

The information in this Infrastructure and Utilities section is from a Preliminary Engineering Report (PER) for the Proposed Action prepared by Kodani & Associates (2017). The PER is included as Appendix G.

4.10.1 Electrical and Communications

4.10.1.1 Existing Conditions

Kauaʻi Island Utility Cooperative (KIUC) is Hawaiʻi's only member-owned electric utility. The utility currently has a generating capacity of 125 megawatts (MW). More than 40% of the electricity generated by KIUC comes from renewable energy resources.

The Keālia Mauka Homesites project is part of the KIUC's Kawaihau region. According to the Kaua'i General Plan, this region is served via a tap off of the *mauka* transmission line that connects the Wainiha Hydroelectric Plant with Port Allen. This tap provides power via the Kapaʻa Switchyard to Kapaʻa Town and other developed coastal areas, as well as to residential communities in Kapaʻa and Wailua homestead areas. Kapa'a Switchyard is also linked to the Lydgate Substation and the Līhuʻe switchyard. Power is also supplied through the Anahola Substation, which was recently completed.

KIUC transmission lines are located along Kūhiō Highway in the vicinity of the Petition Area. Within the last five years, KIUC completed a project relocating overhead lines along Kūhiō Highway to underground. This project was part of an effort to reduce harm to endangered seabirds such as the Newell's shearwater, which often collide with overhead power lines. There are still overhead electrical distribution lines serving residences along Keālia Road, Kaʻao Road, and Hopoe Roads.

4.10.1.2 Potential Impacts and Mitigation

KIUC representatives have indicated that there is sufficient generating capacity to serve the proposed residential development. Standard electrical power transmission improvements would be required to serve the proposed project. However the improvement would likely be limited to the distance from Kūhiō Highway to the Petition Area (Kodani & Associates, 2017).

For planning purposes, KIUC utilizes a unit demand of 3 kilovolt amps (KVA) of power per lot. KIUC typically provides 100 amp services for lots of the size proposed for this development. For 235 lots, electrical demand is estimated at 705 KVA. The utilities for the subdivision will mainly be placed underground. KIUC may utilize the remnant lot near the proposed roundabout that intersects with Keālia Road for switchgear equipment.

Currently, there are overhead utility lines in place that serve the existing lots along Keālia Road and the existing dwellings on Ka'ao and Hopoe Roads. With the proposed subdivision, these overhead lines will need to be upgraded to accommodate the new development. With these upgrades to the utilities, Keālia Road will also need to be improved to further accommodate the new development. The cost of these improvements will be paid for by the developer. The development will tie into KIUC's existing main line that runs along Kūhiō Highway (Kodani & Associates, 2017).

4.10.2 Potable Water

4.10.2.1 Existing Conditions

Existing residential uses in the vicinity, including lots along Ka'ao and Hopoe Road, are serviced through a private domestic water system called the Keālia Water System (KWS). The KWS is owned by the entity, Keālia Water Company Holdings, LLC (Water Company). It is identified by the State of Hawai'i Department of Health as Public Water System #423.

Source water is provided by two wells located on the western side of Keālia Road on TMK (4) 4-7-003:002. Keālia Wells 1A and 2A (State Well No. 3-0618-009 and 010, respectively) currently report average use between 30,000 to 40,000 gallons per day (gpd) since 2008. (Kodani & Associates, 2017). According to the State of Hawai'i Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM), certificates of well construction and pump installation for these two wells were issued on 9/19/2008. The approval pump capacity is 650 gpm for well 3-0618-009 (936,000 gpd) and 540 gpm for well 3-0618-010 (777,600 gpd) (personal communication with Queenie Komori, 3/12/2018).

A 12-inch waterline runs north along Keālia Road and connects the wells to two 67,000 gallon water tanks. This water system services lots along Ka'ao and Hopoe Road with an 8-inch waterline branching off from Keālia Road. There is also a 12-inch waterline that branches off of Keālia Road to serve the Keālia Kai Subdivision on the *makai* side of Kūhiō Highway. This waterline intersects the proposed Petition Area.

Community water systems that serve the same people year-round are required to provide an annual Consumer Confidence Report (CCR) or annual drinking water quality report to their customers. According to the Keālia Water System 2017 Consumer Confidence Report, water for the System is obtained via a groundwater source. The Water System provides water to approximately 60 homes in the former Keālia Plantation Camp and has 35 service connections at the Keālia Makai Subdivision. Water from the Keālia Water System met all U.S. Environmental Protection Agency and state drinking water health standards. Data was collected from testing done from January 1, 2016 through December 31, 2016 (Kodani & Associates, 2017).

According to the DLNR CWRM, there are two other wells, Keālia 6 and 7 (Well No. 3-0618-006 and 005, respectively) that are reporting no use and are not part of the Keālia Public Water System. There are also five abandoned wells in the vicinity of the water system wells. Two have been properly sealed and three which cannot be found are considered lost. If any of these three wells are discovered they should be properly sealed in accordance with the Hawai'i Well construction and Pump Installation Standards, 2004, with work permitted through the DLNR Commission on Water Resource Management.

4.10.2.2 Potential Impacts and Mitigation

The Applicant has a water service agreement with Keālia Water Company which allows a daily aggregate of 300,000 gallons per day (gpd) of potable water to be reserved for the use of the future owners in the Petition Area.

Proposed Water System

Figure 4-6 shows the existing and proposed water system. The State of Hawai'i, Water System Standards is the guiding standard for potable water systems. The standards require that the planning and design of a water system allocate each single family unit an average of 500 gallons of water per day. Furthermore, the maximum daily demand calculations require that the average daily demand allocation be multiplied by a factor of 1.5. Based on the Water System Standards, domestic water demand was estimated at 118,000 gallons/day (average daily demand) with a maximum daily demand of 177,250 gpd (*note: PER calculated water demand for 236 housing units*).

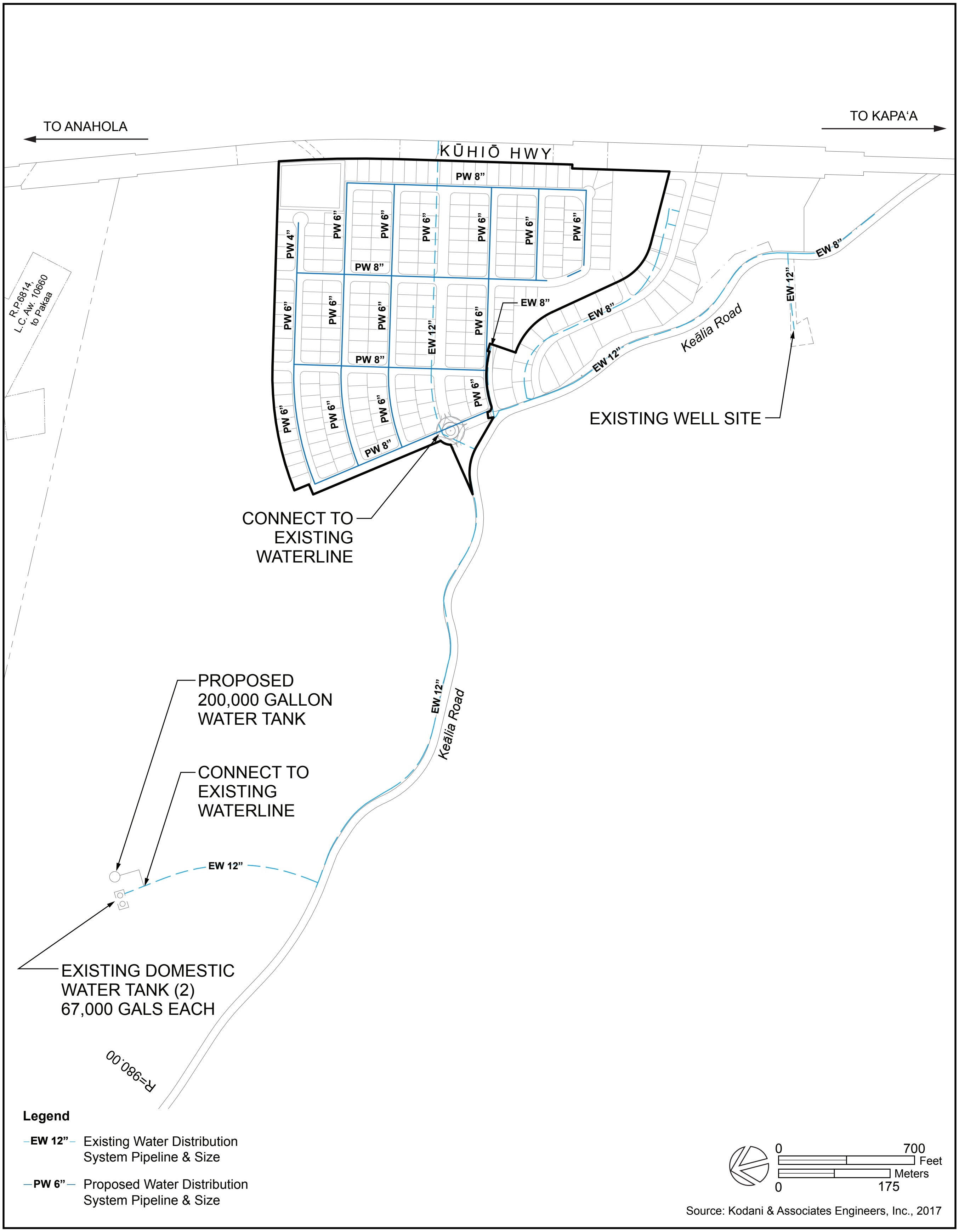
The existing water wells within the KWS will provide the required source capacity of 177,250 gallons per day. Upgrading of the existing well pump assembly may be necessary to achieve the required demand. As noted previously, the existing water service agreement allows for drawing up to 300,000 gallons per day, which will meet project demand.

Groundwater Capacity

The existing and proposed pumpage quantities from the two Keālia wells 1A and 2A will be well within the CWRM's approved pump capacity of 936,000 gpd for Well 1A (3-0618-009) and 777,600 gpd for Well 2A (3-0618-010). The Proposed Action is not expected to have an adverse impact on the groundwater aquifer.

Storage Requirements

The State's Water System Standards also have standards for the sizing of water storage reservoirs. The standards require that the water reservoir for the development have enough capacity to meet fire flow requirements in addition to the maximum daily demand. Fire flow requirements are based on land use and zoning. The proposed subdivision will have density that is roughly equivalent to R-6 zoning. Accordingly, the fire flow requirements include being able to produce a flow of 1,000 gallons per minute, for a duration of 2 hours.



Existing and Proposed Water System

Figure 4-6

Keālia Mauka Homesites

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The Water System Standards require that the reservoir capacity will be sized as follows:

1. Meet maximum daily consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.

2. Meet maximum day rate plus fire flow for duration of fire. Reservoir ¾ full at start of fire, with credit for incoming flow from pumps, one (1) maximum size pump out of service.

3. Minimum size reservoir shall be 0.1 MG. Reservoir size shall be as specified in Section 105.10 – RESERVOIR. Subsection A – Size.

The proposed Keālia Mauka subdivision will have a maximum daily demand of 177,250 gallons per day. Therefore, in accordance with the Water System Standards sizing method, 177,250 gallons water storage capacity is needed. It is proposed that a 200,000 gallon tank be installed adjacent to the two (2) existing 67,500 gallon tanks to satisfy the storage requirements. The proposed water tank will also connect to the existing water system.

The existing potable water transmission and distributions system will be upgraded to service the proposed development. All expansions and improvements of the Keālia Water System shall be in accordance with the Water Service Agreement and the Water System Standards (Kodani & Associates, 2017).

4.10.3 Wastewater

4.10.3.1 Existing Conditions

The County of Kauaʻi operates four wastewater systems serving: 1) Waimea; 2) Hanapepe-ʻEleʻele; 3) Līhuʻe-Hanamaʻulu; and the 4) Kūhiō Highway corridor between Wailua and Kapaʻa. All but the Waimea plant have substantial amounts of available treatment capacity, but this capacity is already committed to existing and planned developments (Kodani & Associates, 2017).

In the Wailua-Kapaʻa area, where the Petition Area is located, wastewater treatment is accomplished with either Individual Wastewater Systems (IWS), such as cesspools or septic tanks, or at the County-owned and operated Wailua Wastewater Treatment Plant (WWTP). IWSs generally used in the parcels that have water service but no sewer service.

The County completed a study of the Wailua-Kapaʻa wastewater system, entitled *Final Wailua Facility Plan2*. According to the *Wailua Facility Plan*, the Wailua Wastewater Treatment Plant was originally constructed in 1964, and is located on approximately 2.1 acres of County owned land next to Lydgate Beach Park. It receives wastewater from Kapaʻa, Papaloa, Waipouli, and Wailua areas. It was originally designed to treat an average flow of 0.5 mgd, but the plant has gone through four (4) phases of construction to expand. The treatment plant's current average daily flow capacity is 1.5 mgd, with a peak flow capacity of 5.03 mgd. The wastewater treatment plant currently receives about 0.7 million gallons per day (mgd) of flow. However, it is considered to have a capacity of about 1.0 mgd due to the estimated treatment capacity of the aeration basins and the chlorine contact tank.

Because the discharge of raw waste into the ground is not beneficial to the environment, the State of Hawaiʻi Department of Health prohibits the construction of any new cesspools. According to the Wailua Facility Plan, approximately 12% of the cesspools in the Wailua-Kapaʻa area have reported cesspool failures. A cesspool failure occurs when a cesspool overflows and is reported to the Department of Health.

4.10.3.2 Potential Impacts and Mitigation

Based on preliminary discussions with representatives from the County of Kaua'i, Department of Public Works, Wastewater Management Division, the County will provide service to the proposed subdivision. The County indicated that a "will serve" letter will be issued after the project has received zoning approval (Kodani & Associates, 2017).

Wastewater generation by the project was estimated using the County of Kaua'i, Department of Public Works, Sewer Design Standards. According to the standards, it is assumed each household has four (4) occupants, with an average daily per capita flow of 100 gallons per day, or an average of 400 gallons of wastewater per household per day. At total build out, the Keālia Mauka subdivision will produce an average daily flow of approximately 94,400 gallons of wastewater per day. The maximum flow of sewage from the development is approximately 472,000 gallons per day (0.472 mgd), calculated by multiplying the average daily flow by a flow factor of 5 (from Sewer Design Standards). The peak flow of sewage is the sum of the maximum flow of sewage and the rate of groundwater infiltration. (*Note: PER calculated wastewater demand for 236 housing units*).

The Preliminary Engineering Report (PER) by Kodani & Associates, Engineers (Appendix G) includes illustrations of the proposed sewer collection layout on site and the location of off-site improvements. The project proposes construction of a new 8-inch diameter gravity main on Keālia Road. The proposed Keālia Mauka Homesites will connect to the County's Wailua-Kapaʻa system. It is anticipated that construction of a wastewater lift station and transmission pipeline on Kūhiō Highway will be necessary for connection to the County system.

4.10.4 Drainage

The PER includes a preliminary drainage study which estimates existing flow patterns and runoff quantities, as well as post-development flow patterns and runoff quantities. The drainage study looked at the entire 1,000-acre "Kumukumu parcel" [(4) 4-7-004:001], which contains the 53.4 acre Petition Area. The U.S. Department of Agriculture, Soil Conservation Service, Technical Report #5510 (TR-55), a hydrologic modeling program, was used to study drainage patterns for the existing and proposed conditions of the Petition Area. A detailed Drainage and Erosion Mitigation Plan will be prepared and submitted to the County Engineer for approval during the design and development stages (Kodani & Associates, 2017).

4.10.4.1 Existing Conditions

The larger "Kumukumu parcel," which includes the 53.4-acre Petition Area, is mostly pasture land that is utilized for cattle ranching. The entire parcel is undeveloped and the few existing drainage structures are remnants of an old irrigation system from the plantation era.

Figure 4-7 illustrates existing drainage conditions on the Keālia Mauka Petition Area. The site generally drains from the *mauka* side towards Kūhiō Highway. A relatively mild ridgeline aligned in the east-west direction causes water north of the ridgeline to run off to a northern exit, and water south of the ridgeline to run off to a southern exit. For analysis purposes, the engineers split the Petition Area into two (2) subareas, Subarea 1 and Subarea 2, with the high ground as the dividing point as shown in Figure 4-7. Stormwater runoff was estimated using the TR-55 model.

Subarea 1 had a land area of 25.44 acres. Two-year storm runoff was calculated at 14.32 cubic feet per second (cfs). Subarea 2 had a land area of 28.10 acres, and two-year storm runoff was calculated at 13.69 CFS. The figure shows three (3) existing drainage outlet points from the Petition Area:

- Subarea 1 outlets to a two (2) foot diameter concrete pipe culvert on the north-east end of the proposed development area that runs under Kūhiō Highway and outlets on the *makai* side of the highway,

- Subarea 2 partially outlets with overland flow via a natural drainage way that spills into an existing concrete swale on the *mauka* side of Kūhiō Highway, and

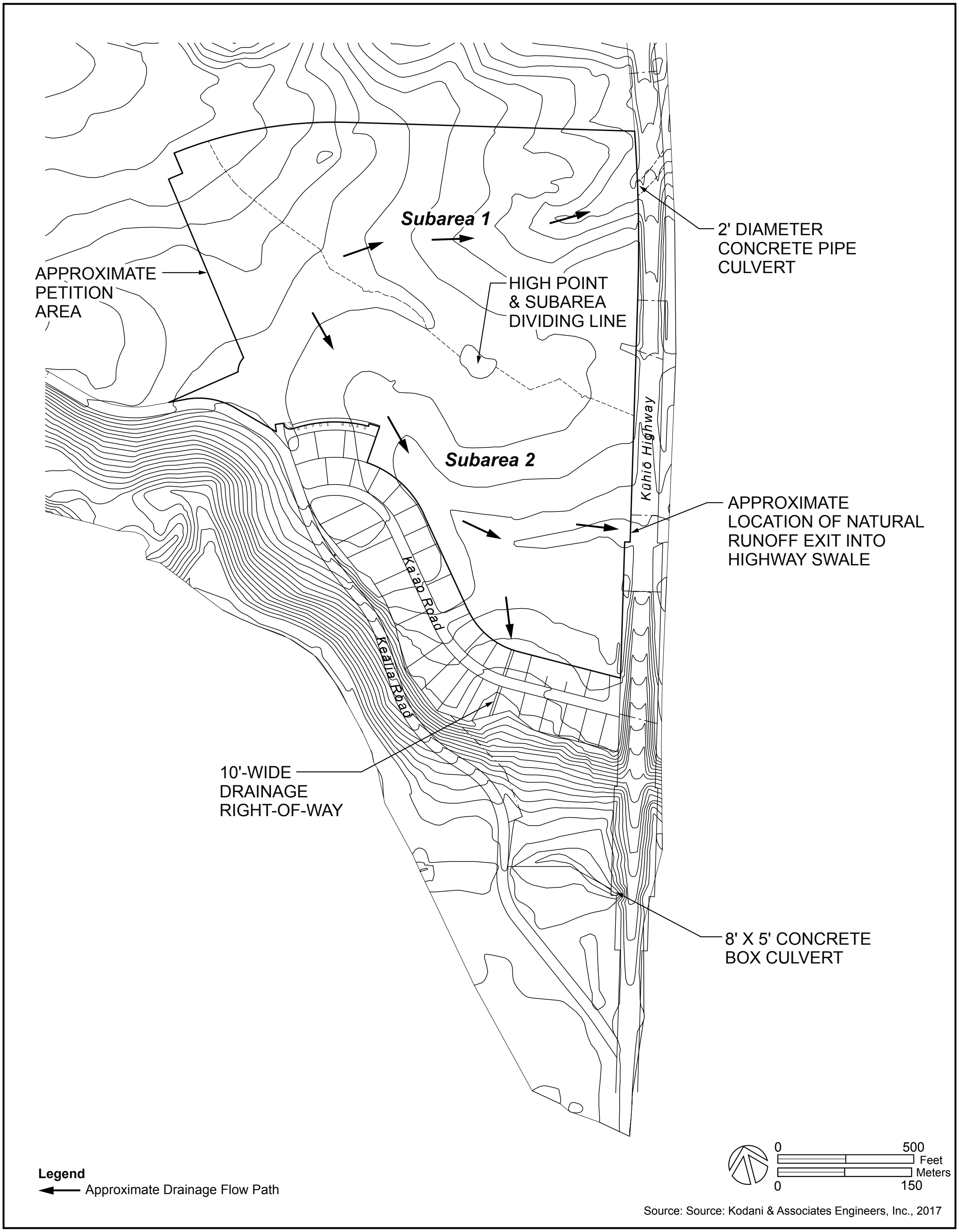
- Subarea 2 remainder outlets to a 10 foot wide Drainage Right-of-Way that connects with the Petition Area, crosses Ka‘ao Road via a 2 foot diameter concrete pipe culvert and outlets on a hillside within the large lot.

Runoff that is transmitted by Subarea 2 combines with other drainage areas and is conveyed by an existing 8 foot by 5 foot rectangular concrete drainage box culvert beyond the south end of the proposed Petition Area and within the large lot that runs under Kūhiō Highway and outlets on the Keālia Beach side of the highway. The location of the box culvert is shown in Figure 4-7.

4.10.4.2 Potential Impacts and Mitigation

Figure 4-8 shows proposed drainage patterns within the developed Petition Area. Storm water generated from each individual lot within the Petition Area will be directed to the nearest downstream street or natural drainage way that will collect the storm water and convey it to the most appropriate of two proposed detention basins on site. The detention basins are intended to moderate the storm flows and allow infiltration back into the soil. They are sized in accordance with the existing peak flows for both the 2-year and 100-year storm events. Detention Basin 2 on the southern end of the Petition Area, will also provide a multiple purpose of green space/park, and provide a buffer between the new subdivision and the existing residential area on Ka‘ao Road.

Kodani & Associates utilized the TR-55 model to estimate post-development storm water runoff from the Petition Area. According to the County’s Storm Water Runoff System Manual, storm water runoff cannot exceed the predevelopment conditions. The analysis of post-development conditions estimated a runoff flow of 13.52 CFS and 12.99 cfs for the first and second sub areas, respectively. This post-development flow for both subareas is less than that of current undeveloped conditions. Therefore, the proposed Keālia Mauka subdivision is not expected to have a negative drainage impact on the surrounding and downstream lands.



Existing Site Drainage Pattern **Figure 4-7**

Keālia Mauka Homesites

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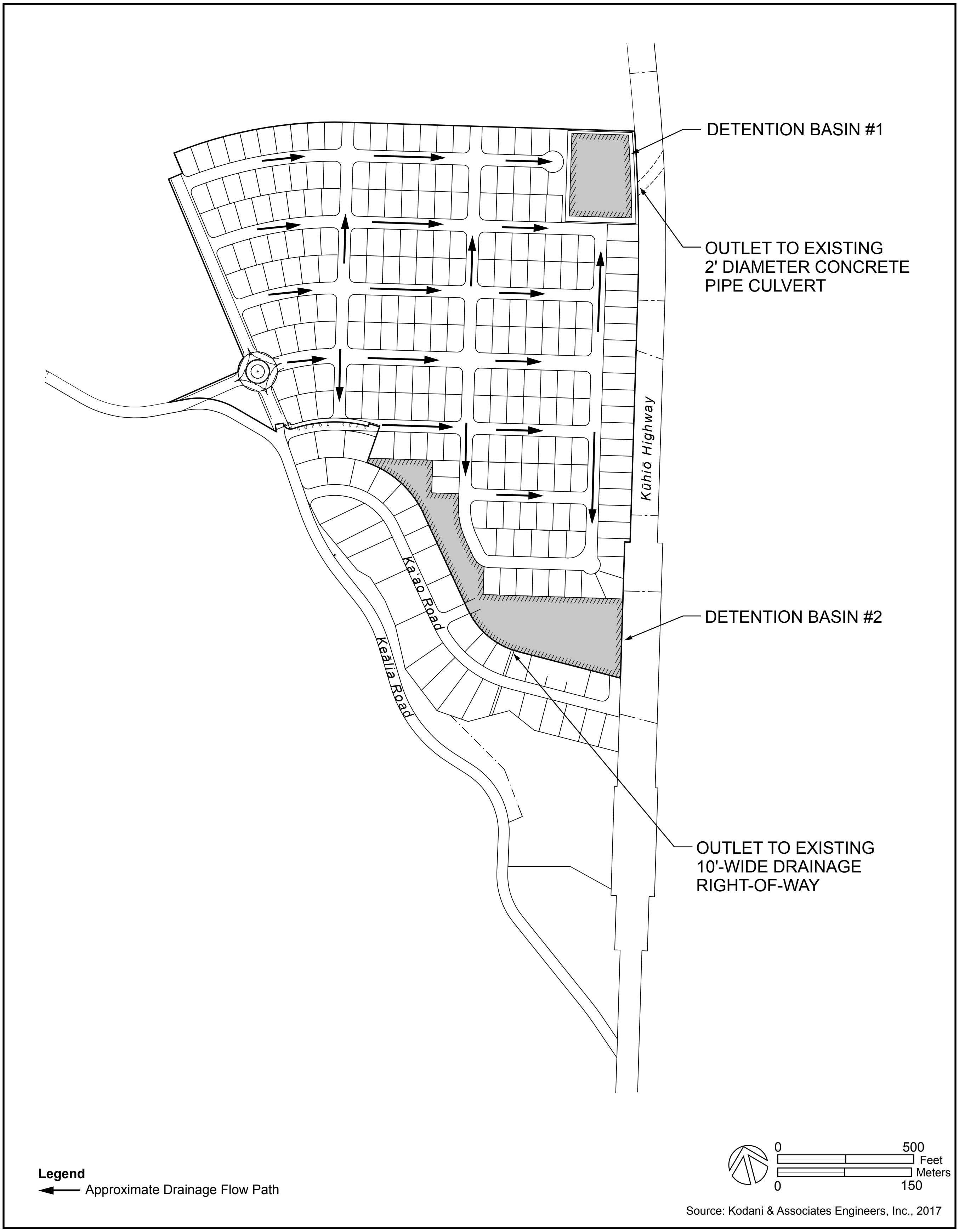


Proposed Drainage **Figure 4-8**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

4.10.5 Solid Waste

4.10.5.1 Existing Conditions

The County Department of Public Works (DPW) refuse collection crews operate out of three baseyards on Kauaʻi. The Kapaʻa Baseyard collects trash from Puhi to Anahola, and includes the Keālia Project Area. There is currently one sanitary landfill and four refuse transfer stations on the island. The transfer stations are at Hanapepe, Līhuʻe, Hanalei, and Kapaʻa, with the latter the closest to the Project Area. The County's single landfill, the Central Kaua'i Landfill, is located in Kekaha and services the entire island. According to the County's Integrated Solid Waste Management Plan, the landfill will need to be expanded to increase capacity. The County Department of Public Works, Solid Waste Division has indicated there are plans to expand the landfill to provide capacity until 2027 (Kodani & Associates, 2017).

Residential waste is collected via the County of Kaua'i's Residential Refuse Collection program. Adjacent residential areas along Kaʻao and Hopoe Roads are served by the County. Currently, there is no solid waste generation from the Petition Area.

The Kauaʻi County Recycling Office is a division of the DPW Solid Waste Division and oversees County recycling programs. Paper, aluminum, other metals, glass, plastic, motor oil, household hazardous waste and green waste are recycled. There are also greenwaste diversion sites located in Hanapepe, Līhuʻe and Kapaʻa.

4.10.5.2 Potential Impacts and Mitigation

The Petition Area is undeveloped and as such, there are few fixed structures that would need to be disposed as construction waste. There are remnants of current and past irrigation systems onsite, such as pipes and small concrete headwalls. Waste generated during subdivision construction will consist primarily of vegetation and debris. Soil and debris displaced from grading and clearing will be utilized as fill throughout the site as required, minimizing disposal and transit/relocation of the materials. Construction materials that are rendered un-recyclable will be disposed of in the Central Kaua'i Landfill.

The County of Kauaʻi provides Residential Refuse Collection via a Pay as You Throw (PAYT) program. Curbside refuse collection is offered on a once-per-week basis, and customers are able to choose a refuse cart size. A representative of the County of Kaua'i's Solid Waste Management Division has indicated that the County would service the proposed subdivision (Kodani & Associates, 2017).

The quantity of solid waste generated from the Proposed Action was estimated by assuming that each household will fill the 64 gallon cart each week. The project is estimated to generate approximately 8.02 tons of waste per year. This compares to the estimated islandwide generation quantity of 157,130 tons per year for the year 2013 (County of Kauaʻi, 2009) and represents an increase of 0.005% in solid waste generation on Kauaʻi. Residents will be required to comply with existing regulations and requirements. The project will not have a significant impact on solid waste management.

4.11 ROADWAYS AND TRANSPORTATION

A Traffic Impact Analysis Report (TIAR) was prepared for the proposed Keālia Mauka Homesites project by Austin, Tsutsumi & Associates, Inc. (ATA). The report is included as Appendix H. The TIAR described existing roadways and traffic conditions, anticipated future traffic conditions, and the potential traffic impacts resulting from the project. The findings are summarized below.

4.11.1 Existing Conditions

4.11.1.1 Roadway System

The following are brief descriptions of the existing roadways in the project vicinity. The locations of these roads and the TIAR study intersections are shown in Figure 4-9.

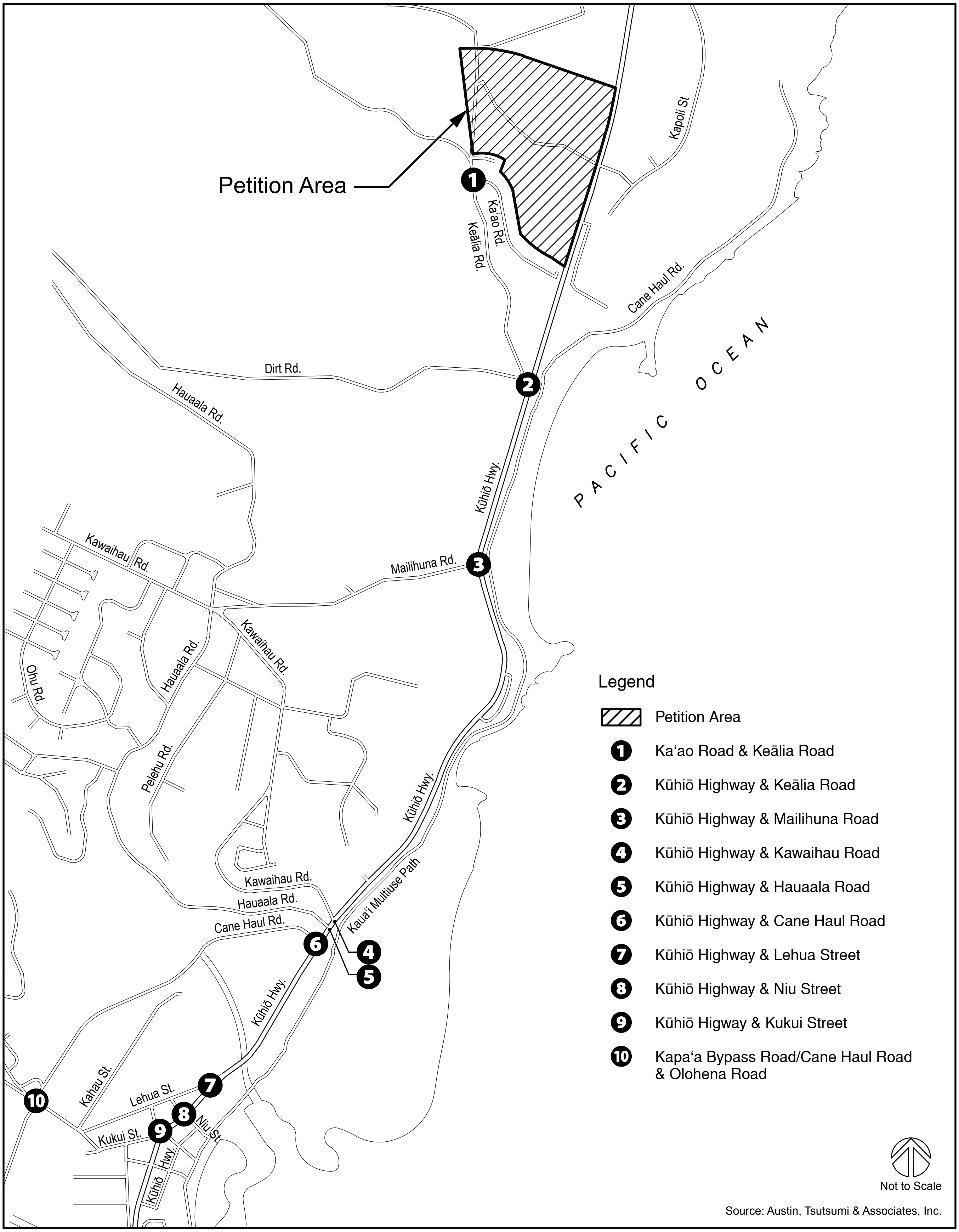
- **Kūhiō Highway** – is generally a north-south, two-way, two-lane principal arterial in the vicinity of the Petition Area. The roadway begins in Līhuʻe at its connection with Kaumualiʻi Highway and travels along the coast before terminating at Keʻe Beach in Hāʻena. Kūhiō Highway is a State roadway and is the major thoroughfare in the East Kauaʻi regions. In the vicinity of the project, Kūhiō Highway has a posted speed limit of 25 to 50 miles per hour (mph) depending on the surrounding land uses. In the immediate vicinity of the project, the highway has a speed limit of 50 mph in the northbound direction and 40 mph in the southbound direction.

- **Keālia Road** – is generally a northwest-southeast, two-way, two-lane roadway in the vicinity of the Petition Area. The roadway begins at its intersection with Kūhiō Highway in the east and extends to the northwest to its intersection with Hauaala Road. The roadway then travels to the northeast where it reconnects to Kūhiō Highway in Anahola. In the vicinity of the Project, Keālia Road has a posted speed limit of 25 mph.

- **Kaʻao Road** – is generally an east-west, two-way, two-lane roadway in the vicinity of the Petition Area. The roadway begins at its intersection with Keālia Road to the west and travels to the east to provide access to the existing residential neighborhood. In the vicinity of the Petition Area, Kaʻao Road has a posted speed limit of 15 mph.

- **Mailihuna Road** – is generally an east-west (*makai-makai*), two-way, two-lane roadway in the vicinity of the Petition Area. The roadway begins on the east end at its intersection with Kūhiō Highway, about a half mile south of the Kūhiō Highway-Keālia Road intersection. Mailihuna Road terminates on the west at its intersection with Kawaihau Road. Mailihuna Road provides access to Kapaʻa High School and residential areas. Closer to Kūhiō Highway, Mailihuna Road has a posted speed limit of 25 mph which drops to 15 mph near Kapaʻa High School.

- **Kawaihau Road** – is generally an east-west (*makai-makai*), two-way, two-lane roadway in the vicinity of the Petition Area. The roadway begins on the east end at its intersection with Kūhiō Highway, about 1.3 miles south of the Kūhiō Highway-Keālia Road intersection. Kawaihau Road terminates to the west at its intersection with Kahuna Road and Pililiamoo Road. Kawaihau Road provides access to Kapaʻa High School, Kapaʻa Elementary School and residential areas. In the vicinity of the Petition Area, Kawaihau Road has a posted speed limit of 25 mph.



Roadways and Traffic Study Intersections **Figure 4-9**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

- **Hauaala Road** – is generally an east-west (*makai-mauka*), two-way, two-lane roadway in the vicinity of the Petition Area. The roadway begins to the east at its intersection with Kūhiō Highway (about 1.4 miles south of the Kūhiō Highway-Keālia Road intersection) and terminates to the northwest at its intersection with Keālia Road. Hauaala Road provides access to residential areas. In the vicinity of the Petition Area, Hauaala Road has a posted speed limit of 25 mph.

- **Cane Haul Road** – is generally a north-south, one-way, one-lane roadway in the vicinity of the Petition Area. The roadway begins to the northeast at its intersection with Kūhiō Highway (about 1.4 miles south of the Kūhiō Highway-Keālia Road intersection) and terminates to the south at the roundabout on Olohena Road where it connects to the two-way Kapaʻa Bypass Road. The roadway provides travel in the southbound direction only. In the vicinity of the Petition Area, Cane Haul Road has a posted speed limit of 25 mph.

- **Kapaʻa Bypass Road** – is a three mile long bypass road providing an alternate to Kūhiō Highway for travelers passing through Kapaʻa and Waipouli. The bypass road is a north-south, two-way, two-lane roadway. The roadway begins to the north at the roundabout on Olohena Road where it connects to the one-way Cane Haul Road. The Olohena Road roundabout is approximately two miles south of the Kūhiō Highway-Keālia Road intersection. The Kapaʻa Bypass Road terminates to the south at its intersection with Kūhiō Highway in Wailua. In the vicinity of the Petition Area, it has a posted speed limit of 25 to 35 mph.

- **Olohena Road** – is generally an east-west, two-way, two-lane roadway. The roadway begins in Kapaʻa Town at Kūhiō Highway, near its connection with Kukui Street, about two miles south of the Kūhiō Highway-Keālia Road intersection. Olohena Road provides access to Kapaʻa Middle School. In the Kapaʻa Town area, Olohena Road has a posted speed limit of 25 mph.

- **Lehua Street** – is generally an east-west, two-way, two-lane roadway in Kapaʻa Town. The roadway begins to the east at its intersection with Kūhiō Highway and terminates to the west at its intersection with Olohena Road, and has a posted speed limit of 25 mph.

- **Niu Street** – is generally a northwest-southeast, two-way, two-lane roadway in Kapaʻa Town. The roadway begins to the northwest at its intersection with Lehua Street and terminates on the *makai* end at the Ke Ala Hele Makalae Multi-Use Path. There is no posted speed limit.

- **Kukui Street** – is generally an east-west, two-way, two-lane roadway in Kapaʻa Town. The roadway begins to the west at its connection with Olohena Road and terminates on the *makai* end at the Ke Ala Hele Makalae Multi-Use Path. Kukui Street has a posted speed limit of 15 mph.

4.11.1.2 Sustainable Transportation Infrastructure

Pedestrian Accessibility

Within Kapaʻa Town, Kūhiō Highway has sidewalks on both sides of the road from the Kukui Street intersection to just north of the Kūhiō Highway/Lehua Street intersection. The sidewalk continues north along the *mauka* side of Kūhiō Highway until the Kawaihau Road intersection. Beyond that, there is no sidewalk until after the Kapaʻa Stream bridge, where the sidewalk on the *mauka* side of the highway resumes until the intersection with Keālia Road. Keālia Road, from Kūhiō Highway up to the existing Kaʻao subdivision, is a narrow two lane road without sidewalks or shoulders. There is minimal pedestrian activity along Kūhiō Highway near the Keālia Road intersection, and no pedestrian activity along Keālia Road.

The Ke Ala Hele Makalae Multi-Use Path provides a pedestrian and bicycle route as an alternative to travel along Kūhiō Highway. The multi-use coastal path begins at Lihi Park in Kapaʻa and travels north to Kuna Bay in Keālia on the *makai* side of Kūhiō Highway. The Ke Ala Hele Makalae also has a Kawaihau Road spur that provides access from the main pathway to the Mahelona Medical Center, Kapaʻa Elementary School and Kapaʻa High School.

Bicycle Accessibility

Bike Plan Hawaiʻi (HDOT, 2003) is the State's bicycle master plan, and outlines how the State intends to accommodate and promote bicycling. *Bike Plan Hawaiʻi* identifies existing and proposed bicycle routes that could potentially be implemented in the future. Kūhiō Highway is a two-lane road in the project vicinity, and is the principal north-south arterial. Bike Plan Hawaiʻi identifies Kūhiō Highway between Wailua and Keālia as a proposed "signed shared roadway," that is, a roadway that is open to both bicycle and motor vehicle travel, and that has been designated by signage as a preferred route for bicycle use. Keālia Road is also identified as a proposed signed shared roadway.

In the project vicinity, Ke Ala Hele Makalae Multi-Use Path provides pedestrian and bicycle accessibility from Kapaʻa Town through Keālia. From the proposed subdivision, it is a just over a 10 minute walk or 5 minute bike ride on a slight downhill grade to access the multi-use path. Within Kapaʻa Town, the Kawaihau Bike Path provides a 3.0 mile long shared use path from Kapaʻa Elementary School to Kapahi Park.

A total of 20 bicycle routes and upgrades are proposed for the Kawaihau region of East Kauaʻi. In the vicinity of the Petition Area, five (5) signed shared roadways and three (3) bicycle paths are proposed. Priority I projects are considered near-term, Priority II are considered mid-term, and Priority III are long-term projects. The projects involve roadway segments under both State and County jurisdiction.

- Signed Shared Road--Kūhiō Highway (Keālia to Anahola) (Priority Level II)
- Signed Shared Road--Kūhiō Highway (Wailua to Keālia) (Priority Level II)
- Signed Shared Road--Keālia Road (Koʻolau to Kūhiō Highway) (Priority Level III)
- Signed Shared Road--Mailihuna Road (Kawaihau Road to Kūhiō Highway) (Priority Level III)
- Signed Shared Road--Olohena Road/Kukui Street (Kamalu Road to Kūhiō Highway) (Priority Level III)
- Bike Path--Extension of Ke Ala Hele Makalae Multi-Use Path (Kuna Bay to Anahola) (Priority Level I)
- Bike Path--Extension of Kawaihau Bike Path (Kapaʻa Elementary School to Kūhiō Highway) (Priority Level II)
- Bike Path--Upgrade of Kawaihau Bike Path (Kapaʻa Elementary School to Kapahi Park) (Priority Level II)

Public Transit

The Kauaʻi Bus public transit system offers several routes that provide service from Kekaha to Hanalei. Routes 400 and 500 serve Līhuʻe to Hanalei, providing several stops in the project vicinity along Kūhiō Highway. There are bus stops on both sides of Kūhiō Highway near the Keālia Road intersection. These stops are a half-mile away from the proposed subdivision, and just over a ten minute walk. However, given Keālia Road's narrow width and lack of sidewalk or shoulders, it is unlikely that many residents of the existing Kaʻao Road subdivision walk between the subdivision and the bus stop.

Route 60 (Kapahi Shuttle) provides service within the Kapaʻa region, including to Mahelona Hospital, Kapaʻa High School, and Kapaʻa Middle School. This route includes several stops along Kūhiō Highway in Kapaʻa Town between the Kukui Street and Kawaihau Road, and along Kawaihau Road. Buses run every hour throughout the day. The Kapahi Shuttle does not stop near the Keālia Road intersection with Kūhiō Highway. In order to access the Kapahi Shuttle, Kaʻao subdivision residents would need to get to a Route 60 stop within Kapaʻa Town, over a mile away. On foot, this would require a half-hour walk along a section of Kūhiō Highway with no sidewalks. Unless they are dropped off in Kapaʻa Town near a Kapahi Shuttle stop, it is unlikely that many existing residents regularly utilize this bus route to get to the high or middle school.

4.11.1.3 Existing Traffic Volumes

The hourly turning movement data was collected at the following intersections, which are located in proximity to the Petition Area. The numbers correspond to the numbers shown in Figure 4-9

- [1] Kaʻao Road/Keālia Road (unsignalized)
- [2] Kūhiō Highway/Keālia Road (unsignalized)
- [3] Kūhiō Highway/Mailihuna Road (unsignalized)
- [4] Kūhiō Highway/Kawaihau Road (unsignalized)
- [5] Kūhiō Highway/Hauaala Road (unsignalized)
- [6] Kūhiō Highway/Cane Haul Road (unsignalized)
- [7] Kūhiō Highway/Lehua Street (unsignalized)
- [8] Kūhiō Highway/Niu Street (unsignalized)
- [9] Kūhiō Highway/Kukui Street (signalized)
- [10] Kapaʻa Bypass Road/Cane Haul Road/Olohena Road (roundabout)[2]

Based on the count data, it was determined that the AM peak hour of traffic occurs between 7:15 AM and 8:15 AM and the PM peak hour of traffic occurs between 3:45 PM and 4:45 PM.

[2] For intersection [10] Kapaʻa Bypass Road/Cane Haul Road/Olohena Road, turning movement data was obtained from the 2015 Kapaʻa Transportation Solutions report and calibrated to collected existing conditions data.

4.11.1.4 Existing Traffic Conditions

Regional Analysis

Kūhiō Highway serves as the main thoroughfare for regional traffic in East Kauaʻi. The highway is contra flowed on Monday through Saturday from 7:00 AM to 1:30 PM to provide two (2) southbound lanes and one (1) northbound lane from the Kapaʻa Bypass south junction to Kapule Highway to accommodate heavier southbound volumes.

During the AM and PM peak hours of traffic, volumes along Kūhiō Highway are generally balanced in both the northbound and southbound directions within the project vicinity. Although southbound traffic is generally higher during the AM peak, volume on Kūhiō Highway is reduced by the use of the Kapaʻa Bypass Road.

Within the region, queuing along southbound Kūhiō Highway was observed to occur during the PM peak hour when contraflow operations were not in place. Occasionally, queues were observed to also form along southbound Kapaʻa Bypass Road during the PM peak hour.

The proposed Keālia Mauka subdivision will be accessed from Kūhiō Highway via Keālia Road. Keālia Road also provides access to the existing residences on Kaʻao Road and Hopoe Road. The entry to the proposed subdivision will be located *mauka* of Hopoe Road.

Currently, there is an existing, unused gated access on the property, on the *mauka* side of Kūhiō Highway, north of the Keālia Road intersection. This is a former plantation era gate and has been chained since the plantation closed. This access point onto Kūhiō Highway will be eliminated. The State Department of Transportation has indicated it will not allow direct access from the Petition Area onto Kūhiō Highway.

Existing Intersection Analysis

The observations and analysis described below are based on observations at the time the TIAR was prepared. Within Kapaʻa Town, queuing was observed during both the AM and PM peak hours of traffic. Queues began near the Kūhiō Highway/Kawaihau Road intersection and extended in both the northbound and southbound directions. Queuing during the AM peak hour was mainly the result of traffic from the nearby Kapaʻa High School (Mailihuna Road) and Kapaʻa Elementary School (Kawaihau Road).

Level of service (LOS) is a term used to describe traffic operating conditions that may occur on a given travel lane or roadway when it is subjected to various traffic volumes. LOS also measures the effect of various factors on traffic such as space, speed, travel time, traffic interruptions, safety, driving comfort, convenience, and freedom to maneuver. LOS is expressed in a qualitative manner through the use of six levels ranging from “A” through “F.” LOS “A” represents free-flowing traffic and no congestion. LOS “F” reflects severe traffic congestion with stop and go conditions.

Study intersections were analyzed using the traffic analysis software Synchro. Because Synchro does not report LOS for uncontrolled movements at unsignalized intersections, LOS is not given for the through movements along Kūhiō Highway. Therefore, existing congestion along Kūhiō Highway at the study intersections is based solely on observations at the time of the traffic counts. Traffic count information for these intersections can be found in the TIAR in Appendix H.

[1] Kaʻao Road/Keālia Road. This intersection has low volumes of traffic, with 46(62) vehicles during the AM(PM) peak hour of traffic. All movements operate at LOS A with minimal delay.

[2] Kūhiō Highway/Keālia Road. The eastbound approach of this intersection operated at LOS C(C) and the westbound approach operated at LOS E(F) during the AM(PM) peak hour of traffic. Delay to the westbound approach was mainly caused by the larger percentage of vehicles making a left-turn onto Kūhiō Highway. However, the number of vehicles making the left-turn was low (≤ 26 vehicles) and adequate gaps were observed along Kūhiō Highway to complete the maneuver. The northbound and southbound left-turn movements from Kūhiō Highway onto Keālia Road operated at LOS A during both peak hours and experienced minimal delay. Although minor street movements and major street left-turn movements were able to proceed during gaps in traffic along Kūhiō Highway, the high speeds along the highway increased the difficulty of these maneuvers.

Although the posted speed limit is 40 mph in the southbound direction and 50 mph in the northbound direction, southbound vehicle speeds were observed to be higher. This is due to a hill on the northbound approach. No congestion along Kūhiō Highway near the Keālia Road intersection was observed during either peak hour.

[3] Kūhiō Highway/Mailihuna Road. The eastbound approach of this intersection operated at LOS F during both peak hours of traffic and at overcapacity conditions during the AM peak hour because of the high volume of vehicles making the left-turn onto Kūhiō Highway. Much of this traffic is associated with the elementary and high schools in the area. Vehicles had difficulty making the eastbound left-turn because of the high speeds of the vehicles on Kūhiō Highway. The northbound and left-turn from Kūhiō Highway onto Mailihuna Road operated at LOS A during both peak hours and experienced minimal delay. No congestion along Kūhiō Highway was observed at this intersection during either peak hour.

[4] Kūhiō Highway/Kawaihau Road. The eastbound approach of this intersection operated at LOS F(C) and the northbound left-turn movement operated at LOS B(B) during the AM(PM) peak hour of traffic. Because of the high volume of eastbound right-turns and northbound left-turns, the vehicles heading southbound along Kūhiō Highway often stopped to allow these vehicles to proceed, and the inter section was observed to self-regulate and operate similar to an all-way stop controlled intersection during the heaviest periods of congestion. During less congested periods, minor movements were able to use gaps in traffic to proceed. Because of the large number of turning movements at this intersection and the proximity of this intersection to the Hauaala Road intersection, Kūhiō Highway became congested in both the northbound and southbound directions.

[*5] Kūhiō Highway/Hauaala Road*. The eastbound approach of this intersection operated at LOS F(D) and the northbound left-turn movement operated at LOS B(B) during the AM(PM) peak hour of traffic. Additionally, the eastbound approach operated under overcapacity conditions during the AM peak hour. Operations at this intersection behaved similarly to the Kūhiō Highway/Kawaihau Road intersection.

[6] Kūhiō Highway/Cane Haul Road. Because Cane Haul Road is one-way and does not allow traffic to enter Kūhiō Highway, minimal delay was observed at this intersection. Many vehicles were observed to make a southbound right-turn onto Cane Haul Road in order to access the Kapaʻa Bypass Road. The majority of Kūhiō Highway congestion in the southbound direction cleared in the vicinity of this intersection. However, congestion in the northbound direction remained due to queues extending from the Kūhiō Highway/Kawaihau Road and Kūhiō Highway/Hauaala Road intersections.

[7] Kūhiō Highway/Lehua Street. The eastbound approach of this intersection operated at LOS F and overcapacity during both peak hours of traffic. Because Kapaʻa Bypass Road terminates at the Olohena Road roundabout, vehicles heading farther north must reenter Kūhiō Highway. The majority of these vehicles use Lehua Street to make a left-turn onto Kūhiō Highway. The high volume of left-turns caused increased delay for the eastbound approach. At this intersection, congestion was observed along Kūhiō Highway in the northbound direction due to queues extending from Kawaihau Road and Hauaala Road intersections during both peak hours of traffic.

[8] Kūhiō Highway/Niu Street. The eastbound approach of this intersection operated at LOS E(C) and the westbound approach operated at LOS C(C) during the AM(PM) peak hours of traffic. At this intersection, congestion was observed along Kūhiō Highway in the northbound direction due to queues extending from the Kawaihau Road and Hauaala Road intersections.

[9] Kūhiō Highway/Kukui Street. The minor street movements operated at LOS F(D) during the AM(PM) peak hours of traffic. Delay to the minor movements was mainly caused by the long coordinated signal favoring the Kūhiō Highway through movements. All movements generally cleared in one cycle. However, during the most congested AM and PM periods, queues from the Kawaihau Road and Hauaala Road intersections caused slow moving traffic heading northbound.

[10] Kapaʻa Bypass Road/Cane Haul Road/Olohena Road. Data from the Kapaʻa Transportation Solutions report indicates the roundabout at this intersection generally operates smoothly during the PM peak hour of traffic, with all approaches operating at LOS C or better. However, during the AM peak hour, the eastbound approach operates at LOS E, near overcapacity conditions. The high volume of traffic is due to vehicles from residential areas and Kapaʻa Middle School entering Kūhiō Highway and Kapaʻa Bypass Road.

4.11.2 Potential Impacts and Mitigation

The TIAR evaluated traffic conditions in a future base year without the project, and then again with the project. The analysis below for “Base Year 2027” represents future conditions without the project. The analysis for “Future Year 2027” represents future conditions with the project.

4.11.2.1 Base Year 2027 (Future Conditions Without Project)

For the TIAR analysis, a Base Year 2027 was selected to represent the full build out and occupancy of the project. The actual construction of the infrastructure improvements and the commencement of lot sales will occur prior to 2027. However, because homes will be constructed by the individual lot purchasers, it is difficult to know when full build out will occur. Year 2027 represents a reasonable estimate for purposes of the TIAR.

The Base Year 2027 scenario represents the traffic conditions within the study area without the project. Base Year traffic projections were formulated by applying a defacto growth rate to the existing 2017 traffic count volumes, and adding trips generated by known future developments in the vicinity.

Defacto Growth Rate

Projections for Base Year 2027 traffic were based upon existing traffic counts performed by ATA for the TIAR, the State of Hawaiʻi Department of Transportation (HDOT)’s Kauaʻi Regional Travel Demand Model (KRTDM) growth for forecast years between 2007 and 2035, and known developments proposed in the vicinity. A 1% annual growth rate was applied to Kūhiō Highway, Cane Haul Road and Olohena Road, and a 2% annual growth rate was applied to Kukui Street.

Other Known Developments

By Year 2027, traffic in the project vicinity is expected to experience significant growth due to several residential and commercial developments proposed in the surrounding regions. The trips generated by these developments are already accounted for in the KRTDM growth forecast.

The locations of these known developments are shown in the TIAR. They are briefly described below.

- Piʻilani Mai Ke Kai – This project is located in Anahola on the *makai* side of Kūhiō Highway on land owned by the Department of Hawaiian Home Lands (DHHL). The project began in 2006 and includes 181 single-family lots. The majority of the lots have already been awarded. It is assumed by 2027, all lots will be built out. This development is already accounted for in the KRTDM growth projections.

- Kulana Subdivision – This project is located north of Olohena Road and east of Hauiki Road. This agricultural subdivision will contain 172 single family houses at full buildout. There is currently no expected completion date, however, the project is included in KRTDM forecasts.

- Hokua Place – This project is located between Olohena Road and Kapaʻa Bypass Road near Kapaʻa Middle School. The project plans to develop 100 single-family units, 700 multi-family units and 8,000 square feet of neighborhood retail. The project also proposes to construct a roadway, Road "A", through the subdivision connecting Kapaʻa Bypass Road to Olohena Road just west of Kapaʻa Middle School. Once constructed, the roadway is expected to reduce traffic volumes at the Kapaʻa Bypass Road/Cane Haul Road/Olohena Road roundabout. The Hokua Place project was previously known as Kapaʻa Highlands Phase II. A TIAR completed for Kapaʻa Highlands dated December 2013, assumes a completion year of 2020. The Kapaʻa Highlands TIAR was used to determine trips generated and rerouted in the study area.

- Coconut Plantation – This project is located along the *makai* side of Kūhiō Highway between the Courtyard by Marriott Kauai at Coconut Beach Hotel and the Mokihana Lodge. The project proposes to develop 192 resort units. There is currently no expected completion date, however, for the purposes of this TIAR, the project was assumed to be completed by 2027.

- Coconut Beach Resort – This project is located along the *makai* side of Kūhiō Highway between the Courtyard by Marriott Kauaʻi at Coconut Beach Hotel and Kauaʻi Coast Resort at the Beachboy. The project proposes to develop 330 condo units as part of a new beachfront timeshare. Completion is anticipated in 2019.

- Coco Palms – This project is located along the *mauka* side of Kūhiō Highway north of Kuamoʻo Road. The project proposes to restore the old Coco Palms hotel into a 350-room resort. These units were factored into traffic projections for 2027.

Planned Roadway Improvements

Roadway projects that are currently planned include a proposed roundabout at Kūhiō Highway and Mailihuna Road. For the purposes of the TIAR, it was assumed that the roundabout will be implemented by Base Year 2027. The existing three-legged intersection on Mailihuna Road, which currently has stop control only, would be reconfigured to improve safety by constructing a roundabout.

There are a number of other proposals to relieve congestion along Kūhiō Highway in the Wailua and Kapaʻa regions that are currently in the planning stages. They include major undertakings such as widening Kūhiō Highway from Kapaʻa Bypass Road to Kuamoʻo Road to include an additional southbound lane; widening Kūhiō Highway from Kuamoʻo Road to Kapule Highway; and extending the Kapaʻa Bypass Road from Olohena Road to Kūhiō Highway by adding a northbound lane. Other proposed improvements include closing the east leg of Kukui Street; improving the Kūhiō Highway/Niu Street intersection; and eliminating the connection from Hauaala Road to Kūhiō Highway and creating a new connection to the Kapaʻa Bypass road. These roadway improvements are not expected to be completed by Year 2027 and therefore were not included in Base Year 2027 traffic predictions.

Base Year 2027 Analysis

It is anticipated that by Base Year 2027, traffic will have increased by approximately 18%(24%) along Kūhiō Highway and by approximately 9%(14%) along Cane Haul Road/Kapaʻa Bypass Road during the AM(PM) peak hour over existing conditions. This is due to the development in the surrounding regions, though actual growth may vary based upon the approval process of the proposed developments.

Peak hour queuing along Kūhiō Highway is expected to operate similar to existing conditions. Although not expected to be completed by Year 2027, the planned widening of Kūhiō Highway from Kapaʻa Bypass Road to Kuamoʻo Road would reduce queues along Kūhiō Highway south of the study intersections. Queuing along Kūhiō Highway near Kawaihau Road is expected to remain in Base Year 2027.

Many minor street movements are expected to experience increases in delay due to the increase in traffic along Kūhiō Highway. However, the Kūhiō Highway/Mailihuna Rd intersection is expected to operate with all movements at LOS C or better due to the construction of the planned roundabout.

The following intersections are expected to continue operating at or worsen to LOS E/F during Base Year 2027 conditions.

- [2] Kūhiō Highway/Keālia Road
- [4] Kūhiō Highway/Kawaihau Road
- [5] Kūhiō Highway/Hauaala Road
- [7] Kūhiō Highway/Lehua Street
- [8] Kūhiō Highway/Niu Street
- [9] Kūhiō Highway/Kukui Street
- [10] Kapaʻa Bypass Road/Cane Haul Road/Olohena Road

Base Year 2027 With Mitigation

The TIAR notes that in order to improve Base Year 2027 traffic operations at the study intersections, the preferred mitigation would be a Kapaʻa Bypass Road extension and the relocation of the Hauaala Road connection, as described under "Planned Roadway Improvements" above. Although the Kapaʻa Bypass Road extension is currently planned by HDOT, the project is not expected to be completed by Year 2027. The TIAR describes 2027 scenarios with and without the Bypass Road Extension completed.

4.11.2.2 Future Year 2027 (Future Conditions With Project)

The Future Year 2027 scenario represents the traffic conditions in the area with the full build out of the proposed Keālia Mauka Homesites project. Access to the 235 lots will be provided via Keālia Road from Kūhiō Highway. A new four-way, one-lane roundabout will be constructed north of the Keālia Road/Hopoe Road intersection to connect Keālia Road to the subdivision. Both the southern and western approaches of the roundabout will have connections to Keālia Road.

There will be no other direct vehicle access to Kūhiō Highway from the Petition Area. An existing, unused gated access along Kūhiō Highway from the plantation era will be removed. By 2027, the 235 house lots will be sold, and homes will be constructed and occupied.

Travel Demand Estimates

In order to project the increase in vehicle trips generated by the project, the TIAR utilized trip rates and formulae from the Institute of Transportation Engineers (ITE) *Trip Generation Manual.* The standard rates selected were based on the future land use (single-family detached housing) and the number of dwelling units (235). The generated trips can be found in Table 5.2 of the TIAR. The traffic generated by the project was added to the forecast Base Year 2027 traffic volumes to estimate "Future Year 2027" traffic conditions.

At full build out, the project is estimated to generate a total of 172(231) net external trips during the AM(PM) peak hour of traffic. Traffic from the project is expected to generate growth along major roadways in the study area.

Future Year 2027 Analysis

The TIAR evaluated traffic conditions at the ten study intersections under two scenarios: 1) With the Kapaʻa Bypass Road Extension and 2) Without the Kapaʻa Bypass Road Extension. The findings are discussed below.

Future Year 2027 With Kapaʻa Bypass Road Extension. Similar to Base Year 2027 (i.e., without project), there will continue to be queuing along Kūhiō Highway south of the study intersections until the widening of the roadway is completed. A decrease in traffic queuing is expected in Kapaʻa town when the extension of the Kapaʻa Bypass Road and relocation of the Hauaala Road connection are complete.

The majority of study intersections are expected to experience increased delays compared to Base Year 2027. The following intersections are projected to either continue operating at or worsen to LOS E/F during the AM and/or PM peak hours. Traffic volume counts can be found in the TIAR,

[2] Kūhiō Highway/Keālia Road. Because Kūhiō Highway/Keālia Road is the only access point to the project from Kūhiō Highway, this intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions. Proposed mitigation is discussed below.

[4] Kūhiō Highway/Kawaihau Road. The eastbound approach is expected to continue operating at LOS F during the AM peak hour. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Because of a lack of feasible alternatives, no mitigation is proposed for this intersection.

[5] Kapaʻa Bypass Road/Hauaala Road. The southbound approach is expected to continue operating at LOS E during the AM peak hour. Because the approach will continue to operate under capacity as in Base Year 2027 with mitigation conditions, no mitigation is proposed for this intersection.

[6] Kūhiō Highway/Kapaʻa Bypass Road. The eastbound approach is expected to continue operating at or worsen to LOS F during both peak hours of traffic. Although the eastbound approach is expected to experience delays over Base Year 2027 conditions, the proposed refuge lane is anticipated to help minimize delays to the eastbound left-turn movement. Additionally, the approach will continue to operate under capacity, and no mitigation is proposed at this intersection during the PM peak hour. Mitigation is proposed in Section 5.4 below.

[7] Kūhiō Highway/Lehua Street. The eastbound approach is expected to continue operating at LOS E during the AM peak hour and worsen to LOS F during the PM peak hour. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. All movements will continue to operate under capacity, and no mitigation is proposed at this intersection.

[8] Kūhiō Highway/Niu Street. The eastbound approach is expected to worsen to LOS F during the AM peak hour and continue operating at LOS E during the PM peak hour. As in Base Year 2027 conditions, adequate gaps in traffic are expected due the intersection's proximity to the Kukui Street signal and the minor street movements are expected to continue operating adequately. No mitigation is proposed at this intersection.

[9] Kūhiō Highway/Kukui Street. Both minor street approaches are expected to continue operating at LOS F during the AM peak hour of traffic due to a longer green time being allotted to the Kūhiō Highway through movements. Because the minor streets will continue to operate under capacity, no mitigation is proposed for this intersection.

Future Year 2027 Without Kapaʻa Bypass Extension. Similar to Base Year 2027, queuing along Kūhiō Highway within and south of the Project area is expected to remain until congestion relief projects are completed in Kapaʻa and Wailua. In the Project area, while major through movements are expected to continue allowing other movements to proceed during congested periods to reduce major left-turn and minor movement delay, all movements are expected to experience longer delays over existing conditions.

The majority of study intersections are expected to experience increased delays compared to Base Year 2027. The following intersections are projected to either continue operating at or worsen to LOS E/F during the AM and/or PM peak hours. Traffic volume counts can be found in the TIAR.

[2] Kūhiō Highway/Keālia Road. Because Kūhiō Highway/Keālia Road is the only access point to the project from Kūhiō Highway, this intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions. Proposed mitigation is discussed below.

[3] Kūhiō Highway/Mailihuna Road. The eastbound approach is expected to worsen to LOS E during the AM peak hour of traffic due to anticipated reroutes of vehicles to this intersection from the congested Kawaihau Road and Hauaala Road. This intersection is expected to continue operating adequately with minimal increases in overall delay. No mitigation is proposed for this intersection.

[4] Kūhiō Highway/Kawaihau Road. The eastbound approach is expected to continue operating overcapacity at LOS F during the AM peak hour and LOS E during the PM peak hour. Similar to Base Year 2027, although a signal may be warranted at this intersection, it may create longer delays. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Additionally, a larger portion of vehicles may use Mailihuna Road to access Kūhiō Highway due to the improved conditions at that intersection with the roundabout. No mitigation is proposed for this intersection.

[5] Kūhiō Highway/Hauaala Road. The eastbound approach is expected to continue operating at LOS F during both peak hours and at overcapacity during the AM peak hour. Similar to Base Year 2027, although a signal may be warranted at this intersection, it may create longer delays. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Additionally, a larger portion of vehicles may use Mailihuna Road to access Kūhiō Highway due to the improved conditions at that intersection with the roundabout. No mitigation is proposed for this intersection.

[7] Kūhiō Highway/Lehua Street. The eastbound approach is expected to continue operating at LOS F and under capacity during both peak hours of traffic. The intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. No mitigation is proposed for this intersection.

[8] Kūhiō Highway/Niu Street. The minor street approaches are expected to continue operating at or worsen to LOS E(F) during both peak hours of traffic. As in Base Year 2027 conditions, adequate gaps in traffic are expected due the intersection’s proximity to the Kukui Street signal, and the minor street movements are expected to continue operating adequately. No mitigation is proposed at this intersection.

[9] Kūhiō Highway/Kukui Street. The northbound shared through/right-turn movement will continue operating at overcapacity during both peak hours of traffic with increases in delay. Additionally, both minor street approaches are expected to continue operating at LOS E or F during both peak hours of traffic. Because there is limited right of way (ROW) to improve capacity along Kūhiō Highway and the minor streets will continue to operate under capacity, no mitigation is proposed for this intersection.

Future Year 2027 With Proposed Mitigation. The TIAR evaluated two potential mitigations for the Kūhiō Highway/Keālia Road intersection. The first was to construct a roundabout. However, this option is problematic from a design standpoint due to the skew of the intersection.

The preferred mitigation is to install a traffic signal to improve operations along Keālia Road. Based on projections for Future Year 2027 and the Four-Hour Vehicular Volume signal warrant condition (Warrant 2) in the Manual on Uniform Traffic Control Devices (MUTCD) (FHWA, 2009), a signal will likely be warranted at this intersection. Although a signal would slow through progression along Kūhiō Highway when vehicles actuate the signal on Keālia Road, the signal would be designed to provide Kūhiō Highway with the majority of green time. Additionally, because the Kūhiō Highway/Keālia Road intersection is relatively isolated, queuing at the signal is not expected to affect traffic operations in the area.

As part of the installation of a traffic signal, a right turn will be provided onto Keālia Road and the existing bus stop/bay to the south of the intersection will need to be relocated. Figure 4-10 illustrates the proposed traffic mitigation at this intersection. With this mitigation, both the eastbound and westbound approaches will operate at LOS C during both peak hours of traffic. Additionally, the intersection will operate with overall LOS B during both peak hours.

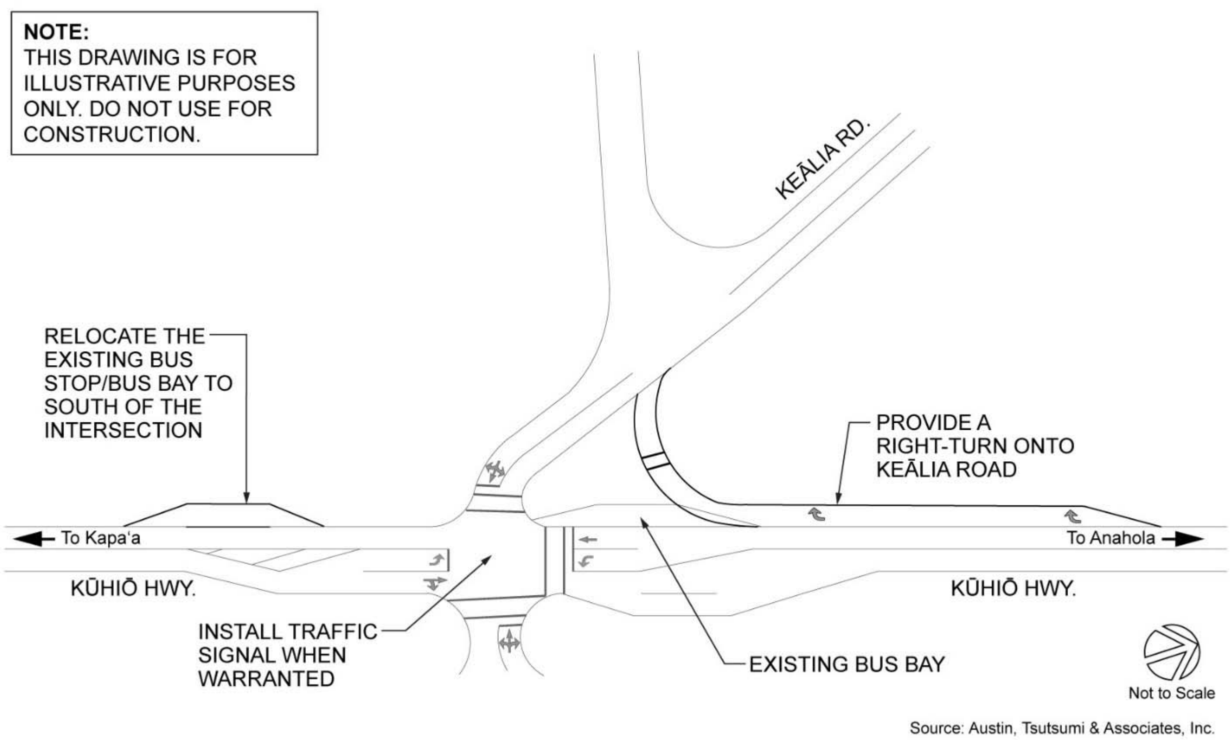


Figure 4-10. Proposed Traffic Mitigation, Kūhiō Highway and Keālia Road

Future Year 2027 Sustainable Transportation

The proposed traffic mitigation for the project will include improvements to the eastbound approach of Keālia Road, including the addition of a sidewalk. The installation of a traffic signal at the Kūhiō Highway/Keālia Road intersection will provide signalized crossings along the southbound, eastbound and westbound approaches. These will improve conditions for pedestrians. The existing bus stops at the intersection will be relocated but will continue to be available.

The County has proposals to modify bus routes to improve access from the project vicinity to Kapaʻa Middle and High Schools. The State Bike Plan has identified Kūhiō Highway near Keālia Road as a future signed shared roadway, furthering the goal of regional bicycle connectivity. Ke Ala Hele Makalae will continue provide a nearby amenity for walking, jogging, or recreational bike riding, and could also provide a transportation option into Kapaʻa.

These improvements to sustainable transportation modes will benefit future residents of Keālia Mauka. That said, the major constraint to the use of sustainable mode of transportation by residents will continue to be the poor connectivity between the subdivision and Kūhiō Highway. The narrow width of Keālia Road, lack of sidewalks or shoulders, combined with the uphill terrain and roadway curves make this segment uninviting—and potentially dangerous--for bicycling and walking. Starting from the Keālia Road and Kūhiō Highway intersection, walking, bicycling, and public transit are more attractive and realistic transportation options.

4.12 PUBLIC SERVICES

There will be an estimated 700 residents of the subdivision that will move into the Keālia region. The project impacts and any recommended mitigation for public services are discussed in the following sub sections.

4.12.1 Police Protection

4.12.1.1 Existing Conditions

The County of Kauaʻi Police Department has three stations located approximately 25 miles apart. The main station and administrative headquarters is located in Līhuʻe, and collocated with the County Civil Defense and County Prosecuting Attorney's office. District stations are located at Waimea in West Kauaʻi and Hanalei on the north shore. A small substation is located in Kapaʻa adjacent to Kapaʻa Beach Park.

The Project Area is under the jurisdiction of the Hanalei District, which extends north from Olohena Road in Kapaʻa and covers the entire northern end of the island. The Hanalei District covers the communities of Kapaʻa, Keālia, Anahola, Kīlauea, Princeville, Hanalei, Wainiha and Hāʻena. The district substation is located on Kūhiō Highway just north of the Princeville Shopping Center. The Hanalei District is comprised of three squads of officers, responsible for staffing three "beats" with 24 hour coverage, 7 days a week. When fully staffed, personnel include one Lieutenant (District Commander), three sergeants, 21 police officers, and a senior clerk.

4.12.1.2 Potential Impacts and Mitigation

The increased number of residents associated with the project is not likely to have a significant impact on the overall need for police services. The majority of future residents (approximately 658 of 700) are expected to be existing Kauaʻi residents, so the project will not result in a large net increase in population. The proposed traffic improvements (signal) will mitigate the impact of increased traffic at the Kūhiō Highway and Keālia Road intersection.

4.12.2 Fire Protection

4.12.2.1 Existing Conditions

The Kauaʻi County Fire Department has eight fire stations islandwide: Hanalei (Princeville), Kaiakea, Kapaʻa, Līhuʻe, Koloa, Kalaheo, Hanapēpē and Waimea. The station nearest the Petition Area is Station 8, Kaiakea Station located in Kapaʻa. The county has a unified, island-wide system of fire protection and rescue services. Satellite stations typically have two to three personnel per station and provide quick response to medical emergencies. The Kaiakea Station is staffed with three to five fire fighters. Firefighting apparatus include one engine (pumper), one truck, and one hazmat vehicle (personal communication with Kalani Abreu, Kaiakea Station, March 6, 2018).

4.12.2.2 Potential Impacts and Mitigation

The project proposes 235 additional homes which will need fire protection from the Kaiakea Station in Kapaʻa. Because most of the 700 subdivision residents are expected to be current Kauaʻi residents, there will not be a significant net population increase to the island. The Proposed Action should not have a significant impact on fire protection resources or service. The subdivision roads will be designed to accommodate fire vehicle access and equipment, and the water system will be designed to provide adequate firefighting and storage capacity. No additional mitigation is required.

4.12.3 Medical Services and Facilities

4.12.3.1 Existing Conditions

The Mahelona Medical Center is Kauaʻi's eastside critical access hospital. The facilities are part of the Kauaʻi region of Hawaiʻi Health Systems Corporation, headquartered at a sister facility, West Kauaʻi Medical Center in Waimea. Services include 24 hour emergency services, imaging (digital x-ray), rehabilitation therapies (occupational, physical, and recreational), skilled nursing, intermediate, long term and acute care. The medical center has approximately 145 employees.

The medical facilities include the Samuel Mahelona Memorial Hospital, which was founded in 1917. The medical campus also includes the East Kauaʻi Clinic, and Hoʻola Lahui Hawaiʻi (Federally Qualified Health Clinic), Kauaʻi Police Athletic League, and state and hospital housing.

4.12.3.2 Potential Impacts and Mitigation

The addition of 235 new housing units will not have an impact on the Mahelona Medical Center or other medical services on the island. The majority of the prospective homeowners are already Kauaʻi residents, and there will be only a negligible increase in demand for medical services, if at all. No mitigation measures are required.

4.12.4 Schools

4.12.4.1 Existing Conditions

Public schools serving the Keālia area include Kapaʻa Elementary School, Kapaʻa Middle School and Kapaʻa High School, as well as the Kanuikapono Public Charter School in Anahola, which serves Grades K-12. According to the State of Hawaiʻi Department of Education (DOE), Kapaʻa Elementary School currently has capacity for approximately 29 additional students. However, excess capacity is expected to be eliminated over the next five years. Kapa'a Intermediate School has classroom capacity for roughly 125 additional students, which is expected to remain the same for the next five years. Kapaʻa High School is over capacity by 100 students. The over-capacity condition will continue over the next five years (correspondence from DOE dated December 22, 2017, see Chapter 9).

Independent (private) schools in the area include the Anahola campus of Kamehameha Schools Preschool. There are also several private pre-schools located in Kapaʻa.

4.12.4.2 Potential Impacts and Mitigation

Public school enrollment generated by the Proposed Action was estimated using student generation rates provided by the DOE Office of School Facilities and Support Services. The student generation rates (SGR) for elementary, middle, and high school students were calculated using the Kealaula Subdivision in Eleʻele as a comparable. This subdivision targets a similar sales demographic and has lot sizes similar to the Proposed Action.

Level	Student Generation Rate (SGR)	Hsg Units	# Students
Elementary	0.2241	235	53
Middle	0.0345	235	11
High School	0.1552	235	37
Total			101

The SGR are subject to the following disclaimers:

1. That the SGR is based on student addresses currently in the HIDOE system and may not be accurate due to inaccurate student addresses (i.e. data entry errors);
2. That Pre-K and Charter school students are excluded from the SGR calculations;
3. That it is assumed that the information regarding street names, addresses, and number of built units are accurate; and
4. That the project is not at mature build out as the subdivision has 61 lots with 58 housing units built.

Utilizing these SGR, the proposed 235 residential lots may generate a total of 101 school-aged children. This includes 53 elementary school age children (235 x 0.2241= 53 students); 11 middle school age students (235 x 0.345= 11 students); and 37 high school age students (235 x 0.1552= 37 students). These projections represent the anticipated number of students at full subdivision build out, which could occur over the next 10 years. The proposed lot sizes do not allow Additional

Dwelling Units (ADU) per the County's zoning ordinance, so no more than one single-family home would be built on each lot.

Because the Keālia Mauka residential lots are targeted to local residents, most of these 101 students are already attending Kauaʻi public schools, although not necessarily in the Kapaʻa schools complex. The economic and market study estimates that over 80 percent of the prospective buyers will be existing Kauaʻi residents. The remaining 20 percent of would be non-resident second/vacation home buyers (CBRE, 2017). Using this assumption, 20 percent of the total 235 lots, or 47 lots could be purchased by an off-island buyer. Applying the DOE standard multipliers to these 47 households, the potential new students to the Kauaʻi island school system is estimated to be eleven elementary school aged children (47x 0.2241=11 students); two intermediate school students (47 x 0.345=2 students); and eight high school students (47 x 0.1552=8). This results in a total of 21 students who are "new" to the Kauaʻi school system. In reality, many of the off-island purchasers will be empty nesters without school aged children. Those with school-aged children may also choose to send their children to Kauaʻi's private, rather than public schools.

In summary, a worst case estimate of 21 new students to the Kauaʻi public schools over a ten year build out period will not have a significant adverse impact.

4.12.5 Parks and Recreational Facilities

4.12.5.1 Existing Conditions

There are 15 parks within the County of Kauaʻi's Kawaihau Planning District, which includes the Keālia Petition Area. These County parks encompass 211 acres of land and include athletic fields, playgrounds, beach parks, and playing courts. Keālia Beach Park, located across Kūhiō Highway from the Petition Area, is 66 acres in size and is serviced by County lifeguards, with portable toilets only. The County's multi-use path, Ke Ala Hele Makalae, extends from Lydgate Park in Kapaʻa to Ahihi Point, and is proposed to continue northward to Anahola. This 6.2 mile multi-use path runs along the coastline and provides a major recreation resource for walking, jogging and bicycling.

The Keālia coastline is used for a number of recreational activities, despite the lack of County facilities. Keālia Beach is a long strip of sandy beach located on the *makai* side of the highway providing scenic views of the coastline. Strip parking occurs along gravel and dirt areas of this beach park from Kapaʻa Stream up to the northern end of the park. The southern section of this beach is commonly used for surfing and fishing. The only public facilities present are a temporary lifeguard stand and a few picnic tables. At the northern end of this beach is an unpaved parking area. This portion of the beach is used for swimming, picnicking, surfing and fishing.

4.12.5.2 Potential Impacts and Mitigation

The Proposed Action will not adversely impact County parks and other public recreation facilities in the area. The majority of subdivision residents are already Kauaʻi residents, so the increased demand on public recreational facilities will be minimal.

5.0 RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS

5.1 STATE OF HAWAIʻI

5.1.1 State Land Use Law (Chapter 205, HRS)

The State of Hawaiʻi Land Use Law, Chapter 205, HRS, is intended to preserve, protect, and encourage the development of lands in the State for uses that are best suited to the public health and welfare of Hawaiʻi's people. The State Land Use Commission (LUC) classifies all lands into four land use districts: Urban, Conservation, Agricultural, and Rural. The entire Petition Area is in the Agricultural District, as shown in Figure 5-1.

The Proposed Action will require a State Land Use District Boundary Amendment to reclassify lands from the State Agricultural District to the State Urban District. A petition for Land Use District Boundary Amendment (Docket No. A17-803) has been filed with the State LUC on behalf of Keālia Properties, LLC ("Petitioner"). The Petitioner is seeking to reclassify approximately 53.4 acres of land from the State Land Use Agricultural District to the State Land Use Urban District, to develop approximately 235 residential lots ranging from 5,600 SF to 7,300 SF for empty lot sales. This Draft EIS has been prepared to support this petition.

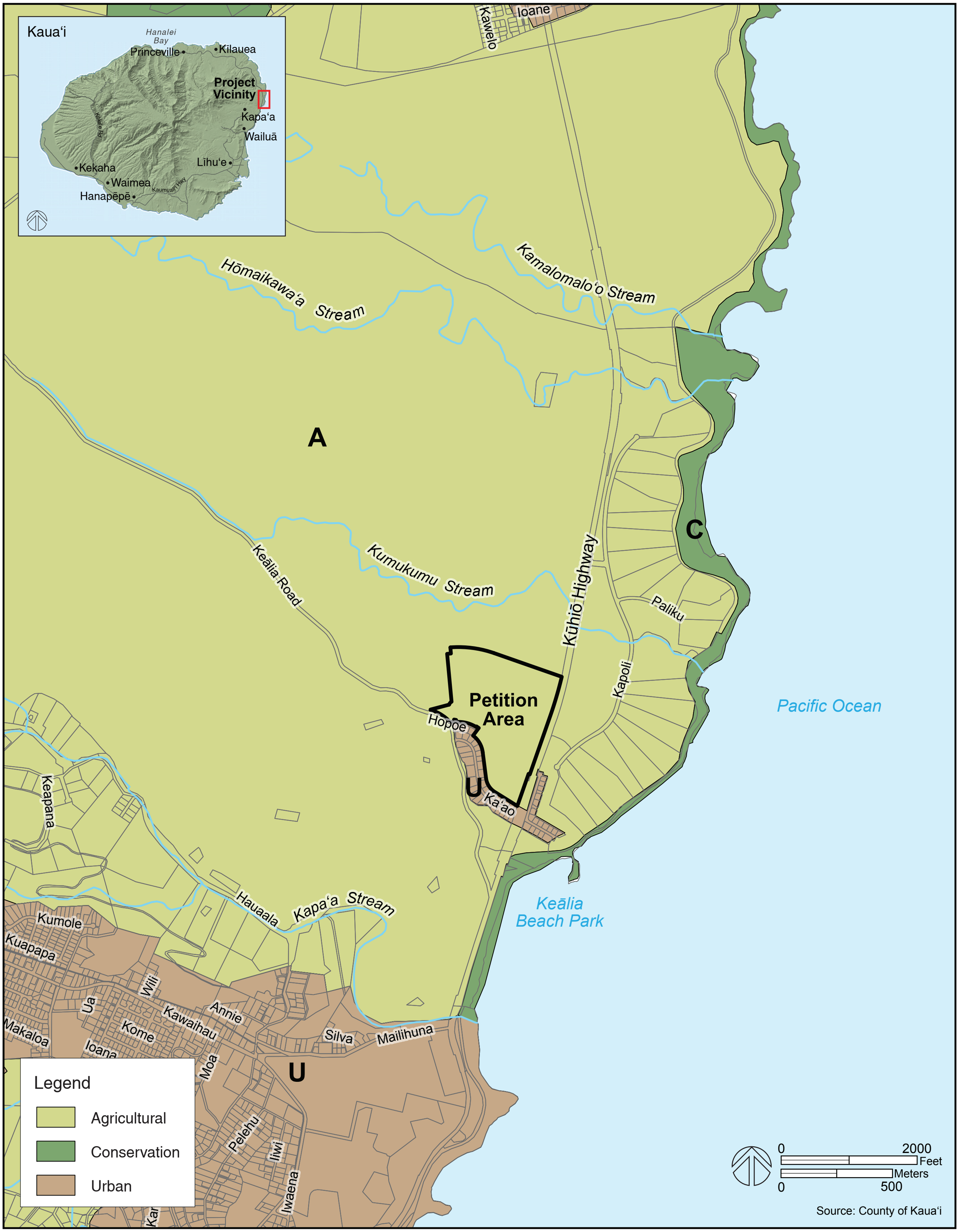
The State LUC, in accordance with Chapter 15-15 HAR (LUC Rules, 2013), must specifically consider the extent to which the proposed reclassification conforms to the applicable District standards. The standards for determining the boundaries for the Urban District include eight (8) areas which are listed below.

(1) It shall include lands characterized by "city-like" concentrations of people, structures, streets, urban level of services and other related land uses;

Discussion: The Proposed Action will create approximately 235 single family house lots served by municipal and private utilities and infrastructure, including potable water, stormwater, drainage, wastewater, electrical power, and telecommunications systems. The project is located adjacent to existing single family subdivisions on Kaʻao Road and Hopoe Road. On the *makai* side of Kūhiō Highway, there are single family residences along Kamole Road. The oceanfront Keālia Kai subdivision is also located on the *makai* side of the highway.

(2) It shall take into consideration the following specific factors:

> *(A) Proximity to centers of trading and employment except where the development would generate new centers of trading and employment;*
> *(B)Availability of basic services such as schools, parks, wastewater systems, solid waste disposal, drainage, water, transportation systems, public utilities, and police and fire protection; and*
> *(C) Sufficient reserve areas for foreseeable urban growth;*



State Land Use Districts Map **Figure 5-1**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

Discussion: The Petition Area is in close proximity to areas of trading and employment, including Kapaʻa, the island's largest (most populous) town which is two miles away. Līhuʻe, the second largest town on Kauaʻi and the county seat, is located approximately ten miles to the south. The East Kauaʻi region, which stretches from Līhuʻe to Moloaʻa (and includes the project area), has evolved into a primary region for economic activity and employment. It is the region of Kauaʻi with the most commercial and industrial space, the most businesses, and the most employment opportunities. East Kauaʻi is currently the focus of economic activity on the island, with resident population forecast to increase between 35 and 40 percent between now and 2040 (CBRE, 2017).

Utility and infrastructure service will be provided to the Petition Area. The subdivision will utilize a private water system. Public services such as schools, parks and beach parks, police and fire protection are available within the Kapaʻa area to serve future residents. The Proposed Action includes construction of a 4.3 acre park/detention basin at the southern entry to the subdivision which will provide passive open space and serve as a buffer between the Petition Area and the adjacent Kaʻao Road subdivision. Another 1.5 acre detention basin at the northeastern corner of the subdivision will also provide an open space buffer. The adjacent Kaʻao subdivision located adjacent to the Petition Area is within the State Urban District. Surrounding *mauka* lands to the west and northwest are within the Agricultural District. These areas are not under active cultivation and are used primarily for grazing. The Petitioner has no plans to develop these surrounding lands.

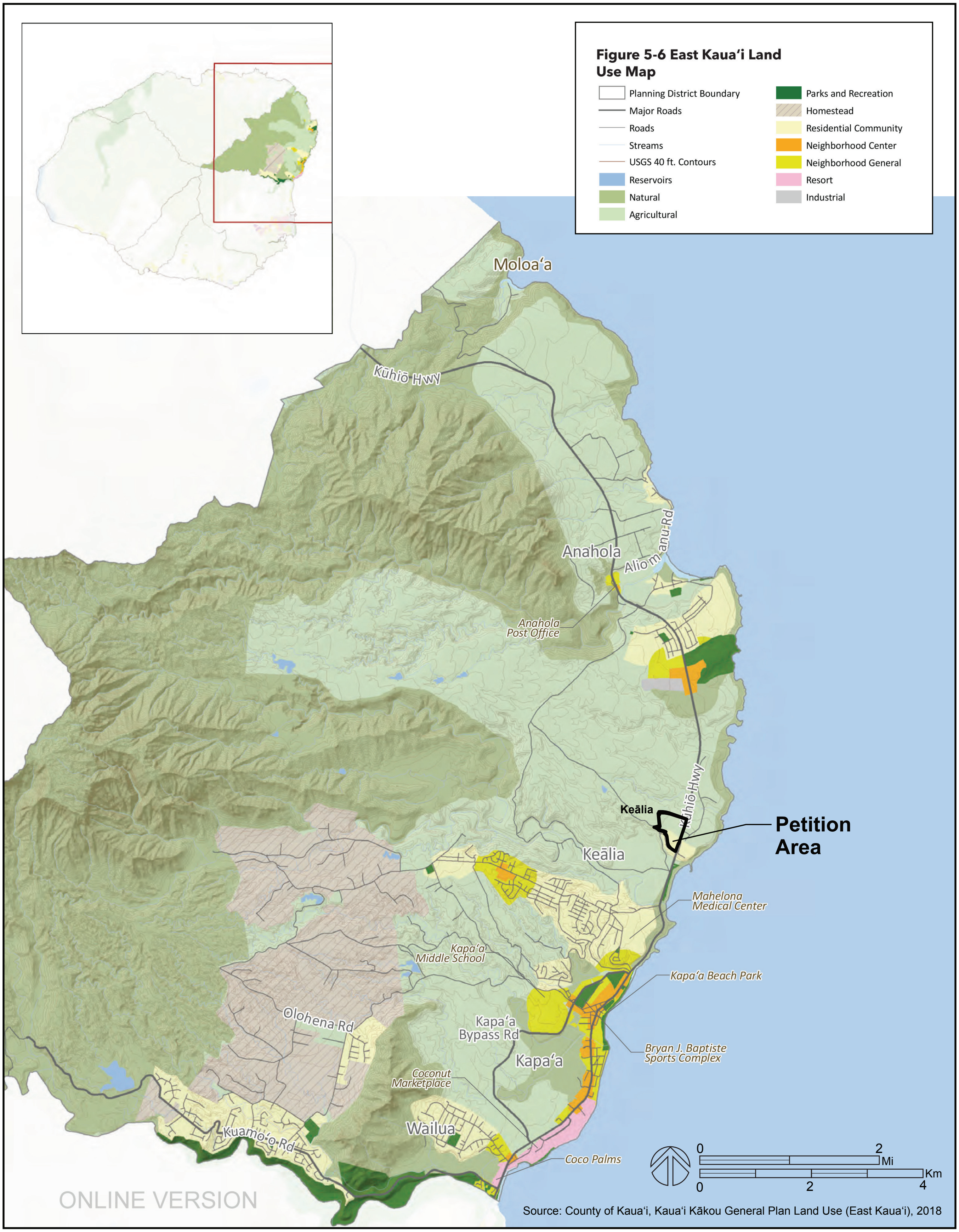
(3) It shall include lands with satisfactory topography, drainage, and reasonably free from the danger of any flood, tsunami, unstable soil condition, and other adverse environmental effects;

Discussion: The Petition Area is readily developable with satisfactory topography and drainage and is free from natural hazard potential such as flooding or tsunami inundation. The proposed infrastructure improvements are not expected to increase susceptibility to natural hazards or have other adverse environmental effects.

(4) Land contiguous with existing urban areas shall be given more consideration than non-contiguous land, particularly when indicated for future urban use on state or county general plans or county community plans or development plans;

Discussion: The Petition Area is immediately adjacent to the existing 36-lot Kaʻao single family subdivision, and includes an area formerly used for plantation housing. There are also three residential lots on Hopoe Road. Another residential community is located on Kamole Road on the *makai* side of Kūhiō Highway. The oceanfront Keālia Kai is a luxury subdivision located adjacent to Keālia Beach Park. In 2016, the County of Kauaʻi determined that the Proposed Action was consistent with the County General Plan Land Use Plan, which identified the project area as "Residential Community." The 2018 Kauaʻi Kākou Kauaʻi County General Plan (County of Kauaʻi, 2018) was recently approved by the County Council and signed into law by Mayor Bernard Carvalho Jr. on March 15, 2018. The updated General Plan Land Use Plan for East Kauaʻi, shown in Figure 5-2, likewise identifies the project area vicinity for "Residential Community," (see discussion of standard (5) below).

(5) It shall include lands in appropriate locations for new urban concentrations and shall give consideration to areas of urban growth as shown on the state and county general plans or county community plans or development plans;



Kauaʻi General Plan Land Use Map (Kawaihau Planning District) **Figure 5-2**

Discussion: The State Land Use and County zoning maps show most of the project area designated for agriculture use. The 2000 Kauaʻi County General Plan Land Use Map (Kawaihau Planning District), showed the northern portion of the planning area as Agriculture and the southern portion (which abuts the Kaʻao subdivision) as Residential Community. In a Boundary Interpretation for General Plan Designation (Departmental Determination DD-2016-70) dated July 6, 2016 (see Appendix A), the Planning Department stated "there is clear intent in the 2000 General Plan, along with previous iterations of the plan, that the [Petition] area generally is earmarked for "Residential Community" growth adjacent to the existing subdivision in Keālia above the Keālia General Store." That is, the proposed residential use is consistent with the intent of the General Plan Land Use Map.

The recently updated General Plan, Kauaʻi Kākou (County of Kauaʻi, 2018) Land Use Plan for East Kauaʻi shows a similar Residential Community designation as the 2000 Plan. As determined by the Planning Department's Boundary Interpretation of July 6, 2016, the Proposed Action is consistent with the 2018 updated General Plan.

The 53.4 acre project area was also used historically as a plantation camp (New Kumukumu Camp). This plantation camp included improved roads, water and communications infrastructure, and buildings, and remnants of these structures remain today.

The Kauaʻi County zoning map, shown in Figure 5-3 shows the majority of the Petition Area in the Agricultural zone, which is consistent with its location in the State Agricultural District. The zoning map shows small portions of the project area that abut the Kaʻao Road subdivision within the Residential zone, although this may be a mapping discrepancy.

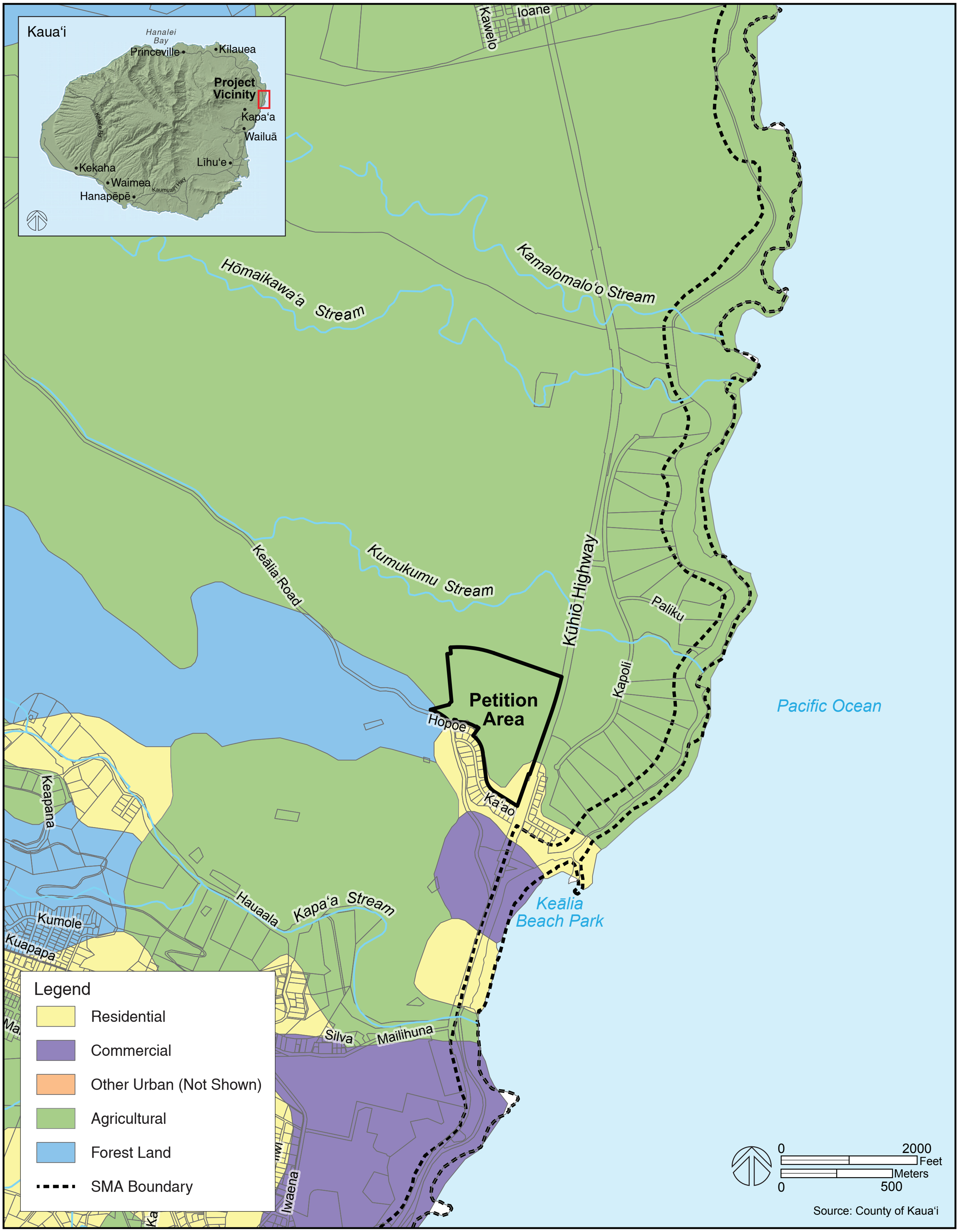
(6) It may include lands which do not conform to the standards in paragraphs (i) to (5): (A) When surrounded by or adjacent to existing urban development; and (B) Only when those lands represent a minor portion of this district;

Discussion: The Petition Area is located adjacent to an existing urban development (residential subdivision) and was determined by the County Planning Department to be consistent with the General Plan Land Use designation as Residential Community.

(7) It shall not include lands, the urbanization of which will contribute toward scattered spot urban development, necessitating unreasonable investment in public infrastructure or support services; and

Discussion: The Petition Area is adjacent to an existing residential use and will not contribute to scattered spot urban development. The Petitioner will construct or participate in developing all additional infrastructure required to service the subdivision. Public (and private) infrastructure and support services are located within reasonable proximity, and are adequate to accommodate the subdivision. It is anticipated that most, if not all future residents of the homesites are current Kauaʻi residents, already being served by community service such as schools, hospitals, and police and fire protection. The Proposed Action will not cause a significant increase in the number of new residents needing public services. Out of 700 projected subdivision residents, 658 are expected to be existing Kauaʻi residents. The other 42 persons may be vacation/second homeowners new to Kauaʻi (CBRE, 2017).

(8) It may include lands with a general slope of twenty percent or more if the commission finds that those lands are desirable and suitable for urban purposes and that the design and construction controls, as adopted by any federal, state, or county agency, are adequate to protect the public health, welfare and safety, and the public's interests in the aesthetic quality of the landscape.



County Zoning and Special Management Area **Figure 5-3**

Keālia Mauka Homesites

Draft Environmental Impact Statement

Kealia Properties, LLC

Discussion: The Petition Area does not include any lands with slopes above 20 percent. The land slopes gradually upward from Kūhiō Highway to the *mauka* most areas, with slopes about 3 percent.

5.1.2 Environmental Impact Statements (Chapter 343, HRS)

A Chapter 343 environmental review is required due to the project's use of State of Hawaiʻi and County of Kauaʻi lands associated with infrastructure improvement within public roadways, including Kūhiō Highway and Keālia Road.

5.1.3 State Environmental Policy (Chapter 344, HRS)

5.1.3.1 Environmental Policy

The purpose of HRS Chapter 344 is to establish a state policy which will encourage productive and enjoyable harmony between people and their environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii. Chapter 344 sets the policy of the state through its programs, authorities and resources to:

(1) Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii.

(2) Enhance the quality of life by:

(C) 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; and

Discussion: The Proposed Action is intended to create a new residential community and provide housing opportunities for local residents, addressing the island's unmet housing demand. The proposed site is appropriate for development in physical characteristics and location. Short-term, construction period impacts to air quality, noise and water quality will be addressed through construction best management practices (BMP).

5.1.3.2 Environmental Guidelines

In pursuance of the state policy to conserve the natural resources and enhance the quality of life, all agencies, in the development of programs, shall, insofar as practicable, consider guidelines related to 1) population; 2) land, water, mineral, visual, air and other natural resources; 3) flora and fauna; 4) parks, recreation and open space; 5) economic development; 6) transportation; 7) energy;, 8) community life and housing; 9) education and culture; and 10) citizen participation. The proposed Keālia Mauka project is consistent with the following guidelines:

(2) Land, water, mineral, visual, air, and other natural resources.

(A) Encourage management practices which conserve and fully utilize all natural resources

Discussion: The proposed subdivision will be designed and constructed in accordance with sound management practices. Construction BMPs will be employed to address construction period noise, dust, and stormwater runoff. Extensive grading or cut and fill is not required. There are no wetlands, flood prone areas, or sensitive natural resources on the site. There will be no adverse impact to federally listed species. Vegetated detention basins will be included on site to control stormwater runoff and provide green open space areas.

(8) Community life and housing.

(A) Foster lifestyles compatible with the environment; preserve the variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods which reflect the culture and mores of the community;

(B) Develop communities which provide a sense of identity and social satisfaction in harmony with the environment and provide internal opportunities for shopping, employment, education, and recreation;

(D) Foster safe, sanitary, and decent homes;

Discussion: The purpose of the Proposed Action is to provide residential lots targeted to Kauaʻi residents. By selling vacant lots, buyers will be able to construct their own homes according to their preferences and at a time most appropriate for their individual situation. This supports the guidelines of preserving lifestyles tradition to Hawaiʻi and creating neighborhoods that reflect the culture and mores of the community. The project's East Kauaʻi location, in proximity to Kapaʻa Town and its supporting services, provides future residents with opportunities for shopping, employment, education, and recreation.

5.1.4 Hawaiʻi State Plan (Chapter 226, HRS)

The Hawaiʻi State Plan, embodied in Chapter 226 HRS, serves as a guide for the future long-range development of the State of Hawaiʻi. The State Plan identifies goals, objectives, policies, and priorities for the development and growth. It provides a basis for prioritizing and allocating the limited resources such as public funds, services, human resources, land, energy, and water.

The Proposed Action conforms to most applicable goals, objectives, policies and priority guidelines of the Hawaiʻi State Plan. The following analyzes project impacts with respect to relevant State Plan goals, objectives, policies and priority guidelines.

5.1.4.1 Section 226-5, Objectives and policies for population

Objective: It shall be the objective in planning for the state's population to guide population growth to be consistent with the achievement of physical, economic and social objectives contained in this chapter.

Policies:

(b)(1) 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.
(b)(3) Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.

Discussion: The proposed subdivision will provide residential lots from 5,600 SF to 7,300 SF in size, and is intended to address the County's residential inventory shortage, responding to the social and economic aspirations of Kauaʻi residents. These lots will be sized and priced to target Kauaʻi residents and will thereby increase opportunities for families to attain the goal of homeownership.

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

Objectives: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaiʻi's scenic assets, natural beauty, and multicultural/ historical resources.

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

Policies:

(b)(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
(b)(3) Take into account the physical attributes of areas when planning and designing activities and facilities.
(b)(4) Manage natural resources and environs to encourage their beneficial and multiple uses without generating costly or irreparable environmental damage.

Discussion: The proposed subdivision is not located on the shoreline. It will incorporate principles of sound physical planning to manage natural resources and to protect the environment. Installation of roads and utilities infrastructure will take into account the physical attributes of the site. Best management practices will be implemented during site work to reduce and minimize erosion and runoff. The inclusion of two detention basins on site will detain off-site flows and allow particulates and pollutants to settle out. One of the detention areas will also serve as a park for passive recreation, and an open space buffer for the adjacent subdivision. This will mitigate the potential adverse effects of changing land use from agriculture/grazing/fallow to urban development. With the detention basins, there will be no net increase in existing flows during storm conditions. There will be no net increase in runoff from the site and no adverse impacts to nearshore coastal waters.

5.1.4.3 Section 226-12, Objective and policies for the physical environment--scenic, natural beauty, and historic resources.

Objective: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai'i's scenic assets, natural beauty, and multicultural/ historical resources

Policies:

(b)(1) Promote the preservation and restoration of significant natural and historic resources.
(b)(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.
(b)(4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage

Discussion: The Petition Area is not part of a scenic corridor or public view shed. The subdivision will not be visible from the Keālia shoreline. Although the future homes will interfere with the *mauka* view from a short section of Kūhiō Highway, this will only be visible for a few seconds from a passing car. Much of the *mauka* view along this stretch of highway is already obscured by existing vegetation. The open space views from Keālia Road looking toward the site will be altered, especially for residents of the adjacent Ka'ao Road subdivision. The project proposes a green space buffer between the Ka'ao Road subdivision and the project to mitigate this visual impact.

The area and its surrounding lands were used for commercial sugar cultivation and operations for much of the twentieth century, and archaeological studies have identified a number of historic remnants associated with that use on the site. A prior Archaeological Inventory Survey that included the current Petition Area (Drennan et al., 2006) project area recommended no additional archaeological work.

The Literature Review and Field Inspection (LRFI) for the project conducted by Cultural Surveys Hawai'i (2017) concluded that the Proposed Action will require the removal of two historic properties associated with modern agricultural activities. This is an adverse impact but no further archaeological work is recommended. In the event that any significant archaeological resources are encountered during future construction activities, all work in the immediate area will be halted and consultation with SHPD sought in accordance with applicable regulations. The treatment of any remains or artifacts will be in accordance with procedures required by the Kaua'i Historic Preservation Review Commission and the Kaua'i-Ni'ihau Island Burial Council.

5.1.4.4 Section 226-13, Objectives and policies for the physical environment--land, air, and water quality.

Objectives: Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:

(1) Maintenance and pursuit of improved quality in Hawai'i's land, air, and water resources.

(2) Greater public awareness and appreciation of Hawai'i's environmental resources.

Policies:

(b)(2) Promote the proper management of Hawaiʻi's land and water resources.
(b)(3) Promote effective measures to achieve desired quality in Hawaiʻi's surface, ground and coastal waters.
(b)(4) Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaiʻi's people.
(b)(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.
(6) Encourage design and construction practices that enhance the physical qualities of Hawaiʻi's communities.
(b)(7) Encourage urban developments in close proximity to existing services and facilities.

Discussion: The Keālia Mauka Homesites will incorporate design principles and features that promote water and energy conservation. The project site is located outside of the flood and tsunami hazard areas. It is not within the County's dam evacuation area. The subdivision plan includes open space areas to provide stormwater retention on site, and which will also provide residents with passive recreation and open space. The project site is within proximity to and compatible with existing residential development, and is convenient to existing public services and facilities in the Kapaʻa region.

5.1.4.5 Section 226-15, Objectives and policies for facility systems—solid and liquid wastes.

Objectives: Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:

> (1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.
>
> (2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.

Policies:

(b)(1) Encourage the adequate development of sewerage facilities that complement planned growth.

Discussion: The subdivision will connect to the County's Wailua-Kapaʻa wastewater collection system. Residential solid waste will be collected by the County, as is done at the adjacent Kaʻao subdivision. No adverse impacts are anticipated.

5.1.4.6 Section 226-16, Objectives and policies for facility systems--water.

Objectives: Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.

Policies:

(b)(1) Coordinate development of land use activities with existing and potential water supply.

Discussion: Existing residential uses in the vicinity, including lots along Ka'ao and Hopoe Road, are served by a private domestic water system (Keālia Water System), owned by the Keālia Water Company Holdings LLC. The Petitioner has an agreement with the Keālia Water Company to reserve potable water service for future homeowners in the Petition Area. The allocation under the existing water agreement will be adequate to provide for the project's water requirement.

5.1.4.7 Section 226-19, Objectives and policies for socio-cultural advancement--housing.

Objectives: Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives:

(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more rental and for sale affordable housing is made available to extremely low-, very low-, lower-, moderate-, and above moderate-income segments of Hawaii's population.

(2) The orderly development of residential areas sensitive to community needs and other land uses.

Policies:

(b)(1) Effectively accommodate the housing needs of Hawaii's people.
(b)(2) Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.
(b)(3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.
(b)(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.
(b)(6) Facilitate the use of available vacant, developable and underutilized urban lands for housing.
(b) (7) Foster a variety of lifestyles traditional to Hawai'i through the design and maintenance of neighborhoods that reflect the culture and values of the community.

Discussion: The purpose of the Proposed Action is to help satisfy the need for housing on the island of Kaua'i, by providing residential lots that are targeted specifically to local residents. The Proposed Action will provide approximately 235 workforce and market housing units. This will help alleviate a projected housing shortfall that will not be met by other planned developments in the Līhu'e/East Kaua'i region.

The proposed lots are consistent with typical densities in the island's existing single family residential communities, and respond to local market preferences. Offering improved, developable lots with infrastructure gives buyers the opportunity to construct the type of house that best meets their needs, within their price range and timetable. There may also be bulk purchasers who will construct the finished homes and offer them for sale, providing another alternative for prospective homeowners. The proposed project will be in compliance with the Housing Policy for the County of Kauaʻi, Ordinance No. 860, including the requirement for workforce housing.

The Petition Area is former agricultural land that is underutilized, and currently serving as pasture with minimal social or economic benefit to the overall region. There will still be more than adequate remaining pasture land in the surrounding area. The location of the Petition Area is convenient to commercial activities and a range of public services. It is also convenient to major employment centers in Kapaʻa, Līhuʻe and other areas of east Kauaʻi.

5.1.5 State Functional Plans

The Statewide planning system requires the development of State Functional Plans which are approved by the Governor of Hawaiʻi. The State Functional Plans set for the policies, statewide guidelines, and priorities within a specific field of activity. They are intended to guide State and County actions in the areas of agriculture, conservation lands, education, energy, health, higher education, health, historic preservation, housing, recreation, tourism, and transportation.

The State Functional Plan most applicable to the proposed Keālia Mauka project is the State Housing Functional Plan, updated in 2017. The update of the Housing Functional Plan was coordinated by the Hawaiʻi Housing Finance and Development Corporation and under the guidance of the Office of Planning and the Special Action Team on Affordable Rental Housing, which was established by Act 127, Session Laws of Hawaiʻi 2016. The Plan presents a balanced set of strategies and implementing actions directed toward meeting Hawaiʻi's housing needs.

The Plan identifies several issue areas including rental housing, homeownership, and impediments to residential development. For each of these issue areas, the Plan identifies objectives, policies, and implementing actions. There are two issue areas applicable to the proposed project: Homeownership and Impediments to Residential Development. These are discussed below.

5.1.5.1 Housing Functional Plan

Issue Area: Homeownership

According to the Housing Functional Plan, research shows that homeownership has positive impacts on the stability of communities as families support and nurture their homes and surrounding neighborhoods. Yet it notes that homeownership in Hawaiʻi has been falling steadily since 2006, due to a number of obstacles including 1) college debt and student loans; 2) not making enough money to purchase a home; 3) not enough money for a down payment and closing costs; 4) low housing inventory and new construction increasingly catering to wealthier buyers; 5) tight credit; and 6) high rent burdens, making it difficult to save (HHFDC, 2017). The Plan states that the impact of a slow economic recovery falls heaviest on first-time buyers, and it is their entry to the market that boosts the homeownership rate.

> ***Objective: Increase the homeownership rate***
>
> Policy B(3): Ensure that housing projects provide a fair share of affordable for-sale housing opportunities.

Implementing Action B(3)(a): Impose realistic and fair housing requirements on projects that seek Urban land use designations, general or development plan amendments, zoning, or development permits.

Discussion: The primary objective of the Proposed Action is to offer opportunities for homeownership to Kauaʻi residents. The market study conducted for the Keālia Mauka project (CBRE, 2017) estimates that there will be demand for 7,447 additional housing units in the East Kauaʻi region between 2017 and 2040, with about two-thirds of the demand for single family households (4,928 homes). Even with currently proposed housing inventory, there will still be a shortfall of more than 2,000 single family homes/lots. The Keālia Mauka Homesite project will help alleviate the shortfall, and provide up to 235 improved house lots for sale. The lots have been sized and will be priced to offer a range of market and workforce housing products to Kauaʻi residents in compliance with the requirements of the County's housing policy, Ordinance No. 860.

5.1.6 Hawaiʻi Coastal Zone Management Program

The federal Coastal Zone Management (CZM) Program was created through the passage of the Coastal Zone Management Act of 1972 to protect, preserve, develop, restore, and enhance the resources of the nation's coastal zone for current and future generations. Hawaiʻi's Coastal Zone Management Program, adopted as Chapter 205A, HRS, provides a basis for protecting, restoring, and responsibly developing coastal communities and resources.

The State's CZM area includes all lands of the State and the area extending seaward of the shoreline. Each county is required to establish special management areas (SMA) and shoreline setbacks within which permits are required for development. The proposed project is not located within the County's designated SMA or shoreline setback area.

The project's compliance with CZM program objectives is discussed below:

5.1.6.1 Recreational Resources

Objective: *Provide coastal recreational opportunities accessible to the public.*

Discussion: The policies supporting this objective pertain mainly to shoreline resources and access. The proposed project is located across Kūhiō Highway from the coast, but will include open space areas within the project site and is easily accessible to coastal recreational resources, including the Ke Ala Hele Makalae Coastal Path which runs along Keālia Beach. The proposed action is not in conflict with any recreational resources policy.

5.1.6.2 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.*

Discussion: Due to the historic agricultural use of the project site for most of the twentieth century, the Petition Area is relatively clear of significant historic sites. The recent LRFI identified five historic features that are associated with previously designated "New Kumukumu Plantation Camp" (SIHP# 50-30-08-7013). The Petition Area was part of a previous Archaeological Inventory Survey (AIS) that recommended no further archaeological work at this historic property, and no additional work is recommended. Consultation with SHPD is being conducted to obtain concurrence that the Petition Area has been adequately addressed in the prior AIS.

5.1.6.3 Scenic and Open Space Resources

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

Discussion: The creation of a residential subdivision on undeveloped land that has been used in agriculture and pasture for the last 100 years will impact scenic and open space resources. The Proposed Action will modify the open space views from the adjacent Kaʻao subdivision, and will briefly be visible from sections of Kūhiō Highway and Keālia Road. The visual appearance of the property will be transformed from an open, undeveloped pasture to an urbanized residential area. Visual impacts to the Kaʻao Road subdivision will be mitigated by the installation of a detention basin/open space area. Policies supporting the CZM scenic and open space objective pertain mainly to shoreline views and open space. The project will not alter shoreline views and is not visible from the Keālia shoreline or the Ke Ala Hele coastal path. The proposed action is not in conflict with any Scenic and Open Space policies.

5.1.6.5 Coastal Ecosystems

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

Discussion: The Petition Area is located on the *mauka* side of Kūhiō Highway, more than 1,000 feet from the shoreline. Development of the site for residential lots will not impact the quantity or quality of surface water entering the ocean. The Proposed Action will comply with all federal, state and County of Kauaʻi water quality regulations during construction and operation. The Petitioner will prepare drainage and erosion control plans, and follow construction best management practices during site work. Two drainage detention basins are proposed on site to detain off and on-site flows and allow particulates and pollutants to settle out of the water column. These actions will mitigate any potential adverse effects resulting from the proposed transition from agriculture/grazing land use to urban development. The Proposed Action is not in conflict with any Coastal Ecosystems polices.

5.1.6.6 Economic Uses

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

Discussion: The Proposed Action does not involve coastal dependent development and this Economic Uses category is not applicable.

5.1.6.7 Coastal Hazards

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

Discussion: The Petition Area is not within an identified flood hazard area or area known for subsidence or erosion. It is not within the tsunami evacuation zone. The proposed on- and off-site drainage improvements will mitigate runoff from the site, and there will be no net increase in runoff. There will be no increase in erosion, subsidence or pollution as a result of the project. The Proposed Action is not in conflict with any Coastal Hazards policies.

5.1.6.8 Managing Development

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

Discussion: The Petitioner is seeking a State Land Use Commission Boundary Amendment, and an Environmental Impact Statement is being prepared. This Draft EIS provides an analysis of the project's anticipated environmental impacts, and will undergo extensive public review and comment.

5.1.6.9 Public Participation

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

Discussion: As mentioned above, the environmental review process will include opportunities for government agencies and citizens to provide their input on the proposed subdivision. The Proposed Action is not in conflict with any public participation policies.

5.1.6.10 Beach Protection

Objective: *Protect beaches for public use and recreation.*

Discussion: The Petition Area is located across Kūhiō Highway more than 1,000 feet from the shoreline. The Proposed Action will not interfere with shoreline access or activities, or with beach recreation. The Proposed Action will not increase beach erosion. It is not in conflict with the policies supporting beach protection, which pertain primarily to shoreline development.

5.1.6.11 Marine Resources

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

Discussion: The Petition Area is located across Kūhiō Highway, more than a 1,000 feet from the shoreline. There are no streams within the property. The development will include detention basins on site to capture stormwater runoff and allow pollutants to settle out. There will be no net increase in runoff from the site. During the construction of subdivision improvements, best management practices will be followed. Vacant lots will be seeded and grassed to avoid bare surfaces and runoff which could impact marine water quality. Lot purchasers will also be required to implement BMPs prior to and during construction on their individual lots. The Proposed Action is not in conflict with the policies supporting marine resources.

5.1.7. Sustainability

Pursuant to Act 181, Session Laws of Hawaii 2011, the Hawaii State Planning Act provides the policy framework establishing sustainability as a state priority. Under the Act, Sustainability is defined as follows:

- Respect of the culture, character, beauty, and history of the State's island communities;

- Striking a balance between economic, social, community, and environmental priorities; and
- Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Priority guidelines and principles to promote sustainability shall include:

(1) Encouraging balanced economic, social, community, and environmental priorities;

(2) Encouraging planning that respects and promotes living within the natural resources and limits of the State;

(3) Promoting a diversified and dynamic economy;

(4) Encouraging respect for the host culture;

(5) Promoting decisions based on meeting the needs of the present without compromising the needs of future generations;

(6) Considering the principles of the *ahupuaʻa* system; and

(7) Emphasizing that everyone, including individuals, families, communities, businesses, and government, has the responsibility for achieving a sustainable Hawaii.

In considering the Petitioner's application for a land use district boundary amendment, the State Land Use Commission will consider the principles and priority guidelines for sustainability. The following four areas must be addressed in a sustainability plan:

5.1.7.1 Sustainable Development

This is the project's contribution to creating a high quality of life and a mutually supportive balance among environmental, economic, and social equity concerns.

Discussion: The Proposed Action will create 235 residential lots to address an existing and future shortfall of housing in East Kauaʻi. This responds to market demand and supports quality of life for local residents. The subdivision is located adjacent to an existing residential area, on land identified for residential community use by the Kauaʻi General Plan. The site will be converted from grazing use, but there is ample surrounding land to support these activities. The Proposed Action will comply with the County's Housing Policy (Ordinance 860) for work force housing, addressing social equity concerns. The Proposed Action provides a mutually supportive balance among environmental, economic and social equity concerns.

5.1.7.2 Smart Growth and Livability Principles

There are ten smart growth and livability principles which land use related activities should consider. The Proposed Action is consistent with the following principles:

> **2. Promote equitable, affordable housing**. Expand location- and energy-efficient housing choices for people of all ages, incomes, races, and ethnicities to increase mobility and lower the combined cost of housing and transportation.
>
> **6. Value communities and neighborhoods**. Enhance the unique characteristics of all communities by investing in healthy, safe, and walkable neighborhoods.

7. Compact Building Design. Design communities to preserve more open space with compact building designs that make efficient use of land and resources.

8. Preserve open space, farmland, natural beauty, and critical environmental areas. Preserve natural areas that provide important community space, habitat for plants and animals, recreational opportunities, places of natural beauty, and critical environmental areas. Protect farm and agricultural lands and promote locally grown foods.

10. Preserve and perpetuate our island cultural values. Consider the *ahupuaʻa* management concept to integrate resource management decisions from the mountains to the sea.

Discussion: The Proposed Action directly supports Principle 2 by providing residential lots targeted to local residents, and meeting the County's work force housing requirements. The Proposed Action is located adjacent to an existing residential neighborhood in an area designated by the General Plan for residential use, consistent with Principle 6. Principles 7 and 8 call for compact design and the preservation of open space. Lot sizes have been kept below 10,000 SF to keep prices within reach of local families, and also to minimize the visual and environmental impact on the surrounding agricultural land and open space. The offering of improved lots responds to market preferences and allows buyers to design and construct their own homes as desired, in accordance with Principle 10.

5.1.7.3 Resource Conservation

Energy Efficiency – incorporate energy efficiency measures in the design, construction, and operation of project/site, infrastructure, and buildings, and use renewable energy generation.

Water Efficiency – incorporate water efficiency measures in the design, construction, and operation of project/site, infrastructure, and buildings, including irrigation and landscaping, and use of non-potable water.

Waste Management – implement solid and liquid waste management, recycling, and reuse.

Low Impact Development – incorporate site design, green infrastructure, and structural best management practices to increase on-site infiltration and reduce off-site flows and pollution from stormwater runoff.

Climate Change and Hazard Mitigation – provide mitigation and adaptation strategies to address the potential risks from natural or man-made hazards, including new or intensified hazards resulting from climate change. These include sea-level rise, hurricanes, tsunamis, drought, wildfires, storm flooding, and coastal erosion.

Discussion: The Proposed Action includes the provision of infrastructure improvements including roads and utilities. Drainage improvements include two detention basins that provide open space and will reduce off-site flows and stormwater runoff. The Petition Area is not within an area vulnerable to natural hazards such as flood, dam flooding, tsunami, coastal hazards. The individual lot buyers will be responsible for constructing their own homes, but will be encouraged to utilize energy efficient design, water efficient features, and renewable energy.

5.1.7.4 Green Building Standards

Hawaii's overall goal for energy efficiency is to meet the Energy Efficiency Portfolio standard of 30% by reducing electricity demands by 2030. The use and pursuit of green building standards such as U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) or similar are encouraged in attaining sustainable community and building designs.

Discussion: Subdivision roads will have sidewalks and access to a green space for passive recreation, encouraging residents to walk within the subdivision. The Petition Area is within a mile of the Ke Ala Hele Makalae multi-use coastal path. However, a major constraint to increased use of sustainable transportation modes such as walking, bicycling and public transit will continue to be the physical conditions of Keālia Road. This two-lane road is narrow, curved and somewhat steep between the subdivision and Kūhiō Highway. It is unlikely that many residents will walk or bike directly from the subdivision down to Kūhiō Highway, where there are bus stops, or to the coast where the multi-use path is located.

Individual lot purchasers will be responsible to construct their homes. Buyers will be encouraged to incorporate green building practices and energy efficient features.

5.2 COUNTY OF KAUAʻI

5.2.1 County General Plan

The County of Kauaʻi General Plan was adopted in 1971 and updated in 1982, 2000, and most recently, in 2018. *Kauaʻi Kākou, Kauaʻi County General Plan* was completed and signed into law by Mayor Bernard Carvalho, Jr. in March 2018.

Pursuant to the provisions of the Charter for the County of Kauaʻi, the General Plan establishes priorities for managing growth and community development over a 20 year planning timeframe, The General Plan guides future action regarding land use and development regulations, urban renewal, and expenditure for capital improvements. The General Plan covers six planning districts on the island; the Project Area is within the East Kauaʻi district.

The General Plan identifies nineteen policies to guide growth and address the issues most important to Kauaʻi residents in the face of existing issues and future growth:

1. Manage growth to preserve rural character
2. Provide local housing
3. Recognize the identify of Kauaʻi's individual towns and districts
4. Design healthy and complete neighborhoods
5. Make strategic infrastructure investment
6. Reduce the cost of living
7. Build a balanced multimodal transportation system
8. Protect Kauaʻi's scenic beauty
9. Uphold Kauaʻi as a unique visitor destination
10. Help business thrive
11. Help agricultural lands be productive
12. Protect our watersheds
13. Complete Kauaʻi's shift to clean energy

14. Prepare for climate change
15. Respect Native Hawaiian rights and wahi pana
16. Protect access to Kauaʻi's treasured places
17. Nurture our keiki
18. Honor our kupuna
19. Communicate with aloha

The proposed Keālia Mauka Homesites project directly responds to the policy to provide local housing. In the General Plan's discussion of the Housing sector, it notes that housing affordability for local residents has reached a crisis level with far-ranging social impacts. Home prices exceed 300 percent of the national average. Lack of housing supply has been due in part to the effects of the Great Recession of 2007-2009. The results at the household level include stress, reduced disposable income, and limit transportation options. The General Plan states that public and private partnerships must work together to ensure that increases in housing inventory will be affordable to residents (County of Kauaʻi, 2018).

The Market Study conducted for the Proposed Action estimated the demand for new housing units in Līhuʻe/East Kauaʻi will range from 6,654 to 8,240 units by 2040, with a midpoint of 7,447. A shortfall of more than 3,500 standard residential units is projected in the study corridor through 2040. The regional single-family sector will be underserved by more than 2,000 homes/lots (CBRE, 2017).

The Proposed Action will provide additional housing inventory by allowing residents to purchase a vacant lot and design and build a home that suits their needs and budget, consistent with the General Plan. The lots will be priced to meet the requirements of the Housing Policy for the County of Kauaʻi (Ordinance No. 860, November 20, 2007).

The Proposed Action will also support a jobs and businesses through the provision of construction employment, and secondary economic effects. This is discussed in the discussion of Social and Economic Factors in Chapter 4 of this DEIS.

5.2.1.2East Kauaʻi Land Use Map Designation

The Petition Area is located within the 2018 Kauaʻi Kākou General Plan's East Kauaʻi Planning District. The Land Use map for East Kauaʻi shows an area identified on the legend as "Residential Community" that straddles both sides of Kūhiō Highway in the project vicinity. This portion of the land use map has not changed since the 2000 General Plan (Kawaihau District Land Use Map). Because the Land Use Maps are conceptual and do not include parcel lines, the Petitioner requested clarification from the County in 2016.

5.2.1.3 Boundary Interpretation for General Plan Designation

In June 2016, the Petitioner, Keālia Properties, LLC, requested a Boundary Interpretation for General Plan Designation from the County of Kauaʻi Planning Department. The interpretation was requested "for the purpose of applying for, communicating, processing, and securing information and permits related to development and regulatory interest of the owner in the County of Kauaʻi." The Planning Department was asked to determine whether the 2000 General Plan Land Use Map for the Kawaihau District could be interpreted to be consistent with the proposed Keālia Homesites subdivision.

The request noted that according to the General Plan document, the General Plan is intended to be a direction setting policy document, and is not intended to be regulatory in the sense of a zoning code or other land use regulation. The applicant's letter stated the following:

> Clearly, the policy for the land identified in yellow on the Kawaihau Planning District Land Use Map in the vicinity of Ka'ao Road is intended as a general guideline to establish a larger pattern of residential development than currently exits. We believe the proposed subdivision on about 50 acres, which includes about 230 lots that average about 6,000 square feet in size, is consistent with the intent of the General Plan, due to its location in relation to the Residential Community designation on the Land Use Map…
>
> …In summary, we believe this request is appropriate for the following reasons:
>
> - The proposed subdivision is consistent with the location of a "Residential Community" designation on the Kawaihau Planning District Land Use Map
> - The proposed subdivision is located adjacent to an existing residential subdivision
> - The vicinity was used for expanded residential purposes to support the Makee Sugar Plantation (later absorbed by the Līhu'e Sugar Plantation) through the 1960s
> - The average lot size of the proposed subdivision is targeted for local residents, addressing a need identified in the General Plan to provide a mix of housing opportunities on Kaua'i
> - The additional housing inventory partially satisfies a shortfall in needed housing units recognized by the General Plan.

In a Departmental Determination (DD-2016-70) dated July 5, 2016 [Boundary Interpretation for General Plan Designation, TMK (4) 4-7-004:001] (Appendix A) the County Planning Department stated that *"there is clear intent in the 2000 General Plan, along with previous iterations of the plan, that the area generally is earmarked for 'Residential Community' growth adjacent to the existing subdivision in Keālia above the Keālia General Store…The proposed Conceptual Keālia Subdivision would generally be in alignment with the General Plan's land use maps and texts."*

In summary, the land use map for the Petition Area in the current Kaua'i Kākou 2018 General Plan has not changed since the 2000 General Plan. It is assumed that the County's July 5, 2016 Boundary Interpretation remains valid. The Keālia Mauka Homesites is consistent with the intent of the General Plan land use maps.

5.2.2 East Kauaʻi Development Plan

Development Plans are intended to direct physical development and public improvements within a specific geographic area of Kauaʻi County within the framework of the General Plan. Kauaʻi County is currently updating the Kapaʻa-Wailua Development Plan, renamed the East Kauaʻi Development Plan (EKDP). East Kauaʻi covers the area from the Wailua Golf Course to Moloaʻa, from the mountains to the coastline, and include the Keālia Mauka area. A draft of the updated EKDP is currently being reviewed by the County.

5.2.3 County Zoning

The County of Kauaʻi's Comprehensive Zoning Ordinance (CZO) provides regulations and standards for land development and the construction of buildings and other structures in the County of Kauaʻi. These regulations and standards prescribed are intended to regulate development to ensure its compatibility with the overall character of the island. The CZO was initially adopted in 1972. Since that time, there have been several amendments to specific provisions. The County concluded the first of two phases of an effort to update the CZO with amendments adopted on December 3, 2012 (Ordinance No. 935). Ordinance No. 935 is the newly adopted zoning code for the County of Kaua'i and will serve as the official zoning code until the County completes the second phase of the project.

Discussion: The Petition Area is zoned agriculture by the County of Kauaʻi. This zoning is consistent with the Petition Area's current State Land Use designation as Agricultural District. The General Plan for Kauaʻi and the Kapaʻa Town Development Plan both designate the general project area as Urban Center. As discussed above, in a Departmental Determination (DD-2016-70 dated July 5, 2016), the Planning Department determined that the Petition Area is within the general area earmarked for residential community growth, and that the Keālia Mauka project would generally be in alignment with the General Plan land use maps.

Following the State Land Use District Boundary Amendment (from Agricultural to Urban), a zone change application will be initiated to change the zoning designation to R-6 Residential District. Given the size of the proposed lots, no more than one single family dwelling unit will be allowed to be developed on each lot.

5.2.4 Special Management Area (SMA)

The Hawaiʻi Coastal Zone Management Program embodied in Chapter 205A, HRS contains the general objectives and policies to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawaiʻi. Each County has structured specific legislation and designated Special Management Areas (SMA) and Shoreline Setback Areas, designated for more intensive management. Any development within the SMA requires a SMA Use Permit. The SMA boundary in the project area is shown on Figure 5-3. The project site is outside the SMA area.

5.2.5 Housing Policy for the County of Kauaʻi (Ordinance 860)

5.2.5.1 Ordinance 860

Ordinance No. 860, adopted by the Kauaʻi County Council in November 2007, established a County housing policy in furtherance of the goals and objectives identified for the Kauaʻi County Housing Agency in Section 2-1.16 of the Kauaʻi County Code 1987. Ordinance 860 amended the Kauaʻi County Code by inserting a new chapter, Chapter 7A, entitled "Housing Policy for the County of Kauaʻi."

Chapter 7A, Kauaʻi County Code requires that a portion of residential and resort developments on Kauaʻi include "workforce housing," defined as dwelling units that "may be rented or sold at price levels that are affordable to households that earn from eighty percent (80%) and below of the Kauaʻi median household income to one hundred forty percent (140%) of the Kauaʻi median household income." Specific household income limits and sales/rental prices that meet these categories are established each year by the federal Department of Housing and Urban Development (HUD). Ordinance 860 stated that the term "workforce housing" was to hereinafter be used collectively in place of the terms "low income," "affordable," and "employee" housing formerly used to describe income groups related to housing requirements and programs established for residential and resort development.

Administrative Rules for the implementation of the County housing policy were adopted on July 21, 2015. They are known as "The Administration of Chapter 7A, Kaua'i County Code, Pertaining to the Housing Policy for the County of Kaua'i."

All State Land Use District Boundary Amendments, Zoning District Boundary Amendments, amendments into the Visitor Destination Area, subdivision, zoning permits, and building permits are subject to the provisions of the Housing Policy, as it applies to residential and hotel development. The workforce housing assessment for an applicable project is resolved with the County Housing Agency prior to final subdivision or zoning permit approval, whichever occurs first. Thirty percent of all proposed units shall be subject to the requirement of Ordinance 860. This equates to 71 of the total 235 lots proposed by the Proposed Action.

5.2.5.2 General Requirements

For residential developments with twenty six (26) units or more, a developer is required to satisfy the workforce housing requirement based on the total number of residential units. Workforce housing units shall be sold to households at the various income categories in accordance with the following:

- Twenty percent (20%) of total units priced to be affordable to households earning up to eighty percent (80%) of the Kauaʻi median household income
- Thirty percent (30%) of total units priced to be affordable to households earning up to one-hundred percent (100%) of Kauaʻi median household income
- Thirty percent (30%) of total units priced to be affordable to households earning up to one-hundred twenty percent (120%) of Kauaʻi median household income
- Twenty percent (20%) of total units priced to be affordable to households earning up to one-hundred forty percent (140%) of Kauaʻi median household income

Incentives are available to developers for projects that incorporate: a) Integration, b) Single Family Units, c) Building "Green", and d) Low-Income Rental Units. Incentives can modify the workforce housing requirements and are granted at the discretion of the County Housing Agency. The Kēalia Mauka Homesites project may be eligible for incentives under the Integration and Single Family Units categories. The maximum cumulative incentive allowed is fifty percent (50%) of the general workforce housing requirements stated above.

The incentive for "Integration" is available for developments that integrate all workforce unit with market rate units. If all workforce units are integrated with market units, the percentage workforce housing requirement shall be reduced by a factor of twenty-five percent (25%) from that stated above. The incentive for "Single Family Units" is available if a developer provides all single family detached units for sale, and may reduce the workforce housing requirement by a factor of twenty-five percent (25%) from that stated above. Using these incentives, the workforce housing requirement for the Kēalia Mauka Homesites is 36 units.

Discussion: The County Housing Policy is applicable to requested land use entitlements, such the current Land Use District Boundary Amendment, zoning district boundary amendments, subdivision, zoning permits, and building permits. The Proposed Action will comply with all applicable provisions of Ordinance 860 regarding workforce housing.

The County of Kaua'i provides guidelines on current (2017) "for sale limits" by income level and family size. The numbers below, effective April 14, 2017, show residential "for sale" prices by income level for a family of four. It assumes a Kaua'i median household income of $79,200. The prices are for house and lot, and the County Housing Agency indicated it does not publish "for sale limits" for lot-only sales. Therefore, a lot-only price was estimated, assuming that the lot-only price will represent approximately 26% of the total for sale price. The numbers shown assume monthly property tax and insurance expenses of $250, maintenance/association fees of $200, and a down payment of 5.00%. A 30-year fixed interest mortgage rate of 4.25% was assumed.

Table 5-1: For Sale Limits by Income Level

Mortgage Rate: 4.25%

HUD Income Limit *(family of 4)*	Annual Household Income	For Sale Price	Estimated* Lot-Only Sales Price
80% Median	$68,250	$310,800	$81,000
100% Median	$79,200	$369,300	$92,000
120% Median	$95,050	$453,800	$95,050
140% Median	$110,900	$538,400	$110,900

Source: Kaua'i County Housing Agency, effective 4/14/2017, URL=http://www.kauai.gov

**Assumes lot-only price will represent approximately 26% of the For Sale Price established by County. Actual lot-only prices to be determined by County of Kaua'i Housing Agency*

5.2.6 Other County Plans

5.2.6.1 Kauaʻi Economic Development Plan

In 2004, the County's Office of Economic Development, in partnership with the Kaua'i Economic Development Board and the Office of State Planning, spearheaded a community-based effort to create an economic development plan for the next ten years. The result was the *Kauaʻi Comprehensive Economic Development Strategy (CEDS), Update 2016-2020*. plan focused on diversifying the Kauaʻi economy beyond tourism, while also playing to the strengths of our tourism-based economy and the values our community has embraced through the County's General Plan Update of 2000.

The document also serves as Kauaʻi's Comprehensive Economic Development Strategy (CEDS) for the purpose of accessing grant funding through the U.S. Department of Commerce Economic Development Administration (EDA).

While acknowledging that tourism is the primary economic engine for Kauaʻi, the plan the widespread recognition that Kauaʻi must focus on diversifying its economy and growing other industries to increase economic resiliency and provide further opportunities for residents. The CEDS focused on six target industry clusters:

1 Food and Agriculture
2 Sustainable Technologies and Practices
3 Science and Technology
4 Health and Wellness
5 Sports and Recreation
6 Arts and Culture

The study summarized the current strengths, weaknesses, opportunities and threats (SWOT) regarding economic development on Kauaʻi. Listed among the weaknesses was "Increasing lack of affordable housing" and the "Need for greater recruitment and retention of educators and education administrators, who often move after a couple of years on the island because of the high cost of living."

The Proposed Action, Keālia Mauka Homesites project, will support the following Goals (G) and Objectives (O) and Action Items (A) listed in the CEDS:

G1: Build, attract and retain a 21st century workforce.

> O2: Increase hiring and retention of Kauaʻi residents among target industry cluster companies and organizations to reduce or prevent "brain drain."

G8: Enhance the community's ability to thrive

> O3: Increase the quality and affordability of life on Kauaʻi.
>
> > A1: Increase availability of affordable housing

Discussion: Increased housing opportunities, particularly for local residents, is critical to quality of life and future economic development. Lack of affordable housing is often cited as a major reason it is difficult to retain talented employees and local youth on island. The provision of 235 single family house lots that are targeted to a local market will enhance housing opportunities, indirectly supporting the island's economic development goals.

5.2.6.2 Kauaʻi Water Use and Development Plan (WUDP)

The *Kauaʻi Water Use and Development Plan* (WUDP) is currently being updated by the County of Kauaʻi. The State Water Code, Chapter 174 HRS, requires the State Commission on Water Resources Management (CWRM) to implement and utilize comprehensive water resources planning its it regulation and management of the State's water resources. The Water Code sets the requirement for the development and update of the *Hawaiʻi Water Plan* (HWP), a long-range guide for water resource management. The HWP consists of five major components (plans) identified as the: 1) Water Resource Protection Plan; 2) Water Quality Plan; 3) State Water Projects Plan; 4) Agricultural Water Use and Development Plan; and 5) County Water Use and Development Plans (WUDP). These individual plans are to be integrated into a comprehensive "master plan" to provide for effective coordination and long range planning between state and county agencies to link water use, development, and protection of the resource. Each county is responsible to update their respective WUDP.

The original Kauaʻi WUDP was adopted by the County Council in 1990, and updated in 1992, but the update was not officially adopted by the CWRM. The current update of the WUDP will include a uniform, island wide review of the sustainability of land use plans, policies and designations. The intent of the WUDP is to guide the County in its planning, management and development of land use and water resources strategies and policies for sustainable development. It will include an inventory of existing water uses, an assessment of available water resources, future water demand projections, and master plan level resource and facility recommendations (CWRM, 2015).

5.2.6.3 County of Kauaʻi Multi-Hazard Mitigation and Resilience Plan, 2015 Update

The federal Disaster Mitigation Act of 2000 establishes criteria for developing state and local hazard mitigation plans. The development of state and local (County) hazard mitigation plans is a requirement for maintaining eligibility for future Federal Emergency Management Agency (FEMA) mitigation and disaster recovery funding. Both state and local plans must be updated every five years. Hawaiʻi's first approved Multi-Hazard Mitigation Plan went into effect in 2004, and the most recent update became effective on August 19, 2013.

The *County of Kauaʻi Multi-Hazard Mitigation and Resilience Plan* was updated and approved in August 2015. The County plan notes that Kaua'i has experienced a range of climate and hydrological hazards, geological hazards, and technological hazards that have resulted in great costs to lives, property, and the economy. The specific hazards identified include: hurricanes, floods, drought, wildfire, erosion, landslides, climate change, earthquakes, tsunami, dam failure, hazardous materials, homeland security threats, and health-related hazards. Climate change and dam failure were newly added in 2009.

Kauaʻi County's updated *Multi-Hazard Mitigation and Resilience Plan* utilized current data to update the risk and vulnerability assessment for these hazards. The Plan notes that in addition to the technical aspects used in conducting risk and vulnerability assessments, there is a need to understand the deeper causes of disaster, which can also result from poor socioeconomic conditions of an affected community. When this underlying condition is present, it deepens the impact on a community's ability to respond and recover to disasters. Some of these issues include poverty and social justice. The high cost of housing for working families on Kauaʻi was identified as increasing the risks to families because they may not be able to afford adequate housing, or several families may dwell in homes with supporting infrastructure designed for fewer tenants (County of Kauaʻi, 2015).

The Mitigation Priorities section of the *Multi-Hazard Mitigation and Resilience Plan* recognizes that hazard mitigation depends on appropriate land use policies and practices, including zoning and coastal zone management, flood control, building codes and standards, infrastructure development and standards, regulatory measures, incentive programs, and participatory planning methods. The document identifies mitigation goals, objectives and priorities, and a list of mitigation actions.

Among the "multi-hazard actions" identified for ongoing implementation are:

> *Look for funding and planning opportunities to develop more affordable housing in Kauaʻi County to meet critical needs of the working population and the poor. [Kauaʻi County] has the highest cost of housing in the four counties, and the high cost of housing and property taxes have resulted in higher costs for rent as well as mortgages, which make it difficult for the younger people to afford to live affordably. In addition, the high demand results in more families occupying homes, which puts added pressure on infrastructure and utilities (water usage, energy, roadways/parking).*
>
> *[Kauaʻi County Housing Agency] continues to work with the county agencies to seek opportunities to improve housing stock, and to use the most updated building codes in development projects.* (Table 7.1, 2015 Kauaʻi County Mitigation Actions, County of Kauaʻi, 2015)

Discussion: The Proposed Action is not located in an area susceptible to hazards such as flood, erosion, tsunami or landslides. The Petition Area is not within the State DLNR's dam evacuation area, which is limited to lands south of Keālia Road. However, if Keālia Road is affected by dam-related flooding, access for subdivision residents could also be impacted.

Kauaʻi County's *Multi-Hazard Mitigation and Resilience Plan* clearly links the availability of affordable housing to community resilience and hazard mitigation. The Proposed Action is specifically intended to increase housing opportunities for Kauaʻi residents, and will meet the County's workforce housing policy. In this way, the Proposed Action promotes community resilience and is consistent with the County's 2015 *Multi-Hazard Mitigation and Resilience Plan.*

5.3 TRANSPORTATION PLANS AND INITIATIVES

5.3.1 Federal-aid Highways 2035 Transportation Plan for the District of Kauaʻi

The *Federal-Aid Highways 2035 Transportation Plan* ("Plan") for the District of Kauaʻi was developed by the State of Hawaiʻi Department of Transportation (HDOT, 2014). The Plan is an update of the *Kauaʻi Long-Range Land Transportation Plan* developed in 1997, and provides guidance for decision making on future improvements for "federal-aid highways" on Kauaʻi through Year 2035. Federal-aid highways include roads under both state and Kauaʻi County jurisdiction which are classified a collectors and arterials. It does not include local roads or rural minor collectors. The Plan states that Kūhiō Highway (from Līhuʻe) is a "principal arterial" that provides access to Kapaʻa and Wailua. North of Kapaʻa (including in the Keālia area), Kūhiō Highway continues around the northeast perimeter of the island as a "minor arterial" through Anahola and

Princeville. Therefore, the Plan applies to Kūhiō Highway in the project vicinity. The Plan does not apply to Keālia Road or Ka'ao Road.

The Plan was developed around a set of eight federal planning factors that are intended to address transportation comprehensively: 1) Safety, 2) Transportation Access Mobility, 3) System Efficiency Management & Operations, 4) Economic Viability, 5) Environment and Sustainability, 6) Modal Integration, 7) System Preservation, and 8) Security.

Stakeholder input was incorporated to identify the following needs and deficiencies of the land transportation system on Kaua'i:

- Addressing capacity needs and congestion
- Providing emergency access/egress to communities
- Improving safety of non-motorized modes
- Maintaining clear highway operations during heavy rains.

The Plan identifies potential solutions to address the recognized needs and issues on Kaua'i. This "wish list" of long-range potential solutions includes projects that address system preservation, safety, capacity, and congestion needs as well as multimodal infrastructure solutions. The list of potential solutions did not consider fiscal constraints, but instead intended to establish the vision and long-term (20+ year) transportation plan for Kaua'i.

The Implementation section of the plan is intended to help set priorities for the Statewide Transportation Improvement Program (STIP), given funding realities and constraints. The STIP is a list of improvements that can reasonably be expected to be completed with available funds over a four year period. In order to bridge the gap between the long-term plan and the four-year STIP, the Plan focuses on a "Mid-Range Plan," representing what is achievable within an 8 to 10 year horizon, given current funding. Both the long-range plan and Mid-Range plans provide guidance to and feed specific projects into the STIP.

The Plan identifies potential sources of federal and State funding, and supplemental funding strategies. It discusses the need to reduce transportation infrastructure funding needs through land use planning, including the development of more intensive development. More intensive development can lead to greater transportation options by making alternate forms of transportation such as walking, bicycling, and mass transit more feasible and attractive.

Discussion: Chapter 4 of the Draft EIS (Section 4.11, Roadways and Transportation) and the Traffic Impact Analysis Report (TIAR) (Appendix H) provide a comprehensive description of existing roads, bikeways, pedestrian systems, and bikeway systems in the vicinity of the Petition Area. The TIAR identifies the numerous State and County roadway and transportation improvements that are proposed for the Kapa'a region, including the Kūhiō Highway/Mailihuna Road intersection where a roundabout is proposed, the proposed Kapa'a Bypass Road extension, and a new connection from Hauaala Road to the Bypass Road. These proposed improvements are identified in the *Federal Aid Highways 2035 Transportation Plan.* The TIAR estimates the level of service (LOS) at nine study intersections with and without the Proposed Action and other proposed improvements.

A recommended mitigation measure for the Proposed Action is the installation of a traffic signal at Kūhiō Highway at Keālia Road. This mitigation will address project-related traffic on this federal-aid highway. No other federal aid roadways require mitigation as a result of the Proposed Action.

From a land use planning perspective, the expansion of an existing residential area (adjacent to Kaʻao Road subdivision) represents the type of land use intensification that the *Federal Aid Highways 2035 Transportation Plan* indicates could increase the future viability of walking, biking, and transit use. In this respect, the Proposed Action supports and is consistent with the *Federal Aid Highways 2035 Transportation Plan.*

5.3.2 Kapaʻa Transportation Solutions

The Kapaʻa Transportation Solutions project was a joint effort between the HDOT and the County of Kauaʻi, and its purpose was to develop "near to mid-term" transportation solutions to address mobility needs and congestion for all modes of transportation in the Kapaʻa area. The project built upon the numerous previous studies and recommendations for the Kapaʻa transportation system. Kapaʻa Transportation Solutions identified those recommendations with a higher chance of implementation because they meet state and local goals and are feasible to fund and construct.

The northern boundary of the study area was Kapaʻa Stream, and it did not include the Keālia area. The Kapaʻa Transportation Solutions study area boundaries were:

- The intersection of Kūhiō Highway and Kapule Highway to the south
- Kapaʻa Stream to the north
- Wailua Homesteads to the west
- The Pacific Ocean to the east

The Kapaʻa Transportation Solutions project was developed to be consistent with the direction set forth in the *Federal-Aid Highways 2035 Transportation Plan for the District of Kauaʻi* which had recently been updated in 2014. While that document provided the policy basis for land transportation decisions, the Kapaʻa Transportation Solutions represented a finer grain look at specific recommendations for the Kapa ʻa subarea. It focused on projects that could be implemented in less than 20 years.

The *Kapaʻa Transportation Solutions* report was released in August 2015. The report included a list of priority improvements. Several of the top priority recommendations are currently funded and are planned for implementation.

- ***Intersection improvements at Kūhiō Highway at Mailihuna Road***. The existing three-legged intersection on Mailihuna Road would be reconfigured to improve safety by constructing a roundabout.

- ***Widening the Temporary Kapaʻa Bypass Road north of Olohena Road.*** The addition of one travel lane in the northbound direction will provide drivers with an alternate northbound connection from downtown Kapaʻa to the north.

- ***Widening Kūhiō Highway between the Temporary Kapaʻa Bypass Road (southern terminus) and Kuamoo Road.*** By adding one southbound lane to the highway, this project would improve capacity and improve intersection operations at Haleilio Road and Kuamoo Road.

Discussion: The TIAR (Appendix H) and Section 4.11 (Roadways and Transportation) of the DEIS evaluated existing and future traffic conditions at major intersections in Kapaʻa to assess the impact of the Proposed Action. The TIAR assumed that the three projects listed above would be completed by Year 2027, the selected "base year" for analysis, representing when the Keālia Mauka subdivision is likely to be completed and occupied. The TIAR recommended signalization at the Kūhiō Highway and Keālia Road intersection to mitigate traffic impacts associated with the Proposed Action. No other roadway or intersection mitigation is recommended.

5.3.3 Bike Plan Hawaiʻi

Bike Plan Hawaiʻi, prepared by the State of Hawaiʻi Department of Transportation (HDOT, 2003), is the State's bicycling master plan. This plan serves as a blueprint to improve conditions for bicyclists throughout the state, and seeks to encourage new users. *Bike Plan Hawaiʻi* includes an inventory of existing bicycling facilities, identification and prioritization of proposed bicycle facility improvements, and strategies for implementing these projects. Bikeway proposals were categorized into four priority levels: Priority I projects less than 10 years to completion; Priority II less than 20 years; Priority III more than 20 years; and Priority IV being those projects whose timetable is contingent to new road construction or widening.

At the time *Bike Plan Hawaiʻi* was prepared, the island of Kauaʻi had 25.6 miles of bike facilities existing and underway, and 261 miles proposed. Several sections of Ke Ala Hele Makalae were identified as near-term (Priority I) recommendations for Kauaʻi.

Discussion: As discussed in Chapter 4 and the Traffic Impact Analysis Report (Appendix H), Ke Ala Hele Makalae multi-use path provides pedestrian and bicycle access through Kapaʻa and Keālia. The TIAR noted minimal, if any bicycle activity along Kūhiō Highway near the Petition Area. A total of 20 bicycle routes/upgrade are proposed for the Kawaihau region of East Kauaʻi. In the vicinity of the Petition Area, these include signed shared road designations on Kūhiō Highway and Keālia Road. Bike Plan Hawaiʻi identifies these proposed facilities as:

- Kūhiō Highway (Keālia to Anahola)—Signed Shared Road, Priority Level II
- Kūhiō Highway (Wailua to Keālia)—Signed Shard Road, Priority Level II
- Keālia Road (Koolau to Kūhiō Highway)--Signed Shared Road, Priority Level III

The Priority Level II improvements to Kūhiō Highway will enhance the condition of bicycling infrastructure in the vicinity of the Petition Area. Improvements to Keālia Road, as Priority III, are still at least 10 or more years out from present, and will have no impact on the Proposed Action.

5.3.4 Statewide Pedestrian Master Plan

The HDOT's *Statewide Pedestrian Master Plan* (HDOT, 2013) is intended to address pedestrian safety as a component of the HDOT mission to provide a safe, efficient, and accessible highway system. The Plan envisions a multi-modal transportation system that provides a safe and well-connected pedestrian network that encourages walking among all ages and abilities. The intent is to promote a positive pedestrian experience, environmental, economic and social sustainability, while also fostering healthy lifestyles and energy conservation.

The goals of the *Statewide Pedestrian Master Plan* are:

1. Improve pedestrian mobility and accessibility
2. Improve pedestrian safety

3. Improve connectivity of the pedestrian network
4. Promote environmental benefits of walking
5. Encourage walking to foster healthy lifestyles
6. Enhance communities and economic development by creating pedestrian-oriented areas and positive pedestrian experiences
7. Promote and support walking as an important transportation mode that reduces overall energy use

The *Statewide Pedestrian Master Plan* indicated that the County of Kauaʻi had relatively few crashes involving pedestrians. The crashes that have occurred have typically clustered in town centers, near pedestrian attractors. The majority of crashes that have occurred have involved pedestrians under the age of 17 (HDOT, 2013). Maps show that in the general Petition Area, there are no sidewalks along Kūhiō Highway for most of the route between Kapaʻa and Keālia. Near the Closer to Keālia Road intersection, there are sidewalks on one side of the highway.

The Statewide Pedestrian Master Plan developed an inventory of the existing pedestrian environment and identified areas of concern. The key factors for determining the areas of concern were locations where there are gaps in the pedestrian system; high concentrations of pedestrian-oriented populations; pedestrian hot spots (crashes); and pedestrian attractors such as schools, shopping centers, employment centers, etc. Six areas of concern were identified for Kauaʻi County. The closest to the Petition area is the intersection of Kūhiō Highway and Kawaihau Road, where three roads from the *mauka* side (Cane Haul Road, Hauaala Road and Kawaihau Road) intersect the highway within a 250-foot stretch. Pedestrians from the residential neighborhood in the area have a difficult time crossing the highway to access the multi-use path on the *makai* side of the road.

Discussion: Pedestrian traffic along Kūhiō Highway between Keālia Road and Kapaʻa is negligible, largely due to the lack of sidewalks. Pedestrian traffic around the Kūhiō Highway-Keālia Road intersection is associated with individuals using the nearby bus stops and accessing coastal recreation areas, including the multi-use path. Proposed signalization at Kūhiō Highway and Keālia Road will include sidewalks at this intersection. The signal will improve crossing safety for bus riders and pedestrians.

There is virtually no pedestrian traffic along Keālia Road between Kūhiō Highway and the Petition Area. While the Proposed Action may result in some additional pedestrian traffic, the narrow width and curves of Keālia Road, the lack of sidewalks and road shoulders, and the incline make this road uninviting for pedestrians, and especially unsafe for children.

Within the proposed Keālia Mauka subdivision, there is likely to be some pedestrian traffic as residents visit neighbors or walk to the future park area. Installation of a traffic signal at the intersection of Keālia Road and Kūhiō Highway will improve pedestrian safety and access across Kūhiō Highway.

5.3.5 Kauaʻi Multimodal Land Transportation Plan

The *Kauai Multimodal Land Transportation Plan* (MLTP) is guided by the 2000 County General Plan and outlines steps the County will need to take to achieve a balanced multimodal transportation system by the year 2035. The MLTP serves as the plan for county roads and streets, public transit, bicycle facilities, pedestrian facilities, agricultural needs, and as a means to integrate land use planning with transportation system development.

The MLTP identifies its most pressing challenge as accommodating a growing population on Kauaʻi while preserving the rural character and high quality of life. The MLTP identified as "Preferred Scenario" to prevent growth in island-wide vehicle miles of travel above the 2010 level, despite an anticipated increase in the resident and visitor population. Accomplishing the preferred scenario will require a gradual shift in some of the drive-alone trips that dominate island travel today to other modes of transportation such as walking, biking and transit (Charlier Associates, Inc. 2012).

Discussion: As discussed in Chapter 4 (Section 4.11), sustainable transportation infrastructure in the vicinity of the Petition Area is currently fair to poor. There are no sidewalks along Kūhiō Highway near Keālia Road connecting to Kapaʻa Town. The Kauaʻi Bus provides service along Kūhiō Highway and there is an existing stop near Keālia Road. Although bus routes connect to downtown Kapaʻa, there is no direct bus access to Kapaʻa High School or Kapaʻa Middle School, two likely destinations for prospective bus riders from a new residential subdivision.

The Proposed Action will provide a traffic signal at the Kūhiō Highway/Keālia Road intersection to mitigate project related traffic impacts. This will include the addition of a sidewalk. For pedestrians in the vicinity, traffic safety would be improved and access to the *makai* side of the highway and down to the coastal areas would be facilitated. The County also has long term plans to modify bus routes to improve access from Keālia Road to the middle and high schools.

Ke Ala Hele Makalae multi-use path along the coast is an existing amenity that is popular for walking, jogging, bike riding. It also provides a multi-modal transportation option, and could be used to get to Kapaʻa. *Bike Plan Hawaiʻi* also designates this area of Kūhiō Highway a signed-shared road.

Although non-vehicle options from the Kūhiō Highway and Keālia Road intersection are expected to improve over the next few years, for Keālia Mauka residents, the major constraint will continue to be the poor connectivity between the subdivision and Kūhiō Highway. As discussed above, Keālia Road is steep and narrow with no shoulders or sidewalks, and no space to add them, and is not conducive to bicycling or walking.

5.4 CHAPTER 343 SIGNIFICANCE CRITERIA

In determining whether an action may have a significant impact on the environment, agencies and applicants are tasked to consider the sum of effects on the quality of the environment, and evaluate the overall and cumulative effects of the action. In most instances, an action shall be determined to have a significant effect on the environment if it meets any of the following criteria (from Section 11-200-12, HAR):

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

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

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;

4. Substantially affects the economic or social welfare of the community or State;

5. Substantially affects public health;

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

7. Involves a substantial degradation of environmental quality;

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

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

10. Detrimentally affects 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;

12. Substantially affects scenic vistas and view planes identified in county or state plans or studies; or,

13. Requires substantial energy consumption.

Discussion: The State Land Use Commission (LUC), as the Accepting Agency, has determined that the Proposed Action meets two significance criteria defined in HAR §11-200. The Proposed Action has the potential to curtail the range of beneficial uses of the environment (Criterion 2) and may involve substantial secondary impacts on public transportation facilities (roadways) (Criterion 6). Therefore, the LUC has determined that the Proposed Action requires the preparation of an Environmental Impact Statement (EIS) versus an Environmental Assessment, and has elected to have the Petitioner move forward with the preparation of the EIS.

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6.0 OTHER IMPACTS AND ISSUES

6.1 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term uses and long-term productivity weighs the limited, temporary effects of construction activities against the long-term socio-economic benefits of the Proposed Action. During construction of subdivision improvements, there will be short-lived construction-related impacts including dust generation, construction noise, vehicle and equipment emissions, and surface runoff. These short-term effects will be mitigated through the implementation of standard best management practices (BMP) for construction activities, as well as mitigation measures prescribed by State and County of Kauaʻi rules and regulations. Measures to mitigate potential impacts to the natural and human made environment, including traffic and infrastructure impacts, can be successfully implemented, as discussed in Chapters 3 and 4 of this Draft EIS (DEIS).

Short-term benefits from the construction of subdivision improvements will accrue to the local economy via direct and indirect construction-related employment and direct spending through the purchase of construction materials and building-related services. Once the subdivision improvements are completed, the residential lots will be sold and individual purchasers will construct homes on the lots. During this period, there will again be direct construction spending, and employment opportunities for the local workforce.

Over the long term, there will be a loss of 53.4 acres of agricultural land that is currently used for cattle grazing. While the Petition Area is suitable for agricultural use, it represents only a small percentage of suitable agricultural land available in East Kauaʻi. The existing grazing lessee has been given an additional 86 acres to compensate for the loss of the Petition Area acreage. There will be no long-term impact on their cattle raising operations.

Over the long term, the occupants of the Keālia Mauka subdivision will contribute to the local government economy through payment of property taxes. Most future residents of the 235-unit subdivision are currently Kauaʻi residents, who are already contributing to the local economy through the payment of sales taxes and the purchase of goods and services from local businesses. New contributions to the local economy will be primarily through the approximately 42"new" residents to the island.

The most significant enhancement of long term productivity is the provision of 235 residential house lots that are targeted to the local Kauaʻi market. The housing opportunities created, particularly for the workforce housing segment of the housing market, will help alleviate the current and projected demand for single family housing in East Kauaʻi. The East Kauaʻi region extending from Līhuʻe to Moloaʻa is the economic center of the island and the fastest growing area in the County. Demand for housing far exceeds existing and currently planned inventory. Single family residential use is the most productive use of the property, will enhance the quality of life for local residents, and is supported by the County of Kauaʻi, as evidenced by the General Plan Land Use Plan. The long-term productivity of the Proposed Action surpasses any short-term effects associated with construction.

6.2 CUMULATIVE AND SECONDARY IMPACTS

Cumulative impacts are the combined effect of a proposed action and other past, present, and reasonably foreseeable future actions, regardless of who initiates the action. "Cumulative impact" is the impact on the environment, which results from the incremental impact of the 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. Past, present, and reasonably foreseeable future projects in the East Kauaʻi area were examined using currently available data.

Līhuʻe/East Kauaʻi has evolved into a primary region for economic and activity and employment on the island, attracting significant development and capital investment over the past four plus decades. This trend is anticipated to continue over the long term (CBRE, 2017). Resident population in the Līhuʻe to Moloaa corridor, currently at about 38,000, is also expected to continue to grow steadily. By 2040, the resident population is projected to reach between 51,600 and 53,600 persons (ibid).

This economic and population growth within the region will continue to increase demand for additional housing for local residents. Currently, there are approximately 16,000 housing units in the Līhuʻe to Moloaa corridor available for standard residential (non-resort) use. Of these, about 82 percent are occupied by full time Kauaʻi resident households, with the remaining 18 percent used by non-resident second/vacation home owners. The demand for new residential (not transient vacation unit) units in the region was projected at approximately 7,400 units through year 2040. Currently planned inventory falls well short of meeting this demand. Over the next 23 years, the shortfall in housing for East Kauaʻi residents was projected at between 1,400 and 3,000 units (ibid). The Proposed Action is intended to address this anticipated housing shortfall by providing residential lots targeted for sale to island residents. Cumulatively, the provision of 235 house lots will have a positive impact in satisfying the demand for housing.

The Proposed Action responds to projected market demand for housing, but otherwise will not cumulatively affect demographic and economic trends. Population and economic growth in East Kauaʻi will continue with or without the project. It is estimated that approximately 42 of the 700 future subdivision occupants will be non-residents. These additional 42 individuals will contribute to total population, but the Proposed Action will not affect in migration to the island. There will be no cumulative or indirect impact on real estate prices or property tax assessments, which are largely driven by larger market forces.

The Proposed Action will bring more cars to the Keālia area, and will have a cumulative impact on traffic and intersection level of service (LOS). The impact of the Proposed Action, as well as other residential developments proposed over the next twenty years were evaluated in the Traffic Impact Analysis Report (TIAR) (Appendix H). Most of the future growth in traffic will occur independent of the Proposed Action.

The project's positive economic and social benefit will also have a cumulative and indirect impact. Combined with other regional economic growth, the Proposed Action will generate construction-related expenditures, support short-term construction jobs, and in the longer term, contribute to discretionary spending by residents. Because most Keālia Mauka residents are currently living on Kauaʻi, the only "new" spending will come from the estimated 42 non-resident second home owners and their guests. Indirectly, the associated wages, profits, and expenditure will have a ripple or multiplier effect on the economy.

There will be a cumulative increase in demand on utilities and public services when combined with other projected residential and commercial developments in East Kauaʻi. Given the 20-year projected population growth in the region, additional demands on fire, police, and schools are inevitable.

6.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Completion of the Proposed Action will result in the irreversible and irretrievable commitment of natural and fiscal resources. The project site will be transformed from a grazing pasture with potential for future agricultural use to a residential area. Other resource commitments include labor; development capital; construction materials; nonrenewable electric energy; and nonrenewable resources (fossil fuels, natural gas, metals, and minerals). The Proposed Action will permanently modify the visual landscape and alter views of the area from Kūhiō Highway, from Keālia Road, and the adjacent Kaʻao subdivision. The commitment of these resources must be weighed against the socio-economic benefits that would be derived by the provision of 235 residential lots, offering homeownership opportunities to local Kauaʻi residents.

6.4 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Chapters 3 and 4 of this DEIS have addressed potential adverse environmental effects associated with the proposed project. All potentially adverse can be minimized or mitigated to levels that are less than significant. For example, construction period impacts such as noise, dust, and the presence of construction vehicles can be mitigated through construction best management practices and compliance with federal, state and County rules and regulations. Long-term impacts such as increased traffic will be mitigated through signalization at the Kūhiō Highway and Keālia Road intersection. The loss of agricultural land will be offset by the availability of similar quality lands for grazing nearby. The visual character of the Petition Area as seen from Kūhiō Highway and Keālia Road will change. An open grazing area will be replaced by an urbanized neighborhood. The unobstructed *mauka* views from the Kaʻao residential lots will be permanently altered. The visual impact will be most severe for the three residential lots on Kaʻao Road, which will directly face several new house lots. The residents of the 22 lots that back onto Kūhiō Highway will be impacted by highway noise. These noise impacts can be mitigated through measures such as berming, sound walls, use of double glazed window, and sound proofed exterior walls. However, noise impacts on these residents cannot be avoided.

6.5 UNRESOLVED ISSUES

As discussed in Section 4.8, there is the potential for ground disturbing activities to encounter areas with existing soil contamination due to historic use of herbicides. The potential presence of hazardous substances, including arsenic, could pose health concerns for future residential use. As recommended by the Department of Health (DOH) Hazard Evaluation and Emergency Response (HEER) Office, soil testing will be conducted in Petition Areas proposed for residential or recreational use. A soil sampling plan identifying chemicals of concern and proposed testing methodology will be developed and submitted to DOH HEER for review and approval prior to testing. If identified, contaminated soils and materials will be remediated to levels appropriate for residential use prior to construction.

The Petitioner is currently awaiting confirmation from the State Historic Preservation Division (SHPD) that the requirements of HRS Section 6E, Historic Preservation have been met. The Petition Area was part of a prior Archaeological Inventory Survey (AIS) that recommended no further archaeological work. On February 27, 2018, the State Land Use Commission sent a letter to the SHPD, with the Literature Review and Field Inspection Report (CSH, 2017), requesting confirmation that Section 6E requirements have been met. While not an "unresolved issue," this is a pending inquiry that is currently awaiting completion. It is anticipated that this will be completed during the DEIS review period.

7.0 DRAFT EIS PREPARERS AND CONTRIBUTORS

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Leslie Kurisaki, Associate
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Bill Eddy, P.E.

TRAFFIC ENGINEERING
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8.0 REFERENCES

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9.0 PARTIES CONSULTED DURING PREPARATION OF THE DRAFT EIS

9.1 AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED DURING THE EISPN PROCESS

Early consultation to discuss the development of the Keālia Mauka Homesites ("Proposed Action") was conducted by the Petitioner, Keālia Properties, LLC, and its consultants. Early consultation was held with several County of Kauaʻi agencies, including the Planning Department, Department of Housing, Department of Public Works and Department of Water.

Following this initial consultation, an Environmental Impact Statement Preparation Notice (EISPN) was prepared. The EISPN was prepared in accordance with the requirements of Hawaiʻi Revised Statutes (HRS) §343 and Chapter 200 of Title 11, Hawaiʻi Administrative Rules (HAR) in support of the Petition for a State Land Use District boundary amendment.

Notice of the EISPN was published in the November 23, 2017 edition of the Office of Environmental Quality Control (OEQC)'s bi-monthly *The Environmental Notice*. The EISPN was available for viewing and download from the OEQC web site, and hard copies were available at the Hawaiʻi State Library (Hawaiʻi Documents Center), Kapaʻa Public Library, and Līhuʻe Public Library. The agencies, groups and individuals listed below were notified in writing of the EISPN.

The 30-day EISPN public comment period ended on December 26, 2017. Parties providing written comments are identified below with an asterisk (*). Copies of comment letters and response are included at the end of this chapter.

Federal

Department of Agriculture, Natural Resources Conservation Service
Department of the Interior, Fish and Wildlife Service*
Department of the Interior, Geological Survey, Pacific Islands Water Science Center
Environmental Protection Agency

State of Hawaiʻi

Department of Agriculture
Department of Accounting and General Services
Department of Business, Economic Development and Tourism
Office of Planning*
Strategic Industries Division
Department of Defense*
Department of Education*
Department of Hawaiian Home Lands
Department of Health*
(Separate letters received from DOH Environmental Planning Office, Kauaʻi District Health Office, Safe Drinking Water Branch, and Hazard Evaluation and Emergency Response (HEER) Office)
Department of Land and Natural Resources*

DLNR State Historic Preservation Division
Department of Transportation*
University of Hawaiʻi, Water Resources Research Center*
Office of Hawaiian Affairs

County of Kauaʻi

Fire Department
Housing Agency
Human Resources
Department of Planning
Police Department
Department of Public Works*
Transportation Agency*
(Letters received from The Kauaʻi Bus and Transportation Agency)
Department of Water

Elected Officials

U.S. Senator Brian Schatz
U.S. Senator Mazie Hirono
U.S. Representative Tulsi Gabbard
Senator Ron Kouchi, State Senate District 8
Representative Nadine Nakamura, State House District 14
Mayor Bernard P. Carvalho, Jr.
County Council Member Mel Rapozo
County Council Member Ross Kagawa
County Council Member Arthur Brun
County Council Member Mason Chock
County Council Member Arryl Kaneshiro
County Council Member Derek Kawakami
County Council Member JoAnn Yukimura

Utilities/Other

Kauaʻi Island Utility Cooperative (KIUC)
Keālia Water Company Holdings, LLC
Keālia Kai Homeowners Association*
(Letters received from residents Karen Gibbons; Jirair and Aderineh Saralou;and Ross-boy and Cindi Link)
Wailua-Kapaʻa Neighborhood Association
Kaʻao Road and Hopoe Road homeowners

The Garden Island
Honolulu Advertiser

United States Department of the Interior

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

In Reply Refer To:
01EPIF00-2018-TA-0105

DEC 2 7 2017

Ms. Moana Palama
Hawaii Management Services LLC
P.O. Box 1630
Koloa, Hawaii 96756

Subject: Environmental Impact Statement Preparation Notice for Kealia Mauka Homesites, Kawaihau District, Island of Kauai

Dear Ms. Palama:

The U.S. Fish and Wildlife Service (Service) received your letter on November 24, 2017, informing us of the availability of the Environmental Impact Statement Preparation Notice (EISPN) for Kealia Properties, LLC's proposal to develop a residential subdivision in the Kawaihau District on the island of Kauai [TMK: (4) 4-7-004: 001 portion]. We understand that HHF Planners prepared the EISPN and will be preparing the Draft EIS on behalf of Kealia Properties, LLC in accordance with Hawaii Revised Statutes Chapter 343 and the EIS rules (Chapter 11-200 Hawaii Administrative Rules). In addition, a petition for a State Land Use District Boundary amendment has been filed with the State Land Use Commission to reclassify the site from the Agricultural District to the Urban District. Kealia Properties, LLC proposes to develop a residential subdivision at Kealia, Kauai, consisting of approximately 235 lots ranging in area from about 5,600 square feet (sq. ft.) to 7,300 sq. ft. The Petition Area (also referred to in this EISPN as "Project Area") is comprised of approximately 53.4 acres of land and located adjacent to and north of an existing residential community in Kealia. The project includes installation of utility infrastructure (*e.g.*, potable water, drainage, wastewater, electrical power, and telecommunications systems) and transportation improvements to serve the new community.

We offer the following comments for your consideration. Our comments are provided under the authorities of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended (ESA); National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 401], as amended (NEPA); Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661 *et seq.*; 48 Stat. 401); and Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703-712), among others.

We have reviewed the information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program as it pertains to listed species and designated critical habitat in accordance with section 7 of the ESA. There is no federally designated critical habitat within the immediate vicinity of the proposed project. Our data indicate that the following federally listed species may occur or transit through the vicinity of the proposed project area: the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*), endangered Hawaiian coot (*Fulica alai*), endangered Hawaiian gallinule (*Gallinula galeata sandvicensis*) and endangered Hawaiian duck (*Anas wyvilliana*) (collectively referred to as Hawaiian waterbirds); the endangered Hawaiian goose (*Branta sandvicensis*); the endangered Hawaiian petrel (*Pterodroma sandwichensis*), threatened Newell's shearwater (*Puffinus auricularis newelli*), and endangered band-rumped storm-petrel (*Oceanodroma castro*) (collectively referred to as Hawaiian seabirds); and the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*). The Service recommends the following measures to avoid and minimize project impacts to the above listed species.

Hawaiian waterbirds

Listed Hawaiian waterbirds are found in fresh and brackish-water marshes and natural or man-made ponds. Hawaiian stilts may also be found wherever ephemeral or persistent standing water may occur. Threats to these species include non-native predators, habitat loss, and habitat degradation. Hawaiian ducks are also subject to threats from hybridization with introduced mallards.

Hawaiian waterbirds, in particular, the Hawaiian stilt, is known to nest in sub-optimal locations (*e.g.*, any ponding water) if present. Hawaiian waterbirds attracted to sub-optimal habitat may suffer adverse impacts, such as predation, reduced reproductive success due to disturbance within the vicinity of a nest, injury or death from being hit by a vehicle and thus the project may create an attractive nuisance. Therefore, we recommend you design the proposed project in a manner that minimizes the amount of time standing water is present (during construction and/or project implementation), thereby, reducing the potential to attract waterbirds.

To avoid and minimize potential project impacts to Hawaiian waterbirds we recommend you consider incorporating the following applicable measures into your project description:

- In areas where waterbirds are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.
- If water resources are located within or adjacent to the project site, incorporate applicable best management practices regarding work in aquatic environments into the project design.
- Have a biological monitor that is familiar with the species' biology conduct Hawaiian waterbird nest surveys where appropriate habitat occurs within the vicinity of the proposed project site prior to project initiation. Repeat surveys again within three days of project initiation and after any subsequent delay of work of three or more days (during which the birds may attempt to nest). If a nest or active brood is found:
    - Contact the Service within 48 hours for further guidance.
    - Establish and maintain a 100-foot buffer around all active nests and/or broods until the chicks/ducklings have fledged. Do not conduct potentially disruptive activities or habitat alteration within this buffer.

  - Have a biological monitor that is familiar with the species' biology present on the project site during all construction or earth moving activities until the chicks/ducklings fledge to ensure that Hawaiian waterbirds and nests are not adversely impacted.

Hawaiian goose

Hawaiian geese are known to occur in the northeast portion of Kauai. They are observed in a variety of habitats, but prefer open areas, such as natural grasslands and shrublands, pastures, wetlands, golf courses, and lava flows. Threats to the species include introduced mammalian and avian predators, wind facilities, and vehicle strikes.

We recommend you consider incorporating the following applicable measures into your project description to avoid and minimize impacts to the Hawaiian goose:

- Do not approach, feed, or otherwise disturb Hawaiian geese.
- If Hawaiian geese are observed loafing or foraging within the project area during the Hawaiian goose breeding season (September through April), have a biologist familiar with the nesting behavior of Hawaiian geese survey for nests in and around the project area prior to the resumption of any work. Repeat surveys after any subsequent delay of work of three or more days (during which the birds may attempt to nest).
  - Cease all work immediately and contact the Service for further guidance if a nest is discovered within a radius of 150 feet of proposed work, or a previously undiscovered nest is found within said radius after work begins.
- In areas where Hawaiian geese are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.

Hawaiian seabirds

Hawaiian seabirds may traverse the project area at night during the breeding season (March 1 to December 15). Outdoor lighting could result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights they may become exhausted and collide with nearby wires, buildings, or other structures or they may land on the ground. Downed seabirds are subject to increased mortality due to collision with automobiles, starvation, and predation by dogs, cats, and other predators. Young birds (fledglings) traversing the project area between September 15 and December 15, in their first flights from their mountain nests to the sea, are particularly vulnerable.

To avoid and minimize potential project impacts to seabirds we recommend you consider incorporating the following applicable measures into your project description:

- Fully shield all outdoor lights so the bulb can only be seen from below bulb height and only use when necessary.
- Install automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area.
- Avoid nighttime construction during the seabird fledging period, September 15 through December 15.

Hawaiian hoary bat

The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and will leave young unattended in trees and shrubs when they forage. If trees or shrubs 15 feet or taller are cleared during the pupping season, there is a risk that young bats could inadvertently be harmed or killed since they are too young to fly or may not move away. Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 feet above the ground and can become entangled in barbed wire used for fencing.

To avoid and minimize impacts to the endangered Hawaiian hoary bat we recommend you consider incorporating the following applicable measures into your project description:

- Do not disturb, remove, or trim woody plants greater than 15 feet tall during the bat birthing and pup rearing season (June 1 through September 15).
- Do not use barbed wire for fencing.

If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may further assist you with ESA compliance. We look forward to reviewing the Draft EIS. If you have questions regarding these comments, please contact Michelle Clark, Fish and Wildlife Biologist (phone: 808-822-4315, email: michelle_clark@fws.gov). When referring to this project, please include this reference number: 01EPIF00-2018-TA-0105.

Sincerely,

Leila Nagatani

for Aaron Nadig
Island Team Manager
Oahu, Kauai, North Western Hawaiian
Islands and American Samoa

cc: Ms. Leslie Kurisaki, HHF Planners
Mr. Daniel Orodenker, State Land Use Commission

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places for people

March 15, 2018

Mr. Aaron Nadig, Island Team Manager
U.S. Department of Interior Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, HI 96850

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 27, 2017, 01EPIF00-2018-TA-0105

Dear Mr. Nadig:

Thank you for your comment letter dated December 27, 2017, referenced above. Your letter confirms that there are no federally designated critical habitat within the immediate project vicinity. You note that several federally listed species may occur or transit through the project vicinity, including several species of Hawaiian waterbirds, in particular the endangered Hawaiian stilt *(Himantopus mexicanus knudseni)* known to nest in areas with ponding water. You also cite the Hawaiian goose or Nēnē, known to occur in the northeast portion of Kauaʻi, and Hawaiian seabirds that may traverse the area at night during the breeding season (March 1 to December 15). Outdoor lighting could result in seabird disorientation, fallout, injury or mortality. The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and overfly the project area on a seasonal basis. The removal of vegetation has the potential to temporarily displace individual bats and young bats during the pupping season.

An avian and mammalian survey of the site was completed for the project, and will be included in the Draft EIS. The Draft EIS will summarize the survey results, describe the listed species, identify the project's potential impacts, and recommend mitigation measures to avoid and minimize impacts, if appropriate.

A copy of your comment letter has been forwarded to the project's biological consultant for their information. Your letter and this response will be reproduced in the Draft EIS. Thank you for your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

DAVID Y. IGE
GOVERNOR

ARTHUR J. LOGAN
MAJOR GENERAL
ADJUTANT GENERAL

KENNETH S. HARA
BRIGADIER GENERAL
DEPUTY ADJUTANT GENERAL

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

RECEIVED
DEC - 6 2017
HHF PLANNERS

December 01, 2017

Hawai'i Management Services, LLC
Attn: Moana Palama
P.O. Box 1630
Koloa, HI 96756

Dear Ms. Moana, Palama:

Subject: Notice of Petition to Amend State Land Use District Boundaries – Kealia, Kauai

Thank you for the opportunity to comment on the above project. The State of Hawaii Department of Defense has no comments to offer relative to the proposed project.

Should you have any questions or concerns, please have your staff contact Ms. Shao Yu Lee, our Land Manager on Oahu, at (808) 733-4222.

Sincerely,

NEAL S. MITSUYOSHI, P.E.
Colonel, Hawaii National Guard
Chief Engineering Officer

c: Mr. David Kennard, Hawaii Emergency Management Agency (HI-EMA)
Ms. Havinne Okamura, HI-EMA
Mr. Albert Chong, HI-EMA
Mr. Karl Motoyama, Hawaii Army National Guard Environmental (HIARNG-ENV)
Maj Nhut Dao, 154th Civil Engineer Squadron (154th CES)
√Ms. Leslie Kurisaki, HHF Planners Consultant
Mr. Daniel Orodenker, State of Hawaii Land Use Commission

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March 15, 2018

Colonel Neal S. Mitsuyoshi, P.E.
Chief Engineering Officer
State of Hawaiʻi Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawaiʻi 96816-4495

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 1, 2017

Dear Colonel Mitsuyoshi:

Thank you for your comment letter dated December 1, 2017, indicating that the State of Hawaiʻi Department of Defense has no comment on the above referenced project.

Your letter and this response will be reproduced in the Draft EIS. Thank you for your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

DAVID Y. IGE
GOVERNOR OF HAWAII

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STATE OF HAWAII
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In reply, please refer to:
File:

EPO 17-298

December 14, 2017

Mr. Scott Ezer, Vice President
HHF Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Email: sezer@hhf.com

Dear Mr. Ezer:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for Kealia Mauka Homesites, Kawaihau District, Kauai
TMK: (4) 4-7-004: por. 001

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your EISPN to our office via the OEQC link:
http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2017-11-23-KA-EISPN-Kealia-Mauka-Homesites.pdf

We understand from the OEQC publication form project summary that *"Kealia Properties, LLC proposes a residential subdivision on 53.4-acres at Kealia, Kawaihau District, Kaua'i. The site was historically used for sugar cultivation and is currently used for grazing. The subdivision will include 235 lots (5,600 to 7,300 SF in size) and infrastructure improvements."*

Hawaii's environmental review laws require Environmental Assessments (EAs) and Environmental Impact Statements (EISs) to consider health in the discussion and the mitigation measures to reduce negative impacts. In its definition of 'impacts,' §11-200-2, Hawaii Administrative Rules (HAR) includes health effects, whether primary (direct), secondary (indirect), or cumulative. Further, §11-200-12(b)(5), HAR, lists public health as one of the criteria for determining whether an action may have a significant impact on the environment.

We advocate that you consider health from a broad perspective; one that accounts for the social, economic, and environmental determinants of health and wellbeing. Community well-being can be impacted by access to physical activity, health care, feelings of social connectedness and safety. Design solutions that take these factors into consideration positively contribute to the social determinants of health in a community, improving the well-being of those who live there by influencing health promoting behaviors. Social determinants contribute to preventable chronic diseases such as asthma, diabetes, obesity, and cardiovascular disease.

In the development and implementation of all projects, EPO strongly recommends regular review of State and Federal environmental health land use guidance. State standard comments to support sustainable healthy design are provided at: http://health.hawaii.gov/epo/landuse. Projects are required to adhere to all applicable standard comments.

We suggest you review the requirements of the Clean Water Branch (Hawaii Administrative Rules {HAR}, Chapter 11-54-1.1, -3, 4-8) and/or the National Pollutant Discharge Elimination System (NPDES) permit (HAR, Chapter 11-55) at: http://health.hawaii.gov/cwb. If you have any questions, please contact the Clean Water Branch (CWB), Engineering

Section at (808) 586-4309 or cleanwaterbranch@doh.hawaii.gov. If your project involves waters of the U.S., it is highly recommended that you contact the Army Corps of Engineers, Regulatory Branch at: (808) 835-4303.

Please note that all wastewater plans must conform to applicable provisions (HAR, Chapter 11-62, "Wastewater Systems"). We reserve the right to review the detailed wastewater plans for conformance to applicable rules. Should you have any questions, please review online guidance at: http://health.hawaii.gov/wastewater and contact the Planning and Design Section of the Wastewater Branch (WWB) at (808) 586-4294.

If temporary fugitive dust emissions could be emitted when the project site is prepared for construction and/or when construction activities occur, we recommend you review the need and/or requirements for a Clean Air Branch (CAB) permit (HAR, Chapter 11-60.1 "Air Pollution Control"). Effective air pollution control measures need to be provided to prevent or minimize any fugitive dust emissions caused by construction work from affecting the surrounding areas. This includes the off-site roadways used to enter/exit the project. The control measures could include, but are not limited to, the use of water wagons, sprinkler systems, and dust fences. For questions contact the Clean Air Branch via e-mail at: Cab.General@doh.hawaii.gov or call (808) 586-4200.

Any waste generated by the project (that is not a hazardous waste as defined in state hazardous waste laws and regulations), needs to be disposed of at a solid waste management facility that complies with the applicable provisions (HAR, Chapter 11-58.1 "Solid Waste Management Control"). The open burning of any of these wastes, on or off site, is strictly prohibited. You may wish you review the Minimizing Construction & Demolition Waste Management Guide at: http://health.hawaii.gov/shwb/files/2016/05/constdem16.pdf Additional information is accessible at: http://health.hawaii.gov/shwb. For specific questions call (808) 586-4226.

If noise created during the construction phase of the project may exceed the maximum allowable levels (HAR, Chapter 11-46, "Community Noise Control") then a noise permit may be required and needs to be obtained before the commencement of work. Relevant information is online at: http://health.hawaii.gov/irhb/noise EPO recommends you contact the Indoor and Radiological Health Branch (IRHB) at (808) 586-4700 with any specific questions.

A phase I Environmental Site Assessment (ESA) and site investigation should be conducted for residential development or redevelopment projects in current or formerly used industrial areas and on formerly and currently zoned agricultural land used for growing sugar, pineapple or other agricultural products. If the investigation shows that a release of petroleum, hazardous substance, pollutants or contaminants may have occurred at the site, the site should be properly characterized through an approved Hawaii State Department of Health (DOH)/Hazard Evaluation and Emergency Response Office (HEER) soil and/or groundwater sampling plan. Please refer to Sections 3 and 4 of the HEER Office Technical Guidance Manual http://www.hawaiidoh.org. If the site is found to be contaminated, then all removal and remedial actions to clean up hazardous substance or oil releases by past and present owners/tenants must comply with State Law (HRS, Chapter 128D, "Environmental Response Law", Chapter 451, "State Contingency Plan"). To identify HEER records related to the property, visit http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/public-records. For information on site assessment and cleanup programs review: http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/site-assessment-and-cleanup-programs. Any specific questions should be directed to the HEER office at (808) 586-4249.

An example of social influences include access to safe pedestrian corridors such as pathways, sidewalks, bike lanes, greenways and open space. §11-200-17(h), HAR, says EISs must discuss how proposed actions may conform or conflict with any policies for the affected area. This includes Hawaii's 2009 Complete Streets law, which requires the state and counties to establish policies to accommodate all users of the road, no matter age, ability, or mode of transportation.

EPO also encourages you to examine and utilize the Hawaii Environmental Health Portal at: https://eha-cloud.doh.hawaii.gov. This site provides links to our e-Permitting Portal, Environmental Health Warehouse, Groundwater Contamination Viewer, Hawaii Emergency Response Exchange, Hawaii State and Local Emission Inventory System, Water Pollution Control Viewer, Water Quality Data, Warnings, Advisories and Postings.

The Hawaii Disability and Communication Access Board (DCAB) recommends the inclusion of access for persons with disabilities through all phases of design and construction. New construction and alteration work shall comply with all applicable accessibility requirements. Projects covered by §103-50, Hawaii Revised Statutes, and Hawaii Administrative Rules Title 11 Chapter 216 shall seek advice and recommendations from DCAB on any construction plans prior to commencing with construction. If you have any questions please contact DCAB at (808) 586-8121 or dcab@doh.hawaii.gov.

To better protect public health and the environment, the U.S. Environmental Protection Agency (EPA) has developed an environmental justice (EJ) mapping and screening tool called EJSCREEN. It is based on nationally consistent data and combines environmental and demographic indicators in maps and reports. EPO encourages you to explore, launch and utilize this powerful tool in planning your project. The EPA EJSCREEN tool is available at: http://www.epa.gov/ejscreen.

We hope this information is helpful. If you have any questions please contact us at DOH.epo@doh.hawaii.gov or call us at (808) 586-4337. Thank you for the opportunity to comment.

Mahalo nui loa,

Laura Leialoha Phillips McIntyre, AICP
Environmental Planning Office

LM:nn

c: Ms. Moana Palama, Kealia Properties, LLC (via email: moana@mskauai.com)
Daniel Orodenker, Executive Officer, LUC (via email: daniel.e.orodenker@hawaii.gov)
DOH: DHO Kauai, CWB, WWB, IRHB, CAB, SHWB, SDWB, DCAB, PHP {via email only}

Attachment: U.S. EPA EJSCREEN Report for Project Area

Please be advised:
The Environmental Planning Office (EPO), along with the Clean Air, Clean Water, and Wastewater Branches moved to Waimano Ridge. The new address, for EPO, **as of December 1, 2017**, is:
Environmental Planning Office, DOH, Hale Ola, 2827 Waimano Home Road #109, Pearl City, Hawaii 96782
Please feel free to come and visit our new offices anytime. Please note that there is a security guard at the bottom of the hill (before entering DOH property). Our office phone numbers, email and website will all remain the same.

Attachment: U.S. EPA EJSCREEN Report for Project Area

EPA United States Environmental Protection Agency

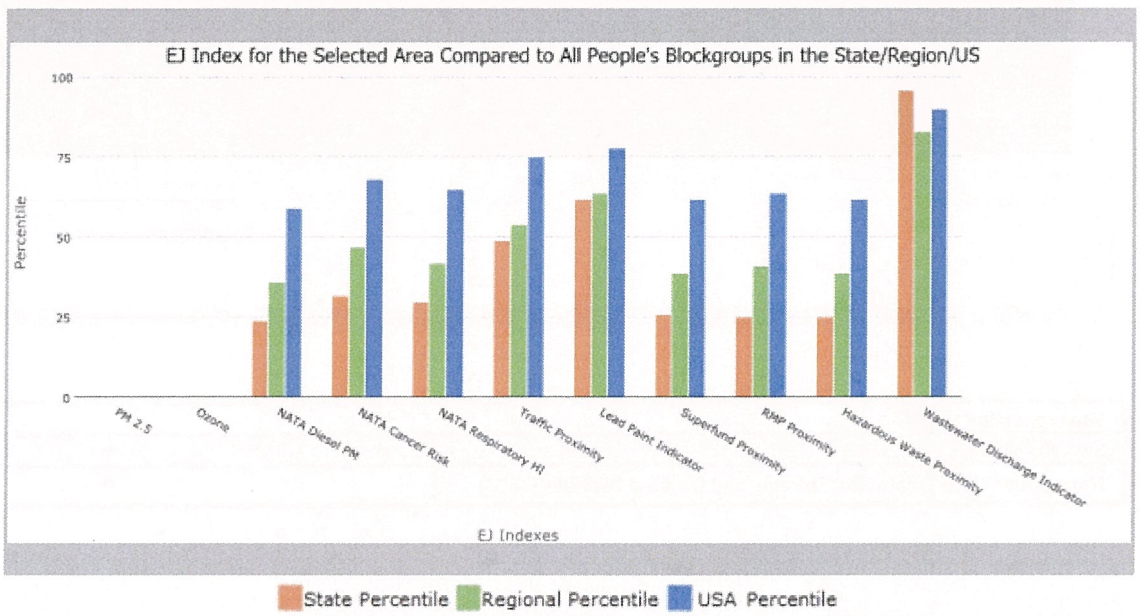
EJSCREEN Report (Version 2017)

1 mile Ring Centered at 22.104293,-159.305009, HAWAII, EPA Region 9

Approximate Population: 337

Input Area (sq. miles): 3.14

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	N/A	N/A	N/A
EJ Index for Ozone	N/A	N/A	N/A
EJ Index for NATA* Diesel PM	24	36	59
EJ Index for NATA* Air Toxics Cancer Risk	32	47	68
EJ Index for NATA* Respiratory Hazard Index	30	42	65
EJ Index for Traffic Proximity and Volume	49	54	75
EJ Index for Lead Paint Indicator	62	64	78
EJ Index for Superfund Proximity	26	39	62
EJ Index for RMP Proximity	25	41	64
EJ Index for Hazardous Waste Proximity	25	39	62
EJ Index for Wastewater Discharge Indicator	96	83	90

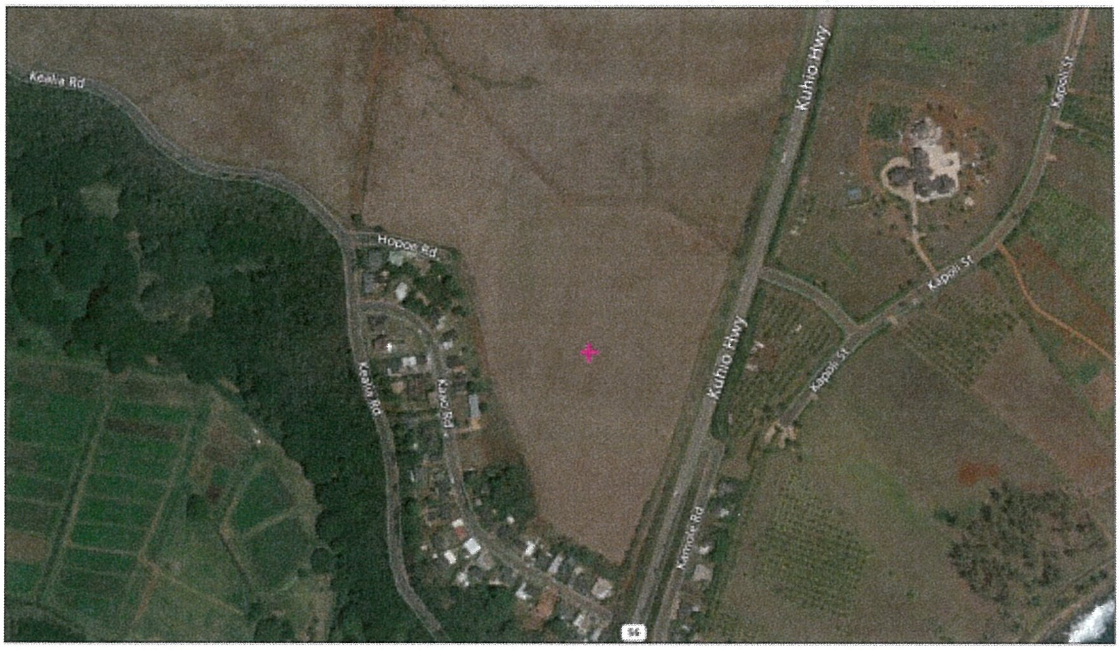


This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

1 mile Ring Centered at 22.104293,-159.305009, HAWAII, EPA Region 9

Approximate Population: 337

Input Area (sq. miles): 3.14



December 14, 2017

+ Digitized Point

1:4,514

0 0.0375 0.075 0.15 mi

0 0.05 0.1 0.2 km

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EPA United States Environmental Protection Agency

EJSCREEN Report (Version 2017)

1 mile Ring Centered at 22.104293,-159.305009, HAWAII, EPA Region 9

Approximate Population: 337

Input Area (sq. miles): 3.14

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in $\mu g/m^3$)	N/A	N/A	N/A	9.9	N/A	9.14	N/A
Ozone (ppb)	N/A	N/A	N/A	41.8	N/A	38.4	N/A
NATA* Diesel PM ($\mu g/m^3$)	0.0172	0.149	12	0.978	<50th	0.938	<50th
NATA* Cancer Risk (lifetime risk per million)	26	34	17	43	<50th	40	<50th
NATA* Respiratory Hazard Index	0.58	1	18	2	<50th	1.8	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	97	1000	44	1100	36	590	50
Lead Paint Indicator (% Pre-1960 Housing)	0.18	0.16	64	0.24	55	0.29	48
Superfund Proximity (site count/km distance)	0.0067	0.1	25	0.15	5	0.13	1
RMP Proximity (facility count/km distance)	0.067	0.39	12	0.98	5	0.73	8
Hazardous Waste Proximity (facility count/km distance)	0.0061	0.1	21	0.12	2	0.093	1
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0.01	0.04	93	13	76	30	80
Demographic Indicators							
Demographic Index	55%	51%	62	47%	62	36%	77
Minority Population	64%	77%	21	59%	53	38%	76
Low Income Population	46%	26%	89	36%	67	34%	71
Linguistically Isolated Population	2%	6%	39	9%	28	5%	56
Population With Less Than High School Education	9%	9%	63	17%	39	13%	46
Population Under 5 years of age	3%	6%	20	7%	22	6%	23
Population over 64 years of age	15%	16%	47	13%	68	14%	60

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

For additional information, see: www.epa.gov/environmentaljustice

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March 15, 2018

Ms. Laura Leialoha Phillips McIntyre, AICP
Environmental Planning Office
State of Hawaiʻi Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 14, 2017

Dear Ms. McIntyre:

Thank you for your comment letter dated December 14, 2017 referenced above. We appreciate your providing references and links to so many useful and pertinent sources of environmental data. We will review DOH's standard comments and strategies for healthy and sustainable design, and regulations and requirements of the Clean Water Branch, Wastewater Branch, and Clean Air Branch. We appreciate the references provided pertaining to hazardous waste and noise, the Hawaiʻi Environmental Health Portal and DCAB.

A Phase I Environmental Site Assessment that included the project has been completed and will be discussed in the Draft EIS. The EIS will also discuss conformance with Hawaiʻi's Complete Streets law, pedestrian corridors and other social influences on public health.

Thank you for the link to the U.S. Environmental Protection Agency's Environmental Justice (EJ) mapping and screening tool (EJSCREEN) and for including a copy of the EJSCREEN Report for the project area.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Pacific Guardian Center | 733 Bishop Street, Suite 2590 | Honolulu, Hawaii 96813
Telephone: 808.545.2055 | Facsimile: 808.545.2050 | www.hhf.com | email: info@hhf.com

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

JANET M. BERREMAN, M.D., M.P.H., F.A.A.P.
DISTRICT HEALTH OFFICER

STATE OF HAWAII
DEPARTMENT OF HEALTH
KAUAI DISTRICT HEALTH OFFICE
3040 UMI STREET
LIHUE, HAWAII 96766

December 22, 2017

Mr. Scott Ezer, Vice President
HHF Planners
733 Bishop Street, Suite 2590
Honolulu, HI 96813
Email: sezer@hhf.com

Dear Mr. Ezer,

SUBJECT: **EISPN Kealia Mauka Homesites**
Project: **Kealia Mauka (EPO 17-298)**
Applicant: Kealia Properties, LLC.

We have reviewed the subject Environmental Impact Statement Preparation Notice online and in addition to the comments submitted by the Environmental Planning Office of the Department of Health, we offer the following environmental health comments for consideration.

1. The subdivision consists of 50 lots/dwelling units or more. The use of individual wastewater systems is not allowed under the provisions of Title 11, Hawaii Administrative Rules (HAR), Chapter 11-62, 'Wastewater Systems". Please have your engineer submit plans for a wastewater treatment works to the State Department of Health (DOH) Wastewater Branch (WWB) or produce a 'Will Serve' letter from the County of Kauai for connection to the county sewer system. This project appears to require significant infrastructure for any connection to the county sewer system and WWB supports any sewer infrastructure requirements made by the County for this project. The Wailua Wastewater Treatment Plant capacity appears be around 50% of the design capacity. However, there are other housing developments proposed that could substantially impact this available capacity.

2. The size of the proposed subdivision will modify the existing Kealia Water Company Holdings, LLC drinking water distribution system significantly. The applicant shall contact the Safe Drinking Water Branch of the Department of Health at 808-586-4258 to resolve this concern.

3. The property may harbor rodents which will disperse to the surrounding areas

when the site is cleared. In accordance with Title 11, HAR, Chapter 11-26, "Vector Control", the applicant shall ascertain the presence or absence of rodents on the property. Should the presence of rodents be determined, the applicant shall eradicate the rodents prior to clearing the site.

4. Noise will be generated during the construction phase of this project. The applicable maximum permissible sound levels as stated in Title 11, HAR, Chapter 11-46, "Community Noise Control", shall not be exceeded unless a noise permit is obtained from the DOH.

5. Temporary fugitive dust emissions could be emitted when the project site is prepared for construction and when construction activities occur. In accordance with Title 11, Hawaii Administrative Rules, Chapter 11-60.1, "Air Pollution Control", effective air-pollution control measures shall be provided to prevent or minimize any fugitive dust emissions caused by construction work from affecting the surrounding areas. This includes the off-site roadways used to enter/exit the project. The control measures include but are not limited to the use of water wagons, sprinkler systems, dust fences, etc.

6. The construction waste that will be generated by the project shall be disposed of at a solid waste disposal facility that complies with the applicable provisions of Title 11, HAR, Chapter 11-58.1, "Solid Waste Management Control", the open burning of any of these wastes on or off site prohibited.

7. The DOH, Clean Water Branch (CWB) has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii 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://health.hawaii.gov/epo/files/2013/05/Clean-Water-Branch-Std-Comments.pdf

8. 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).

9. You may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).

10. For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for a NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee ($1,000 for an individual NPDES permit or $500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: https://eha-cloud.doh.hawaii.gov/epermit/. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the appropriate form. Follow the instructions to complete and submit the form.

11. If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6);
Title 40 of the Code of Federal Regulations, Section 122.2; and Hawaii Administrative Rules (HAR), Chapter 11-54.

12. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

13. It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:

   a. Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects natural ecosystems and traditional beneficial uses of State waters, like

community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological
bioengineering of drainage ways must be identified in the planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

b. Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g. minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.

c. Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.

d. Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.

e. Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.

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

14. National Pollutant Discharge Elimination System (NPDES) permit coverage is required for pollutant discharges into State surface waters and for certain situations involving storm water (HAR, Chapter 11-55).

   a. Discharges into Class 2 or Class A State waters can be covered under an NPDES general permit only if all of the NPDES general permit requirements are met. Please see the DOH-CWB website (http://health.hawaii.gov/cwb/) for the NPDES general permits and instructions to request coverage.

   b. All other discharges into State surface waters (including discharges from Concentrated Animal Feeding Operations) and discharges into Class 1 or Class AA State waters require an NPDES individual permit. To request NPDES individual permit coverage, please see the DOH-CWB forms website located at: http://health.hawaii.gov/cwb/site-map/clean-water-branch-home-page/forms/

c. NPDES permit coverage for storm water associated with construction activities is required if your project will result in the disturbance of one (1) acre or more 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. NPDES permit coverage is required before the start of the construction activities.

Land disturbance includes, but is not limited to clearing, grading, grubbing, uprooting of vegetation, demolition (even if leaving foundation slab), staging, stockpiling, excavation into pavement areas which go down to the base course, and storage areas (including areas on the roadway to park equipment if these areas are blocked off from public usage, grassed areas, or bare ground).

15. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

Should you have any questions, please call me at 241-3323.

Sincerely,

Gerald N. Takamura

Gerald N. Takamura, Chief
District Environmental Health Program Kaua'i

GNT: DTT

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March 15, 2018

Mr. Gerald N. Takamura, Chief
State of Hawaiʻi Department of Health
Kauaʻi District Health Office
3040 Umi Street
Līhuʻe, Hawaii 96766

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 22, 2017

Dear Mr. Takamura:

Thank you for your comment letter dated December 22, 2017 providing additional comments to those submitted by the DOH Environmental Planning Office. We offer the following responses to your comments:

1. The project civil engineers have held preliminary discussions with the County of Kauaʻi Department of Public Works, Wastewater Management Division. The County indicated that it would service the proposed subdivision, but that they typically do not issue "will serve" letters until the developments have obtained zoning approvals. The Draft EIS will discuss the existing and proposed wastewater system and estimated wastewater generation quantities.
2. The Draft EIS will describe the existing Keālia Water System (KWS), source wells, and the project's proposed water system. The KWS is owned by the entity Keālia Water Company Holdings LLC (Water Company). There is a Water Service Agreement between the KWS and the owners of the subject property, which allows a daily aggregate of 300,000 gallons of potable water per day to be reserved for the use of the owners of the project site. This is sufficient to meet the potable water needs of the project.
3. The applicant will comply with Title 11, HAR Chapter 11-26, Vector Control prior to site clearing.
4. The applicant will comply with Title 11, HAR Chapter 11-46, Community Noise Control during the construction phase of the project.
5. The project will comply with Title 11, HAR Chapter 11-60.1, Air Pollution Control, to prevent or minimize fugitive dust caused by construction work.
6. All construction waste will be disposed of in accordance with Title 11, HAR, Chapter 11-58.1, Solid Waste Management Control. No open burning of waste will occur.
7. Acknowledged.
8. The project will comply with the state's antidegradation policy, designated uses, and water quality criteria as cited.

9. The project will comply with applicable NPDES requirements for discharges of wastewater, including storm water runoff, into State surface waters.
10. Acknowledged.
11. The U.S. Army Corps of Engineers, Regulatory Branch has been asked to comment on the project as part of the EISPN process. There is no proposed work in, over or under waters of the U.S., and it is not anticipated that the project will impact waters of the U.S.
12. Project will comply with State Water Quality Standards.
13. The proposed subdivision includes two proposed detention basins on site. Storm water generated from each individual lot within the project area will be directed to the nearest downstream street or natural drainage way that will collect the storm water and convey it to the detention basins on site. The detention basins will moderate the storm flows and allow infiltration back into the soil. Post-development runoff will be less than that of current undeveloped conditions. Drainage issues and recommendations will be discussed further in the Draft EIS.
14. Project will comply with applicable National Pollutant Discharge Elimination System (NPDES) permit requirements.
15. All discharges related to project construction and operation will comply with the State's Water Quality Standards.

A copy of your comment letter has been forwarded to the project's civil engineering consultant for their information and incorporation into their report. Your letter and this response will be reproduced in the Draft EIS. Thank you for your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
SAFE DRINKING WATER BRANCH
2385 WAIMANO HOME ROAD
ULUAKUPU BLDG. 4
PEARL CITY, HI 96782

In reply, please refer to:
File: SDWB
Keālia Mauka01.docx

December 27, 2017

Mr. Scott Ezer
Vice President
HHF Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
[via sezer@hhf.com only]

Dear Mr. Ezer:

SUBJECT: PROPOSED KEĀLIA MAUKA HOMESITES
ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
KEĀLIA, KAWAIHAU, PUNA, ISLAND OF KAUAI
TMK: (4) 4-7-004: POR. 001

The Safe Drinking Water Branch (SDWB) has reviewed the subject document and has the following comments:

1. Section 5.2.2.2 – Potable Water indicates the Keālia Mauka Homesites owner and the Keālia Water Company Holdings, LLC have signed a water agreement to provide 300,000 gallons per day of potable water to the future owners of 235 residential lots in the Project Area. A copy of the signed water agreement shall be submitted to SDWB for review when the construction plans are submitted.

   This project qualifies as a substantial modification of the existing Keālia (PWS 423) water system.

2. Projects proposing substantial modifications to existing public water systems must receive approval by the Director prior to construction of the proposed system or modification in accordance with Hawaii Administrative Rules (HAR) Section 11-20-30, "New and modified public water systems." These projects include treatment, storage and distribution systems of public water systems.

3. All projects which propose the use of dual water systems or the use of a non-potable water system in proximity to an existing drinking water system to meet irrigation or other needs must be carefully designed and operated to prevent the cross-connection of these systems and prevent the possibility of backflow of water from the non-potable system to the drinking water system. The two (2)

systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow prevention devices to avoid contaminating the drinking water supply. In addition, backflow devices must be tested periodically to assure their proper operation. Further, all non-potable spigots and irrigated areas should be clearly labeled with warning signs to prevent the inadvertent consumption on non-potable water. Compliance with HAR, Chapter 11-21, "Cross-Connection and Backflow Control" is also required.

4. All projects which propose the establishment of a potentially contaminating activity (as identified in the Hawai`i Source Water Assessment Plan) within the source water protection area of an existing source of water for a public water supply should address this potential and identify activities that will be implemented to prevent or reduce the potential for contamination of the drinking water source.

If there are any questions, please call Ms. Jennifer Nikaido of the SDWB Engineering Section at 586-4258.

Sincerely,

Joanna L. Seto

JOANNA L. SETO, P.E., CHIEF
Safe Drinking Water Branch

JN:cb

c: EPO 17298 [via email only]
Mr. Darren Tamekazu, Kauai DHO [via darren.tamekazu@doh.hawaii.gov only]
Mr. Greg Kingsley, Kealia Water Co. Holdings, LLC
[via gkingsley@cstoneholdings.com only]

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March 15, 2018

Ms. Joanna L. Seto, P.E., Chief
State of Hawaiʻi Department of Health
Safe Drinking Water Branch
2385 Waimano Home Road
Uluakupu Bldg. 4
Pearl City, HI 96782

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 27, 2017

Dear Ms. Seto:

Thank you for your comment letter dated December 14, 2017. We offer the following responses to your comments:

1. A copy of the signed water agreement will be submitted to SDWB for review when construction plans are submitted.
2. Plans for the water system improvements will be submitted to the DOH prior to construction of the proposed system or modification in accordance with HAR Section 11-20-30, "New and modified public water systems."
3. The project will comply with HAR, Chapter 11-21, "Cross-Connection and Backflow Control" as applicable.

Your letter has been forwarded to the project's civil engineering consultant for their information and incorporation. Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Leslie Kurisaki

From:	Scott Ezer
Sent:	Tuesday, December 19, 2017 12:25 PM
To:	Leslie Kurisaki
Subject:	FW: Comment regarding Keälia Mauka Homesites EIS, on Kauai

FYI

From: Peard, Randall John [mailto:randall.peard@doh.hawaii.gov]
Sent: Tuesday, December 19, 2017 12:17 PM
To: Orodenker, Daniel E <daniel.e.orodenker@hawaii.gov>
Cc: Scott Ezer <sezer@hhf.com>; moana@mskauai.com; Mow, Steven P <steven.mow@doh.hawaii.gov>; DOH.EPO <DOH.epo@doh.hawaii.gov>; Grange, Gabrielle Fenix <Gabrielle.Grange@doh.hawaii.gov>
Subject: Comment regarding Keälia Mauka Homesites EIS, on Kauai

To whom it may concern,
I recently saw information in the November 23, 2017 OEQC newsletter about the Subject proposed residential development project on Kaua'i. I want to recommend, if this has not already been recommended by the Dept. of Health, that any EIS approval or future residential development at this location be "conditioned" on the requirement that the applicant's environmental consultant conduct an assessment of the site for potential soil contamination from past sugarcane production activity on this site. This is a standard recommendation from the Department of Health for all new residential (or commercial) developments on former sugarcane or pineapple agricultural lands … especially those that were in production after about 1912 when arsenic and subsequently pentachlorophenol (with dioxin contaminants) and possibly organochlorine pesticides were utilized for weed or insect control by the agriculture industry. These chemicals, now all generally banned due to unacceptable human or environmental health risks, are stable or persistent in the environment and sometimes still found decades after their use at levels that present unacceptable health risks … especially for kids in a proposed residential land use. Levels of these chemicals will vary depending on the past practices of the plantation that was in that area, nature of the work/operations on the specific site, and these factors vary significantly from location to location. Hopefully, levels are low on this particular site and will not present a situation where remediation of the soil would be necessary before development, but only good representative soil sampling can answer that question.

If the proposed development area was only formerly used as sugarcane growing fields (based on best estimates from a quality Phase 1 ESA including aerial photos and other historical records, interviews, and a walkaround of the entire site) then the chemicals of potential concern to be evaluated in soils would be limited to only arsenic and the organochlorine pesticides. If the Phase 1 ESA reveals there were other associated sugarcane operations on a portion of the site (e.g. pesticide storage or mixing areas, former camp housing, drum disposal areas, equipment storage areas), then additional chemicals of concern would be required to be investigated for those areas. Target chemicals for assessing former sugarcane or pineapple lands as well as HDOH-approved sampling strategies and soil sampling methods are provided in the HDOH HEER Office's Technical Guidance Manual (TGM; www.hawaiidoh.org). Section 9.1 of the TGM includes specific guidance on selecting contaminants for the investigation of former sugarcane or pineapple lands, and Sections 3, 4, and 5 provide detailed guidance on soil sampling strategy and sampling methods that should be followed. I also suggest that any soil sampling plan developed for the site be first reviewed and approved by the HDOH HEER Office … request for such as review can be made through contacting our main office in Pearl City on O'ahu, at 808-586-4249. Once results of the soil sampling data is available, the HEER Office can also provide a "closure letter" documenting "No Further Action" necessary if all soil contaminant concentrations are below applicable State Environmental Action Levels, or provide additional guidance regarding additional evaluation or remediation work if any contaminant(s) are detected above applicable Action Levels.

As I noted above, these are standard recommendations by the HDOH HEER Office for former sugarcane or pineapple agricultural lands being converted to residential or commercial use, so are applicable to any similar current or future request for environmental impact review or land use change by the Reviewing Authority, unless the applicant has already investigated the extent of historic soil contamination on the former agricultural lands and has documentation to prove the soil sampling methods used were representative and soil contaminant levels for chemicals of potential concern were below applicable HDOH HEER Office Environmental Action Levels for residential or commercial use (as applicable).

Thank you. I understand that the comment period for this site extends through Dec. 26, 2017, so please include these comments in the record for review and response. Also, please let me know if you have any questions regarding these comments. John

John Peard, Remediation Project Manager
Hawai‘i Dept. of Health, Hazard Evaluation & Emergency Response Office (HEER Office)
Hawai‘i District Health Office
1582 Kamehameha Ave., Hilo, HI 96720-4623
randall.peard@doh.hawaii.gov
(808) 933-9921 (office)

HHF PLANNERS
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March 15, 2018

Mr. Randall John Peard, Remediation Project Manager
State of Hawaiʻi Department of Health
Hazard Evaluation & Emergency Response Office (HEER)
Hawaiʻi District Health Office
1582 Kamehameha Ave.
Hilo, Hawaiʻi 96720-4623

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Email comments dated December 19, 2017

Dear Mr. Peard:

Thank you for your email sent December 19, 2017 providing comments from the DOH HEER Office. Your letter recommends that future residential development be conditioned on an assessment of the site for potential soil contamination from past sugarcane production activity. You indicate this is a standard DOH recommendation for all new residential (or commercial) developments on former sugar cane or pineapple agricultural lands, especially those in production after about 1912 when arsenic and subsequently pentachlorophenol (with dioxin contaminants) and possibly organochlorine pesticides were utilized for weed or insect control.

A Phase I Environmental Site Assessment was completed for a 2,000 acre area (comprised of several TMK parcels), which were at the time owned by Cornerstone Hawaiʻi Holdings and Kealia Plantation. The Phase I ESA was as conducted for Kealia Plantation Partners Kauaʻi, LLC as part of their due diligence activities prior to purchase of the property. The 235-acre Kealia Homesites project area is part of that 2,000 acre study area. The Phase I ESA (Belt Collins Hawaii Ltd, June 2005) revealed previous land uses within the study area included a sugar mill, vehicle storage and maintenance, service station, and rodeo ring. The area also included above and underground storage tanks. According to maps provided in the document, these activities do not appear to have been conducted within the current Keālia Mauka Homesites project area.

As recommended in your letter, soil sampling within the project area will be conducted prior to development of the site. A soil sampling plan, identifying chemicals of potential concern and the proposed testing methodology will be developed based on guidance in the DOH HEER Office's Technical Guidance Manual. The sampling plan will be submitted to the HEER office for review and approval. Test results and recommendations will be submitted to your office, and a closure letter documenting "No Further Action" will be obtained. Additional evaluation and/or remediation work needed will be completed prior to the commencement of construction.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawai'i Management Services LLC
Daniel Orodenker, State of Hawai'i Land Use Commission

DAVID Y. IGE
GOVERNOR

DR. CHRISTINA M. KISHIMOTO
SUPERINTENDENT

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

OFFICE OF SCHOOL FACILITIES AND SUPPORT SERVICES

December 22, 2017

Ms. Moana Palama
Hawaii Management Services, LLC
P.O. Box 1630
Koloa, Hawaii 96756

Re: Environmental Impact Statement Preparation Notice for the Proposed Kealia Mauka Homesite Project, Kawaihau District Kauai, TMK: 4-7-004: por. 001

Dear Ms. Palama:

The Department of Education (DOE) has the following comments for the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Kealia Mauka Homesite Project (Project). According to the EISPN, the proposed Project is for the development of 235 single-family house lots on approximately 53.4 acres of land located at Kealia Ahupuaa, Kawaiahu District, Island of Kauai, TMK: 4-7-004: por. 001.

The DOE schools currently serving the proposed Project are Kapaa Elementary, Kapaa Intermediate, and Kapaa High School. Kapaa Elementary School has classroom capacity for approximately 29 additional students. However, excess capacity is expected to be eliminated over the next five years. Kapaa Intermediate School has classroom capacity for roughly 125 additional students, which is expected to remain the same for the next five years. Kapaa High School is over capacity by 100 students. The over capacity condition will continue over the next five years.

The Draft EIS should include a discussion on whether the Project meets zoning and code requirements that allows for the construction of Additional Dwelling Units (ADU). This information will assist the DOE to estimate the number of students who will reside in there.

Thank you for the opportunity to comment. Should you have any questions, please contact Heidi Meeker of the Planning Section, Facilities Development Branch at (808) 784-5094.

Respectfully,

Kenneth G. Masden II
Public Works Manager
Planning Section

KGM:jmb

c: Mr. Daniel Orodenker, State Land Use Commission
Ms. Leslie Kurisaki, HHF Planners

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March 15, 2018

Mr. Kenneth G. Masden II
Public Works Manager
State of Hawaiʻi Department of Education
Planning Section
P.O. Box 2360
Honolulu, Hawaiʻi 96804

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment Letter dated December 22, 2017

Dear Mr. Masden:

Thank you for your comment letter dated December 22, 2017. Your letter identified the DOE schools currently serving the proposed project area as Kapaʻa Elementary, Kapaʻa Intermediate, and Kapaʻa High School. You indicate that while Kapaʻa Elementary School currently has classroom capacity for approximately 29 additional students, this excess capacity is expected to be eliminated over the next five years. Kapaʻa Intermediate School has classroom capacity for about 125 additional students which is expected to remain the same, and Kapaʻa High School is over capacity by 100 students.

It is anticipated that the majority of Keālia Mauka families will be Hawaiʻi residents living on-island. The project is intended to provide housing opportunities for local families who are already part of the island population base, and their children are already attending Kauaʻi schools. However, it is possible that some of these families currently live outside the Kapaʻa region; therefore their children may be a new addition to enrollment at the Kapaʻa complex schools. The Draft EIS will estimate the number of school aged children generated by the proposed subdivision at the elementary, intermediate, and high school levels, based on standard DOE multipliers. It will also discuss what percentage of homeowners are expected to be existing Hawaiʻi versus new residents.

As requested, the Draft EIS will include a discussion on whether the project meets zoning and code requirements that allows for the construction of Additional Dwelling Units (ADU), in order to assist the DOE in estimating the number of students. We are working with Ms. Heidi Meeker of your Facilities Development Branch to come up with these estimates.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 21, 2017

Hawaii Management Services, LLC
Attention: Ms. Moana Palama
P.O. Box 1630
Koloa, Hawaii 96756

via email: moana@mskauai.com

Dear Ms. Palama:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites; Kawaihau District, Island of Kauai

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

At this time, enclosed are comments from the (a) Engineering Division and (b) Land Division – Kauai District on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

cc: David Orodenker; Dept. of Business, Economic Development and Tourism
Daniel.e.orodenker@hawaii.gov
Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2017 DEC 14 AM 11:09
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

SUZANNE D. CASE
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

November 27, 2017

'17 NOV 28 AM 10:36 ENGINEERING

MEMORANDUM

~~TO:~~ FROM

DLNR Agencies:
__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
X Land Division – Kauai District
X Historic Preservation

~~FROM:~~ TO Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites
LOCATION: Kawaihau District, Island of Kauai; TMK: (4) 4-7-004:001 (por.)
APPLICANT: Kealia Properties LLC

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **December 21, 2017.**

The EISPN can be found on-line at: http://health.hawaii.gov/oeqc/ (Click on the Current Environmental Notice in the middle of the page.)

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

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

Signed: [signature]

Print Name: Carty S. Chang, Chief Engineer
Date: 12/12/17

Attachments

cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites, Kawaihau District, Island of Kauai;
TMK: (4) 4-7-004:001 (por.)

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high risk areas). Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM), which can be viewed on our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT).

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7253.
- Kauai: County of Kauai, Department of Public Works (808) 241-4846.

Signed: [signature]
CARTY S. CHANG, CHIEF ENGINEER

Date: 12/12/17

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
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

November 27, 2017

MEMORANDUM

~~TO:~~ FROM

DLNR Agencies:
__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
_X_Land Division – Kauai District
_X_Historic Preservation

~~FROM:~~ TO ~~Russell Y. Tsuji, Land Administrator~~

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites

LOCATION: Kawaihau District, Island of Kauai; TMK: (4) 4-7-004:001 (por.)

APPLICANT: Kealia Properties LLC

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **December 21, 2017**.

The EISPN can be found on-line at: http://health.hawaii.gov/oeqc/ *(Click on the Current Environmental Notice in the middle of the page.)*

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

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

Signed: Wesley Matsunaga

Print Name: Wesley T. Matsunaga

Date: 12/7/17

Attachments

cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 28, 2017

Hawaii Management Services, LLC
Attention: Ms. Moana Palama
P.O. Box 1630
Koloa, Hawaii 96756

via email: moana@mskauai.com

Dear Ms. Palama:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites; Kawaihau District, Island of Kauai

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent you on December 21, 2017, enclosed are comments from the (a) Commission on Water Resource Management and (b) Division of Forestry & Wildlife on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

cc: David Orodenker; Dept. of Business, Economic Development and Tourism
daniel.e.orodenker@hawaii.gov
Central Files

RECEIVED
LAND DIVISION
2017 DEC 22 AM 10: 28

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
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
COMMISSION ON WATER RESOURCE MANAGEMENT
2017 NOV 28 AM 11:05

November 27, 2017

MEMORANDUM

TO: **DLNR Agencies:**
__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
X Land Division – Kauai District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites
LOCATION: Kawaihau District, Island of Kauai; TMK: (4) 4-7-004:001 (por.)
APPLICANT: Kealia Properties LLC

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **December 21, 2017.**

The EISPN can be found on-line at: *http://health.hawaii.gov/oeqc/* *(Click on the Current Environmental Notice in the middle of the page.)*

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

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

Signed: /s/ Jeffrey T. Pearson, P.E.

Print Name: Deputy Director
Date: December 21, 2017

Attachments

cc: Central Files

FILE ID: RFD.4737.2
DOC ID: 18760.1

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

December 21, 2017

REF: RFD.4737.2

TO: Mr. Russell Tsuji, Administrator
Land Division

FROM: Jeffrey T. Pearson, P.E., Deputy Director
Commission on Water Resource Management

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Kealia Mauka Homesites

FILE NO.: RFD.4737.2
TMK NO.: (4) 4-7-004:001 (por.)

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

Our comments related to water resources are checked off below.

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

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

[X] 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.

[X] 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EAP as having high water efficiency can be found at http://www.epa.gov/watersense.

[X] 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://planning.hawaii.gov/czm/initiatives/low-impact-development/

[X] 6. We recommend the use of alternative water sources, wherever practicable.

[ ] 7. We recommend participating in the Hawaii Green Business Program, that assists and recognizes businesses that strive to operate in an environmentally and socially responsible manner. The program description can be found online at http://energy.hawaii.gov/green-business-program.

[ ] 8. We recommend adopting landscape irrigation conservation best management practices endorsed by the Landscape Industry Council of Hawaii. These practices can be found online at http://www.hawaiiscape.com/wp-content/uploads/2013/04/LICH_Irrigation_Conservation_BMPs.pdf.

- [ ] 9. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.
- [ ] 10. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water. The Water Use Permit may be conditioned on the requirement to use dual line water supply systems for new industrial and commercial developments.
- [ ] 11. A Well Construction Permit(s) is (are) are required before the commencement of any well construction work.
- [ ] 12. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.
- [ ] 13. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.
- [ ] 14. Ground-water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.
- [ ] 15. A Stream Channel Alteration Permit(s) is (are) required before any alteration can be made to the bed and/or banks of a steam channel.
- [ ] 16. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is constructed or altered.
- [ ] 17. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.
- [ ] 18. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

- [X] OTHER: The Draft EIS should discuss water requirements for the project, both potable and non-potable, and the calculations for the demand projections. The EIS Preparation Notice indicates that potable water will be supplied by two existing wells via an existing private domestic water system, for which the there is a water service agreement in place. The Draft EIS should identify the two wells by their State Well Nos., their installed pump capacities, and current pumpage amounts. In general, the Commission encourages the use of alternative water sources for non-potable needs, and any proposed alternative sources should be identified. The Draft EIS should disclose the water conservation and efficiency measures to be implemented. The Draft EIS should also discuss ground and surface water resources of the project area and how those may be impacted by the proposed development.

  Kealia Wells 1A & 2A (well nos. 3-0618-009 & 010, respectively) currently report a combined average use between 30,000 to 40,000 gallons per day since 2008. There are two other wells Kealia 6 & 7 (well nos. 3-0618-006 & 005, respectively) that are reporting no use and are not part of the Kealia Public Water System. There are also 5 abandoned wells in the vicinity of the water system wells, 2 that have been properly sealed, and 3 which cannot be found and are considered lost. If any of those 3 wells are discovered they should be properly sealed in accordance with the Hawaii Well Construction and Pump Installation Standards, 2004 with work permitted through the Commission.

If you have any questions, please contact Lenore Ohye of the Planning Branch at 587-0216 or W. Roy Hardy of the Regulation Branch at 587-0225.

DAVID Y. IGE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

December 21, 2017

TO: Russel Tsuji
Land Administrator

ATTN: Lydia Morikawa

FROM: James Cogswell
Wildlife Program Manager

SUBJECT: Division of Forestry and Wildlife Comments on the Kealia Mauka Homesites Environmental Impact Statement Preparation Notice

The Division of Forestry and Wildlife has received your inquiry regarding the Kealia Mauka Homesite Environmental Impact Statement Preparation Notice. The proposed project is located in the Kawaihau District, Island of Kauai, TMK (4) 4-7-004: por. 001. The proposed project would be a 53.4 acre residential subdivision and include 235 lots and infrastructure improvements such as installation of utility infrastructure and transportation improvements.

The State and Federally listed Hawaiian hoary bat or ʻŌpeʻapeʻa (*Lasiurus cinereus semotus*) has the potential to occur in the vicinity of the proposed project. DOFAW recommends to avoid using barbed wire, as bat mortalities have been documented as a result of becoming ensnared by barbed wire during flight. Hawaiian hoary bats roost in both exotic and native trees. If any trees are planned for removal during the bat breeding season there is a risk of injury or mortality to juvenile bats. To minimize the potential for impacts to this species, woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15). Site clearing should be timed to avoid disturbance to breeding Hawaiian hoary bats.

The State and Federally listed Hawaiian goose, or Nēnē (*Branta sandvicensis*) has been observed in the mauka pasture lands adjacent to Kuhio Highway. While DOFAW has no records of nesting activity in the proposed project site, we recommend a survey be conducted during the fall/winter nesting season between October and March to determine whether birds are using the area.

Should night work be required, DOFAW cautions that artificial lighting can adversely impact endangered and threatened seabirds that may pass through the area at night, causing disorientation which could result in collision with manmade artifacts or grounding of birds. DOFAW recommends that any lights used be fully shielded to minimize impacts. If night work is to occur during the seabird fledging period (September – December) we request further consultation with DOFAW.

We appreciate your efforts to work with our office for the conservation of native species. Should the scope of the project change, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Katherine Cullison, Conservation Initiatives Coordinator at (808) 587-4148 or Katherine.cullison@hawaii.gov.

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March 15, 2018

Mr. Russell Y. Tsuji, Land Administrator
State of Hawaiʻi Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawaiʻi 96809

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
DLNR Comments transmitted on December 21 and December 28, 2017

Dear Mr. Tsuji:

Thank you for submitting DLNR's comments in response to the subject EISPN, which were transmitted on December 22, 2017 and December 28, 2017. We offer the following responses to the comments provided:

Engineering Division
The project site is located in the Federal Emergency Management Agency (FEMA) flood Zone X, area of minimal flood hazard, determined to be outside the 500-year flood. The project will comply with the rules and regulations of the National Flood Insurance Program.

Land Division
We note the Land Division has no comments.

Commission on Water Resource Management
The project engineers have held preliminary discussions with the County of Kauaʻi Department of Water Supply, and the Planning Department and the Hawaiʻi Department of Agriculture have been contacted as part of this EIS process. Best management practices will be implemented for stormwater management.

The project will utilize the Keālia Water System, a private domestic water system in the area controlled by the Keālia Water Company Holdings LLC. There is a Water Service Agreement (dated December 22, 2004) between the Keālia Water Company and the owners of the subject property, which allows a daily aggregate of 300,000 gallons of potable water per day to be reserved for the use of the owners. This is sufficient to meet the potable water needs of the project. The Draft EIS will discuss the project's water requirements, describe the existing Keālia Water System, source wells, and the project's proposed water system.

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Division of Forestry and Wildlife
The Draft EIS will discuss potential project impacts on the state and federally listed species mentioned in your letter, including the Hawaiian hoary bat *(Lasiurus cinereus semotus)*, Hawaiian goose or Nēnē *(Branta sandvicensis),* and species of Hawaiian waterbirds; in particular the endangered Hawaiian stilt *(Himantopus mexicanus knudseni)* known to nest in areas with ponding water. The DEIS will recommend mitigation measures including those cited in your comments.

A copy of your letter has been forwarded to the project engineers for their information. Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

UNIVERSITY of HAWAI'I®
MĀNOA

Water Resources Research Center

December 7, 2017

Hawaii Management Services, LLC
PO Box 1630
Koloa, HI 96756
Attn: Ms. Moana Palama

Ms. Palama:

This is to acknowledge receipt of your letter for review of an Environmental Impact Statement Preparation Notice for the Kealia Mauka Homesites, Kawaihau District, Island of Kauai.

Unfortunately, the Water Resources Research Center does not have the capacity to review the EISPN at this time due to the faculty position vacancy.

While we continue to explore filling the current vacancy, the Center will exclude itself from commentary on this specific environmental assessment study.

Sincerely,

Darren T. Lerner, PhD
Interim Director

2540 Dole Street, Holmes Hall 283
Honolulu, Hawai'i 96822
Telephone: (808) 956-7847
Fax: (808) 956-5044

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March 15, 2018

Dr. Darren T. Lerner, Ph.D.
University of Hawaiʻi at Mānoa
Water Resources Research Center
2540 Dole Street, Holmes Hall 283
Honolulu, HI 96822

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 7, 2017

Dear Dr. Lerner:

Thank you for your comment letter dated December 7, 2017, stating that the Water Resources Research Center does not have the capacity to review the EISPN at this time.

Your letter and this response will be reproduced in the Draft EIS. Thank you for your input.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

DAVID Y. IGE
GOVERNOR

JADE T. BUTAY
INTERIM DIRECTOR

Deputy Directors
ROSS M. HIGASHI
EDWIN H. SNIFFEN
DARRELL T. YOUNG

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

IN REPLY REFER TO:
DIR 1479
STP 8.2273

December 14, 2017

Ms. Moana Palama
Hawaii Management Services, LLC
P.O. Box 1630
Koloa, Hawaii 96756

Dear Ms. Palama:

Subject: Kealia Mauka Homesites
Environmental Impact Statement Preparation Notice
Kawaihau District, Kauai, Hawaii
TMK: (4) 4-7-004:001 (por.)

Kealia Properties, LLC, proposes to develop a housing development of approximately 235 single-family dwellings and associated improvements on 53.4 acres of land. The project will access Kuhio Highway, State Route 56 through a connection to Kealia Road. To facilitate development of the property, the project proposes a land-use boundary amendment to change the land-use from State Agriculture District to State Urban District.

The DOT anticipates that the project will have a significant impact on the Kuhio Highway and understands a Traffic Impact Analysis Report (TIAR) will be prepared. The TIAR should address the following:

1. While the DEIS will discuss the relationship of the proposed action to Bike Plan Hawaii and the Statewide Pedestrian Master Plan, the TIAR should address existing and future pedestrian and bicycle use along Kuhio Highway, and if any improvements are needed.

2. While the proposed project will be accessed from Kuhio Highway via Kealia Road, there appears to be a gated, unused access on the mauka side of Kuhio Highway opposite from a chained driveway to Kapoli Street on the makai side of Kuhio Highway. This access should be noted in the TIAR and the project intentions for it discussed.

Additionally, no direct access shall be permitted from the subject project onto Kuhio Highway. The subject project should include a stipulation in the title documents for parcels adjacent to Kuhio Highway that direct vehicle access to Kuhio Highway is not authorized.

If there are any questions, please contact Mr. Norren Kato of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Sincerely,

JADE T. BUTAY
Interim Director of Transportation

c: State Land Use Commission
HHF Planners

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March 15, 2018

Ms. Jade Butay, Interim Director of Transportation
State of Hawaiʻi
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaiʻi 96813-5097

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 14, 2017

Dear Ms. Butay:

Thank you for your comment letter dated December 14, 2017 in response to the above referenced EISPN. A Traffic Impact Analysis Report (TIAR) has been conducted and will be included in the Draft EIS. Your comments were forwarded to the traffic engineer who conducted the TIAR. The following response is offered to your two comments pertaining to the TIAR:

1. The TIAR and Draft EIS will address existing and future pedestrian and bicycle use along Kūhiō Highway, including future improvement needs.
2. The gated unused access on the mauka side of Kūhiō Highway will be noted in the TIAR and Draft EIS. This access will be removed. No vehicular access from the subject property onto Kūhiō Highway will be allowed at this location.

Your letter and this response will be reproduced in the Draft EIS. Thank you for your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

OFFICE OF PLANNING
STATE OF HAWAII

DAVID Y. IGE
GOVERNOR

LEO R. ASUNCION
DIRECTOR
OFFICE OF PLANNING

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

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://planning.hawaii.gov/

DTS201801250944BE

January 25, 2018

Hawaii Management Services, LLC
P.O. Box 1630
Koloa, HI 96756
Ms. Moana Palama

Dear Ms. Palama:

Subject: Kealia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
TMK: (4) 4-7-004: por. 001
Kawaihau, Kauai, Hawaii

Thank you for the opportunity to review the subject Environmental Impact Statement Preparation Notice (EISPN) for Kealia Mauka Homesites. The Petitioner is proposing to develop 235 lots (between 5,500 square feet and 7,300 square feet) on 53.4 acres at Kealia, Kawaihau, Kauai. The buyers of the lots will be responsible for construction of the homes. The lot sizes are designated as affordable and will meet county workforce housing ordinances. The lots will be served with a mixture of public and private utilities, including water (potable and waste), electrical, telecommunications, drainage and roads.

The area is currently zoned as agricultural and in use for cattle grazing, hence a boundary change request has been submitted. A 36-lot subdivision (south) and Kuhio Highway (west) are adjacent to the proposed area, with agricultural lands forming the remaining borders north and west of the area.

The Office of Planning (OP) offers the following comments.

1. The majority of the Petition Area lies within the State Agricultural District. The proposal will require that the subject property be reclassified to the State Urban District through the Land Use Commission (LUC). OP represents the State as a mandatory party in proceedings before the LUC. In developing its position, OP evaluates whether the project meets the LUC decision-making criteria in Hawaii Revised Statutes (HRS) § 205-17, as well as its conformance with Coastal Zone Management objectives and policies in HRS § 205-A-2.
Attached for your consideration is a document entitled "Issues of Concern in District Boundary Amendment Proceedings Based on LUC Decision-Making Criteria." The

Draft Environmental Impact Statement (DEIS) should address these issues and criteria - particularly the areas of State concern in this document and best practices that could or will be incorporated in the proposed project to address State priority guidelines for sustainability. A short list of resources related to best practices can be found at the OP website at http://planning.hawaii.gov/

We also strongly recommend that petitioners consult with affected State agencies early in the project formulation process; and that they continue to do so in the preparation of any environmental compliance documents required under HRS Chapter 343, so that potential impacts to resources, facilities, and services managed or provided by the State and appropriate mitigation measures are identified in petitions and their environmental compliance documents.

2. We understand the DEIS will include a more thorough analysis of the impact of the proposed project on area schools. This discussion should include the following:
    a. Projected population increase for the Kawaihau region
    b. Whether the Petitioner will be required to establish an Education Contribution Agreement with the State Department of Education

3. The EISPN indicates that the proposed project will proceed through 2026. In the DEIS, please provide a schedule of development for each phase of the total project and a map showing the location and timing of each phase of development. Regarding infrastructure (e.g. improvements), the Petitioner should discuss how improvements will be completed to ensure that mitigation coincides with the impact created by the proposed project.

4. OP provides technical assistance to state and county agencies in administering the statewide planning system in HRS Chapter 226, the Hawaii State Plan. The Hawaii State Plan provides goals, objectives, priorities, and priority guidelines for growth, development, and the allocation of resources throughout the State. The Hawaii State Plan includes diverse policies and objectives of state interest including but not limited to the economy, agriculture, the visitor industry, federal expenditure, the physical environment, facility systems, socio-cultural advancement, climate change adaptation, and sustainability.

   We acknowledge that the EISPN document has identified the need to address the Hawaii State Plan. The Draft EIS should include an analysis that addresses whether the proposed project conforms or is in conflict with the objectives, policies, and priority guidelines listed in the Hawaii State Plan.

5. The coastal zone management area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and

management authority, including the U.S. territorial sea" see HRS § 205A-1 (definition of "coastal zone management area").

We acknowledge that the EISPN document has identified the need to address the enforceable policies of the Hawaii Coastal Zone Management Program. HRS Chapter 205A requires all State and county agencies to enforce the coastal zone management (CZM) objectives and policies. The Draft EIS should include an assessment as to how the proposed project conforms to the CZM objectives and its supporting policies set forth in HRS § 205A-2. The assessment on compliance with HRS Chapter 205A is an important component for satisfying the requirements of HRS Chapter 343. These objectives and policies include: recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection, and marine resources.

6. According to the EISPN, pg. **21**, the Draft EIS will contain a Drainage Report that will analyze drainage patterns, in project area and regionally. Additionally, according to the review material, this project will need a National Pollutant Discharge Elimination System permit for construction activity to safeguard against erosion and sediment loss. In order to ensure the coastal waters of Kawaihau and the nearshore waters of Eastern Kauai remain protected, the negative effects of both natural processes such as stormwater runoff and a wide range of human activities should be considered and mitigated. The Draft EIS should summarize the area's relation to wetlands and perennial streams, the tsunami evacuation zone, and flood zone. These items, as well as the nearshore water quality, should be considered when developing mitigation measures to protect the coastal ecosystem.

OP has a number of resources available to assist in the development of projects which ensure sediment and stormwater control on land, thus protecting the nearshore environment. OP recommends consulting these guidance documents and stormwater evaluative tools when developing strategies to address polluted runoff. They offer useful techniques to keep soil and sediment in place and prevent contaminating nearshore waters, while considering the practices best suited for each project. These three evaluative tools that should be used during the design process include:

- Hawaii Watershed Guidance provides direction on site-appropriate methods to safeguard Hawaii's watersheds and implement watershed plans http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/hi_watershed_guidance_final.pdf

- Stormwater Impact Assessments can be used to identify and evaluate information on hydrology, stressors, sensitivity of aquatic and riparian resources, and management

measures to control runoff, as well as consider secondary and cumulative impacts to the area
http://files.hawaii.gov/dbedt/op/czm/initiative/stomwater_imapct/final_stormwater_impact_assessments_guidance.pdf

- Low Impact Development (LID), A Practitioners Guide covers a range of structural best management practices (BMP's) for stormwater control management, roadway development, and urban layout that minimizes negative environmental impacts http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid_guide_2006.pdf

The responsiveness of the project and proposed petition to concerns identified in the environmental review process will influence OP's evaluation and development of the State's position on the proposed petition to ensure conformance with Chapter 205, HRS.

Thank you for the opportunity to review this project. If you have any questions please call either Josh Hekekia of our Coastal Zone Management Program at 587-2845 or Tomas J. Oberding of our Land Use Division at (808) 587-2883.

Sincerely,

Leo R. Asuncion
Director

Attachment

cc: Land Use Commission
HHF Planners
County of Kauai Planning Department
Matsubara, Kotake & Tabata

Issues of Concern in District Boundary Amendment Proceedings Based on LUC Decision-Making Criteria

The following issues are commonly discussed and analyzed for project proposals in petitions and their supporting environmental assessments (EAs) or environmental impact statements (EISs) prepared pursuant to Hawaii Revised Statutes (HRS) Chapter 343. This list reflects the range of issues the State Land Use Commission (LUC) must take into consideration in its decision-making under HRS Chapter 205, and Hawaii Administrative Rules (HAR) Chapter 15-15. This list is not exhaustive or complete.

1. **Water Resources.** Groundwater and surface water resource protection and water quality are critical State issues. A thorough evaluation of these resources includes identifying and discussing: (a) estimated water demand by types of land use; (b) proposed potable and non-potable water sources to be used for the project and measures to reduce water demand and promote water reuse in the project; (c) whether the proposed project is within a designated Water Management Area; (d) the impact of the project on the sustainable yield and water quality of affected aquifers and surface water sources; (e) permits or other approvals required for proposed water source use; and (f) the consistency of the project and impact of the project in terms of proposed water use and system improvements and priorities contained in the county water use and development plan, prepared pursuant to the State Water Code, HRS Chapter 174C.

2. **Agricultural Lands.** Article XI, Section 3, of the Hawaii State Constitution provides that "[t]he State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency, and assure the availability of agriculturally suitable lands." Protecting agriculture is a policy objective in the Hawaii State Plan, HRS Chapter 226, and in the State Administration's New Day Comprehensive Plan, which is available at http://hawaii.gov/gov/about/a-new-day. Agricultural activity in the vicinity of the proposed project should be identified, and the impact of urban use or conversion of project lands on existing and future agricultural use and the viability of agricultural use of adjoining agricultural lands needs to be examined. Please discuss how the proposed project meets policy objectives to promote and protect agriculture, particularly in cases where the lands have high agricultural value.

3. **Affordable Housing.** Increasing the supply of affordable housing is a critical State and county issue. Every county has an affordable housing policy and both the Hawaii State Plan, HRS Chapter 226, and the State Administration's New Day Comprehensive Plan identify affordable housing as a policy priority. If applicable, please discuss specifically how the proposed project will meet State and county affordable housing policy objectives, to include a discussion of how the project's proposed residential product types will be allocated among the market and various affordable housing target populations, and the expected price ranges for the different product types.

4. **Coastal Zone Management (CZM).** The Office of Planning is the lead agency for the Hawaii CZM Program, which is a Federal-State partnership for protecting, restoring, and responsibly developing coastal communities and resources. The coastal zone is defined as all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States territorial sea (HRS § 205A-1). EA/EISs should reference this definition of the coastal zone. State agency actions must be consistent with the CZM program objectives and policies under HRS § 205A-2. The EA/EIS needs to discuss the project in terms of its consistency with the following CZM objective areas.

    a. **Coastal and Ocean Resources.** The State has an interest in protecting coastal and marine ecosystems and resources, as well as coastal and marine water quality. The EA/EIS should identify any coastal and marine resources and ecosystems that may be impacted by the proposed project, and the potential for nonpoint sources of pollution from the project to adversely affect coastal and marine water quality. Project impacts on existing site and offsite hydrology and measures to manage stormwater and runoff need to be discussed. The Office of Planning recommends the use of low impact development (LID) techniques and other best management practices (BMPs) that promote onsite infiltration and minimize runoff from storm events. More information on LID and stormwater BMPs can be found at http://hawaii.gov/dbedt/czm/initiative/lid.php.

b. **Coastal and Other Hazards.** The EA/EIS should describe any hazard risks that are relevant to the site and describe the measures that are proposed to mitigate any hazard impacts, such as from tsunami, hurricane, wind, storm wave, sea level rise, flood, erosion, volcanic activity, earthquake, landslide, subsidence, and point and nonpoint source pollution. This should include a discussion of any wildfire hazard and any mitigation measures that might be required to address potential threats from wildfires.

The EA/EIS process also provides an opportunity to address the sustainability of proposed projects in terms of natural hazards and hazard mitigation, and the potential impact of climate change on the proposed project over time. To this end, OP recommends the final EA/EIS include a discussion of the proposed project with respect to the *State Multi-Hazard Mitigation Plan, 2010 Update*, adopted in September 2010, available at http://www.scd.hawaii.gov/documents/HawaiiMultiHazardMitigationPlan2010PUBLIC.pdf, as well as the respective County Hazard Mitigation Plan.

c. **Coastal-dependent Uses and Beach Protection.** If the project is located on or near the coast, the EA/EIS should discuss why the proposed development needs to be located on the coast, the economic uses that will be of benefit to the State, as well as potential impacts on beach access. The discussion should identify measures to protect beach systems and ensure short- and long-term public access to beaches.

d. **Coastal Recreational Resources.** If the project is located on the coast, the EA/EIS should include a description of recreational uses and facilities on or near the project site, and discuss how the impact of increasing users on coastal and ocean recreational resources and competing uses will be mitigated and managed during project development and buildout.

e. **Scenic Resources.** The EA/EIS should discuss the impact of the proposed project on scenic views to and from the coast and along the coast and coastal open space, and how any impacts on these scenic and open space resources will be avoided, minimized, or mitigated.

f. **Special Management Area (SMA) Permitting.** The SMA is defined by the counties and includes areas in the coastal zone that are particularly sensitive so that it requires special attention. Please identify whether the proposed project is within the SMA and how SMA permitting requirements pursuant to HRS Chapter 205A, will be satisfied.

For additional resources and information, visit http://hawaii.gov/dbedt/czm.

5. **Cultural, Archaeological, and Historic Resources.** Another CZM objective is to protect, preserve, and where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone that are significant in Hawaiian and American history and culture. If archaeological or historic properties or artifacts, including native Hawaiian burials, are identified in an archaeological inventory survey on the property, the EA/EIS should discuss how the petitioner has consulted with the State Historic Preservation Division (SHPD), what plans will be prepared to monitor or protect identified resources, and how the petitioner intends to comply with HRS Chapter 6E, related to historic preservation, and the CZM objective and policies for historic resources contained in HRS §§ 205A-2(b) and (c). SHPD has information and guidance available at http://hawaii.gov/dlnr/hpd/hpgrtg.htm.

The EA/EIS document should identify any cultural resources and cultural practices associated with the property, including visual landmarks, if applicable, and discuss the impact of the proposed project on identified cultural resources and practices as well as proposed mitigation measures. The LUC is obligated under Article XII, Section 7 of the Hawaii State Constitution to protect the reasonable exercise of customarily and traditionally exercised native Hawaiian rights. Thus, the LUC requires information as to the presence of cultural resources and cultural practices associated with the project site and vicinity for decision-making on petitions. The State Office of Environmental Quality Control (OEQC) provides guidance for preparing a cultural assessment at http://oeqc.doh.hawaii.gov, at "Environmental_Assessment_PrepKit." (http://oeqc.doh.hawaii.gov/Shared%20Documents/Preparation_of_Hawaii_Environmental_Policy_Act_Documents/Guidance_on_Cultural_Impact/1997%20Cultural%20Impacts%20Guidance.pdf)

6. **Biota.** The EA/EIS should include an inventory and assessment of flora and fauna, including invertebrates, found on or in proximity to the project site and in any lava tubes and caves on the property that are listed on the federal or State list of endangered or threatened species. Please also discuss species of concern and candidates for listing. The petitioner should consult with the Database Manager at the Hawaii Biodiversity and Mapping Program, Center for Conservation Research and Training, University of Hawaii, (808) 956-8094, as to the potential for the presence of rare species in the project area. The EA/EIS should discuss measures to be taken to protect rare, threatened, or endangered species or ecosystems of concern as required by law. The design of the biological survey should consider both wet and dry season observations to capture the fullest range of flora and fauna.

7. **Wastewater Treatment and Disposal.** The EA/EIS needs to identify the anticipated volume of wastewater to be generated by type of user, as well as the proposed means of wastewater treatment and disposal. A discussion of the availability of county wastewater collection and treatment capacity and its existing service levels, design capacity, and allocated capacity is also needed. The EA/EIS should also identify whether any facility improvements would be required to accommodate additional wastewater generated within the service area, including the proposed project. If a private wastewater treatment system is identified as the preferred option, the EA/EIS should discuss the type of plant to be used, permitting requirements, plans for reuse and/or disposal of treated effluent and waste solids, and how the private system will be operated and maintained.

8. **Energy Use and Impacts.** The State Hawai'i Clean Energy Initiative has adopted a goal of using efficiency and renewable energy resources to meet 70 percent of Hawaii's energy demand by 2030, with 30 percent from efficiency measures and 40 percent from locally-generated renewable sources. The EA/EIS should quantify the projected energy requirements of the project and discuss measures to be taken to reduce energy demand, promote energy efficiency, and to promote use of alternative, renewable energy sources. Please discuss how energy efficiency and energy demand reduction, including reduced transportation energy use will be incorporated in the design of the project and identify the kinds of green building and sustainable design practices that could be used to promote energy and resource conservation in the proposed project. Please also identify any generating or transmission capacity constraints that may arise as a result of the proposed project and other projects planned for the region.

9. **Impact on State Facilities and Resources.** The EA/EIS should quantify the impacts of the proposed project on State-funded facilities, including schools, highways, harbors, and airports, and discuss these impacts in terms of existing and planned capacity of the impacted facilities. The EA/EIS should cite the mitigation measures proposed to be used in the development of the project and describe efforts to address identified State agency concerns. Regarding transportation impacts, consider project design options that limit the need to drive, including mixed land uses, compact site design, walkable neighborhoods, and providing a variety of transportation choices (e.g., biking, public transit, etc.).

10. **Conservation District.** If the proposed project is within the State Conservation District, the EA/EIS should provide an inventory of conservation resources, and discuss how the loss of these resources (habitat, watershed area, etc.) will impact the public.

11. **Conformance with County Plan Designations and Urban Growth or Rural Community Boundaries.** Act 26, Session Laws of Hawaii (SLH) 2008, reaffirmed the Land Use Commission's duty to consider any proposed reclassification with respect to the counties' adopted general, community, or development plans. If the proposed project is not consistent with the county plans or lies outside a county urban growth or rural community boundary, the EA/EIS should provide an analysis and discussion of the following:

    a. **Alternative Sites Considered.** Describe and discuss alternative sites that were considered for the project, and discuss why the project could not be accommodated on lands within the urban growth or rural community boundary, if the county plan delineates such boundaries, or on land already designated by the county for similar uses.

    b. **Impact on Surrounding Lands.** Discuss what the impacts of changing the county plan designation or extending the urban growth or rural community boundary would have on the surrounding lands.

    c. **Significant Public Benefit.** Discuss what, if any, public benefits are provided by the proposed project above that already required under existing approval and permitting requirements.

    d. **Plan Amendment.** Provide a timeframe for application for and approval of any required plan amendment.

12. **Environmental Health Hazards.** The EA/EIS should discuss the potential for the project or project users to generate hazardous materials or release possible contaminants to the air, soil, or water, as well as measures to be taken to ensure that environmental and public health and safety will be protected during construction and after buildout. The EA/EIS should also identify and discuss any potential health and environmental threats that may be present due to site-specific contamination from past or current use. If contaminants of concern are identified for the project site, OP recommends that the petitioner consult with the State Department of Health's Hazard Evaluation and Emergency Response Office as to measures to be taken to address possible or actual contamination at the site.

13. **Solid Waste Management.** The EA/EIS should quantify the volume of solid waste likely to be generated by the project by types of users, and describe the impact the project will have on the county's existing and planned capacity for managing solid waste as represented in the county's solid waste management plan. The EA/EIS should discuss specific mitigation measures to be taken to reduce solid waste generation and ensure that recycling and reuse are incorporated within the project area by residential, commercial, and institutional users.

14. **Sustainability Analysis.** OP is implementing the sustainability elements of the State Administration's New Day Comprehensive Plan and Act 181, SLH 2011 (the new sustainability priority guideline of the Hawai'i State Planning Act) by requesting petitioners to prepare sustainability plans for their projects in district boundary amendment proceedings before the LUC. LUC Dockets A06-771, DR Horton-Schuler Homes (Hoopili) and A11-793, Castle & Cooke Homes (Koa Ridge Makai/Castle & Cooke Waiawa) provide a good point of reference for sustainability plans. The Koa Ridge Sustainability Plan and Hoopili Sustainability Plan can be found on the LUC's web site under each respective docket's exhibits.

    To address the principles and priority guidelines for sustainability, OP recommends that a sustainability plan or relevant elements thereof be incorporated as part of program and plan development. The sustainability plan should be included as part of the applicant's submission for development review and approval, including environmental assessments or in petitions for district boundary amendment to the State Land Use Commission submitted pursuant to HRS Chapter 205. See Technical Assistance Memorandum 2013-1 in Planner's Toolbox available online at http://planning.hawaii.gov.

The sustainability plan should address the following areas:

a. **Sustainable Development** - the development's contribution to creating a high quality of life and mutual supportive role among environmental, economic, and social equity concerns, as enumerated in HRS §226-108.

b. **Smart Growth and Livability Principles** - the principles that promote safety and options with transportation choices, the promotion of energy-efficient, equitable and affordable housing choices, the enhancement of economic competitiveness and support to the existing communities.

c. **Resource Conservation** – incorporation of energy and water efficiencies, including the implementation of solid or liquid waste management through methods of recycle and reuse, low impact development with respect to site design considerations and structural best management practices to increase on-site infiltration and reduce off-site flows and pollution from stormwater runoff, and climate change and hazard mitigation and adaptation strategies.

d. **Green Building Standards** - the planned use of green building and sustainable design practices.

15. **Development Timetable.** The LUC requires that projects seeking reclassification be substantially completed within ten years or seek incremental approvals, pursuant to HAR § 15-15-50. The EA/EIS and/or petitioner should provide a schedule of development for each phase of the total project and a map showing the location and timing of each phase or increment of development. Regarding infrastructure (e.g., highway improvements), the petitioner should discuss how improvements will be completed to ensure that mitigation coincides with the impact created by the proposed project.

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March 15, 2018

Mr. Leo R. Asuncion, Director
Office of Planning
State of Hawaiʻi
235 South Beretania Street, 6th Floor
Honolulu, HI 96804

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated January 18, 2018

Dear Mr. Asuncion:

Thank you for your comment letter dated January 18, 2018 providing comments on the EISPN referenced above. We offer the following responses to your comments:

1. Thank you for attaching the *"Issues of Concern in District Boundary Amendment Proceedings Based on LUC Decision-Making Criteria."* The Draft EIS will address these issues and criteria.

   State agencies were consulted during the EISPN period and will continue to be informed and consulted through the environmental process.
2. The Draft EIS will address the projected population increase for the Kawaihau region. The State Department of Education (DOE) has provided comments in response to the EISPN. We will continue to continue to communicate with the DOE regarding appropriate mitigation for this project.
3. The Draft EIS will include a development schedule. Please note that this project involves the creation of a residential subdivision (with infrastructure) with 235 lots that will be available for sale. While we are able to estimate the completion of the subdivision improvements and absorption of the lots, the actual construction of homes on the lots will be up to the individual owners.
4. The Draft EIS will include an analysis addressing project conformance with State Plan objectives, policies, and priority guidelines.
5. The Draft EIS will include an assessment of how the proposed project conforms to CZM objectives and policies.

6. The Draft EIS will discuss area wetlands and streams, tsunami evacuation zone and flood zone. We appreciate your providing references to available resources and guidance documents on sediment and stormwater control, watersheds, stormwater impact assessments, and low impact development.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Bernard P. Carvalho Jr.
Mayor

Wallace G. Rezentes Jr.
Managing Director

Lyle Tabata
Acting County Engineer

DEPARTMENT OF PUBLIC WORKS
County of Kaua'i, State of Hawai'i

4444 Rice Street, Suite 275, Līhu'e, Hawai'i 96766
TEL (808) 241-4992 FAX (808) 241-6604

December 21, 2017

Moana Palama
Hawai'i Management Services, LLC
P.O. Box 1630
Koloa Hawai'i 96756

Subject Environmental Impact Statement Preparation Notice
Keālia Mauka Homesites
Kawaihau District, Island of Kauai, Hawaii
Tax Map Key (4) 4-7-004: por. 001

Dear Ms. Palama:

Your letter dated November 21, 2017 provided the Engineering Division of the Department of Public Works of the County of Kaua'i notice of the availability for review of the Environmental Impact Statement Preparation Notice (EISPN) for the Keālia Mauka Homesites project. We have reviewed the EISPN and found that it contains a fairly complete listing of items to be further discussed and evaluated in the Draft Environmental Impact Statement (DEIS). We recommend that the following items also be included for discussion in the DEIS:

1. Short term (construction) impacts of the project on air quality.
2. Identification of downstream drainage areas and the impact of drainage from the project on these properties.
3. Evaluation and discussion on the use of Keālia Road between the project site and Kūhi'ō Highway.
4. The Traffic Impact Analysis Report (TIAR) should assume that a roundabout will be constructed at the intersection of Kūhiō Highway and Mailihuna Road, as is currently being designed by the Hawai'i Department of Transportation.
5. The TIAR should include trip generation and trip distribution information for daily motor vehicle traffic volumes generated from the site The TIAR should compare existing and project-generated traffic volumes for the following roadway segments:
   a. Keālia Road between the project site and Kūhiō Highway;
   b. Kūhiō Highway immediately north of Keālia Road;
   c. Kūhiō Highway between Keālia Road and Mailihuna Road;
   d. Mailihuna Road immediately mauka of Kūhiō Highway;
   e. Kūhiō Highway between Mailihuna Road and Kawaihau Road;
   f. Kūhiō Highway immediately south of the Kapa'a Bypass;

g. Kapa'a Bypass between Kūhiō Highway and Olohena Road;
h. Kapa'a Bypass immediately south of Olohena Road

Mailihuna Road is misspelled as "Milihuna" Road in at least one sentence in the EISPN.

Thank you for providing this opportunity for consultation on this pending project. We look forward to receipt of the DEIS. If you have any questions or need additional information, please contact Stanford Iwamoto, Engineering Division at (808) 241-4896 or siwamoto@kauai.gov .

Sincerely,

MICHAEL MOULE, P.E.
Chief, Engineering Division

MM/SI
Copy to: State of Hawai'i Land Use Commission, Attn: Daniel Orodenker
(P.O. Box 2359 Honolulu, HI 96813)
HHF Planners, Attn: Leslie Kurisaki
(733 Bishop Street Suite 2590, Honolulu, HI 96813)
Design and Permitting

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March 15, 2018

Mr. Michael Moule, P.E.
Chief, Engineering Division
Department of Public Works
County of Kauaʻi, State of Hawaiʻi
4444 Rice Street, Suite 275
Līhuʻe, Hawaiʻi 96766

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 21, 2017

Dear Mr. Moule:

Thank you for your comment letter dated December 21, 2017. The Draft EIS will include a discussion of short term impacts on air quality, and downstream drainage areas, as requested in your Comments 1 and 2. A copy of your letter has been forwarded to the traffic engineer, who provided the following response to Comments 3, 4 and 5 pertaining to the Traffic Impact Analysis Report (TIAR):

> Comment 3. The Draft EIS will evaluate and discuss use of Keālia Road between the project site and Kuhio Highway.
>
> Comment 4. The TIAR assumes the Kuhio Highway/Mailihuna Road roundabout is completed by 2020.
>
> Comment 5. The TIAR includes trip generation and distribution for weekday AM and PM peak hours for all segments noted in your letter.

The misspelling of Mailihuna Road will be corrected.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Leslie Kurisaki

From:	Scott Ezer
Sent:	Wednesday, December 20, 2017 11:39 AM
To:	Leslie Kurisaki
Subject:	FW: Kealia Mauka Homesites (4)4-7-004: por. 001 EISPN

FYI

From: Moana Palama [mailto:moana@mskauai.com]
Sent: Wednesday, December 20, 2017 4:16 AM
To: Scott Ezer <sezer@hhf.com>
Subject: FW: Kealia Mauka Homesites (4)4-7-004: por. 001 EISPN

From: Jeremy Lee [mailto:jlee@kauai.gov]
Sent: Monday, December 18, 2017 3:00 PM
To: moana@mskauai.com
Cc: Celia Mahikoa <cmahikoa@kauai.gov>; Lee Steinmetz <lsteinmetz@kauai.gov>; Michael Dahilig <mdahilig@kauai.gov>; Michael Moule <mmoule@kauai.gov>
Subject: Kealia Mauka Homesites (4)4-7-004: por. 001 EISPN

Ms. Palama,
If your rezoning is permitted.
The County of Kauai, Transportation Agency would like to be kept abreast of any development actions.
A residential development of this size and its proximate location to existing bus service would make coordination key.

MERRY CHRISTMAS

Jeremy Kalawaia Lee
The Kauai Bus
Program Specialist III
3220 Hoolako Street
Lihue, HI 96766
(808)246-8112
jlee@kauai.gov

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March 15, 2018

Mr. Jeremy Kalawaia Lee
Program Specialist III
The Kauaʻi Bus
3220 Hoolako Street
Līhuʻe, Hawaiʻi 96766

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Emailed comments sent December 18, 2017

Dear Mr. Lee:

We have received a copy of your email to Ms. Moana Palama on December 18, 2017, providing comments on the above referenced EISPN. As requested, the County of Kauaʻi Transportation Agency will be kept abreast of any development actions. The Draft EIS will discuss County bus service in the area, and we hope you have an opportunity to review and comment on this document.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Leslie Kurisaki

From:	Lee Steinmetz <lsteinmetz@kauai.gov>
Sent:	Monday, December 18, 2017 4:25 PM
To:	moana@mskauai.com
Cc:	Michael Dahilig; Celia Mahikoa; Lyle Tabata; Michael Moule; Leslie Kurisaki; Marie Williams; Lawrence.J.Dill@hawaii.gov; daniel.e.orodenker@hawaii.gov
Subject:	RE: Kealia Mauka Homesites EISPN TMK (4) 4-7-004 por. 001

Sorry, resending, one of the email addresses was incorrect.
Thanks,
Lee

From: Lee Steinmetz
Sent: Monday, December 18, 2017 3:28 PM
To: 'moana@mskauai.com' <moana@mskauai.com>
Cc: Michael Dahilig <mdahilig@kauai.gov>; Celia Mahikoa <cmahikoa@kauai.gov>; Lyle Tabata <ltabata@kauai.gov>; Michael Moule <mmoule@kauai.gov>; 'daniel.e.orodenker@hawaiil.gov' <daniel.e.orodenker@hawaiil.gov>; 'lkurisaki@hhf.com' <lkurisaki@hhf.com>; Marie Williams <mwilliams@kauai.gov>; Lawrence.J.Dill@hawaii.gov
Subject: Kealia Mauka Homesites EISPN TMK (4) 4-7-004 por. 001

Dear Ms. Palama,

Thank you for the opportunity to review and comment on the Keālia Mauka Homesites EISPN. Related to 5.2.3, Roadways and Traffic, please include a multimodal analysis of the project to address the following:

- Bicycle and pedestrian access from the project area to Keālia Beach and Ke Ala Hele Makalae,
- Bicycle and pedestrian access from the project area to Kapaʻa Elementary School, Saint Catherine School, and Kapaʻa High School,
- Bicycle and pedestrian access from the project area to the Kauaʻi Bus mainline, and potential improvements to bus stops serving the project area,
- Onsite and offsite improvements that could support the mode shift goals found in the County of Kauaʻi Multimodal Land Transportation Plan

Regards,
Lee Steinmetz

Lee Steinmetz
County of Kauai Transportation Planner
808.241.4978
lsteinmetz@kauai.gov

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March 15, 2018

Mr. Lee Steinmetz
County of Kauaʻi Transportation Planner
lsteinmetz@kauai.gov

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Emailed comments sent December 18, 2017

Dear Mr. Lee:

Thank you for your emailed comments sent December 18, 2017 in response to the above referenced EISPN. As requested, the Draft EIS will include a multimodal analysis of the project addressing bicycle and pedestrian access between the project site and Keālia Beach, Ke Ala Hele Makalae multi-use path, area schools, and County bus stops. The Draft EIS will also address the County of Kauaʻi's Multimodal Land Transportation Plan.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

KEALIA KAI
Kealia Kai Owners Association (KKHOA)
C/O: Associa Hawaii (Alina Kuznetsova)
4-1579 Kuhio Hwy., #102A, Kapaa, HI 96746
Ph: (808) 629-7163, (808) 821-2122

December 19, 2017

State of Hawaii Land Use Commission
Department of Business, Economic Development, and Tourism
P. O. Box 2359
Honolulu, HI 96813
Attn: Mr. Daniel Orodenker

SUBJECT: Petition filed by Kealia Properties LLC, Docket No: A17-803
For the proposed project identified as Kealia Mauka Homesites on Kauai
Comments and Concerns from the Kealia Kai Home Owners Association

Dear Mr. Orodenker,

On behalf of the Kealia Kai Home Owners Association ("KKHOA"), I hereby present to you and the Land Use Commission our comments and feedback regarding the petition filed with LUC by Kealia Properties LLC ("Developer") proposing to build 235 home sites on 53.4 acres of land in Kealia, Kawaihau, Puna, Island of Kauai, State of Hawaii, with the TMK: (4) 4-7-004:001.

At this point, we do not have enough information about the proposed development to fully apprise all of the owners at Kealia Kai and take a vote on whether we oppose or support this development.
We look forward to discussions with the developer and obtaining additional information so we can fully understand the impacts of the proposed project on the area. Thank you for including us in this process.

As community members, we naturally have concerns, most but not all of which are raised in the Kealia Mauka October 2017 Environmental Impact Statement (EIS) Preparation Notice. With some additional information and better defined plans for the development, we believe we can be supportive of the project, if our concerns are addressed. Thus, we are raising our concerns with you and plan to discuss them with the Developer as well.

Concern #1 - Traffic: First and foremost, there is no doubt that the project will increase traffic in the already congested area in the North end of Kapaa. Access to the project should be carefully evaluated including necessary improvements to Kuhio Highway that need to be incorporated to safely accommodate the traffic along with signalized access points to the developments in the area.

Concern #2 - Density: A plan with additional 235 homes in the North side of Kapaa is not ideal from our personal vantage point, but from the overall Island's perspective, it is probably an acceptable tradeoff in order to provide needed, more affordable housing. Having said that, 235 additional homes in that area is probably enough and would likely better serve the residents, if they were located closer to Kapaa. The Developer owns significant land holdings closer to Kapaa without the agricultural characteristics of the proposed rezoning location. Those lands also include rodeo grounds, equipment buildings, and the former location of the Kealia sugar mill, all of which are not in agricultural production. We would ask the developer to consider evaluating alternative locations on other land parcels that he owns for the proposed project.

Concern #3 – View from Kuhio Highway: The Kealia Mauka homes on Kuhio Highway, as planned, may be somewhat of an eyesore both from the Highway and from some homes at Kealia Kai. We at Kealia Kai were required to maintain 300' setbacks for residences from Kuhio Highway, install a large landscaped berm of Hau and Bougainvillea along our border with the Highway, and preserve critical view corridors from the Highway to minimize the view of our homes. We would ask the equivalent from Kealia Mauka. Specifically, we would ask that the 22 homes adjacent to Kuhio Highway (less than 10% of the total) be eliminated and replaced with a green area, and a similar landscape berm of Hau and Bougainvillea. We believe everyone on the Island, as well as the tourists, would prefer to see that in lieu of having homes right on the Highway with what appears to be zero setback. If the project is relocated closer to Kapaa near the rodeo grounds where a large grove of ironwood exists, that would effectively screen the development from view, if it were maintained.

Other Concerns: Other concerns we have are not as problematic in our view, but given the relatively short notice we have had about this planned development, we would like to better understand them and look forward to doing so both through review of the EIS when complete, additional studies and evaluations by the Developer, and discussions with the Developer. Such additional concerns include:

- Any potential adverse impact on the availability of **public services** (fire, police, paramedics, schools, etc.), public facilities, parks, drainage, waste water, and other County and State public services provided to the area.
- Any potential adverse impact on **potable water** availability (private water sources serve the area), though our preliminary analysis suggests this is not a concern but we believe this should be confirmed (see Concern #2 above).
- Any potential adverse impact on **agricultural water** quantity, allocation, easements, and interference with the infrastructure currently in place, for the Kealia Kai Subdivision which is agriculturally zoned and relies on irrigation water crossing the Developer's property.
- Excessive potential adverse impact on **property values** in our subdivision. We do not expect Kealia Mauka to have a positive impact on our property values, and in fact expect it to be at least somewhat negative. We just want some more time to ensure it would not be expected to have an excessive negative impact and believe location and design are critically important in this area.

- The permanent loss of **quality agricultural lands** and the impacts of the loss of resources that come from fertile soil that exists at the proposed rezoning location.

Thank you for your consideration of our concerns and suggestions. We hope that the most serious of them can be mitigated. We look forward to further evaluation and discussion of this proposed development and rezoning application.

Please do not hesitate to contact me, the Board of Directors of Kealia Kai HOA, or our subdivision management representative with any questions.

Thank you.

Best regards,

Adrian Saralou

Adrian Saralou
Kealia Kai Home Owners Association
President

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March 15, 2018

Ms. Adrian Saralou, President
Kealia Kai Home Owners Association
c/o Associa Hawaiʻi
4-1579 Kūhiō Highway, #102A
Kapaʻa, HI 96746

SUBJECT: Kealia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Emailed comments sent December 18, 2017

Dear Kealia Kai Home Owners:

Thank you for your comment letter to the State of Hawaiʻi Land Use Commission (LUC) dated December 19, 2017. On behalf of the LUC, we offer the following responses to your comments:

Concern #1--Traffic.
The Draft EIS will include a Traffic Impact Analysis Report (TIAR) which will estimate vehicle trips generated by the project during the AM and PM peak hours for a number of roadway segments in the vicinity of the project. The TIAR will include recommended roadway improvements to mitigate the project-related increase in traffic.

Concern #2—Density.
The subject site is appropriate for residential development, as it is currently designed in the Kauaʻi General Plan Land Use Map (Kawaihau Planning District) for residential use, and is located adjacent to existing residential communities.

Concern #3—View from Kūhiō Highway.
The construction of a residential subdivision at the proposed site will alter the visual landscape and be visible from Kūhiō Highway. It will not be visible from most areas of Kealia Kai or from the shoreline. There will be a setback from Kūhiō Highway, and we will investigate including a landscape buffer to mitigate visual impacts.

Other Concerns
The Draft EIS will address the project's impact on public services (fire, police, schools etc.) and utilities (water, sewer etc.). An economic and market study is being conducted and will be included in the Draft EIS. The objective of the proposed project is to provide residential house lots for local working families, and to satisfy the need for housing on the island. The impact of the loss of agricultural land will be discussed in the Draft EIS.

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Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Jirair and Aderineh Saralou
P. O. Box 687
Kapaa, HI 96746
Ph: (818) 800-9810
saralous@aol.com

December 21, 2017

State of Hawaii Land Use Commission
Department of Business, Economic Development, and Tourism
P. O. Box 2359
Honolulu, HI 96813
Attn: Mr. Daniel Orodenker

RE: Petition filed with State of Hawaii Land Use Commission (LUC) by Kealia Properties LLC Docket No: A17-803 for the proposed project on Kauai identified as Kealia Mauka Homesites

SUBJECT: Comments and Concerns by property owner at Kealia Kai

Dear Mr. Orodenker,

As property owners at Kealia Kai, we would like to communicate to you and the Land Use Commission our comments and concerns in regards to the petition filed with LUC by Kealia Properties LLC proposing to build 235 home sites on 53.4 acres of land in Kealia, Kawaihau, Puna, Island of Kauai, State of Hawaii, with the TMK: (4) 4-7-004: por 001.

- At this time, it does not seem like there is enough information available to discern the petitioner's intentions for developing the remaining portion of the 2000 acres where the proposed project (53.4 acres) is located. This knowledge would be essential to foresee the manner in which the area may potentially be transformed in the future.

- In the submittal, it seems like there are several alternative plans proposed by the petitioner for the 53.4 acres. The alternative plan with fewer home sites and larger lot sizes appears to fit the area more appropriately.

- The proposed project area (53.4 acres) is across Kuhio Highway from the Kealia Kai Subdivision. It would be reasonable to expect that a potentially proposed project in this area would be complementary to the existing subdivision plans in the immediate area. The aforementioned 2000 acres was approved for a subdivision plan a few years ago with fewer homes and larger lot sizes that remained agriculturally zoned. It seems like this type of subdivision would be more suitable than a high-density housing project with many home sites in a small acreage area.

- It appears that the potential approval of the petitioner's proposal by the State of Hawaii Land Use Commission for Land Use District Boundary Amendment from **Agricultural to Urban** (Residential) will predictably affect several characteristics of the area.
    - The land parcel involved in this proposal is **Prime Agricultural land** with **highly fertile soil.** This land parcel is currently being used for **farming** by the local community. It would be great if an area with such attributes remain agriculturally zoned and the land be farmed for its intended purpose with its available resources to contribute to the needs and demands of the local community, as well as the visitors.
    - The proposed land area is also currently being used as **cattle grazing pasture land** which accommodates the needs of the community members involved in **raising cattle**.
    - The proposed land area has served as a fairly sizable **open-space** area on the East side of Kauai. The proposed project can potentially reduce this privilege.
    - Potential approval of the petitioner's proposal, as one might expect, may give rise to several **environmental issues** as well as creating some levels of **public nuisance** for the current local residents and visitors. The matters that are concerning are listed below:
        - Adversely impacting **traffic** in the immediate and surrounding areas. Kuhio Highway (the only highway/roadway in the proposed project area) is a two-lane highway with strictly limited existing capability to accommodate the current traffic in the area.
        - Adversely **burdening public services** (fire, police, etc.), public facilities, drainage, potable water, waste water, etc.
        - Adversely impacting the availability of **potable water** (private water sources serve the area) as well as generation of waste water and solid waste by adding 235 homes in a small acreage area.
        - Adversely impacting the **agricultural water** quantity, allocation, easements, and interference with the infrastructure currently in place, for the communities that are agriculturally zoned and rely on the irrigation water there.
        - Potentially cause decline in the **property values** of the surrounding properties and subdivisions.
        - Adversely affecting the nearby **historic sites and scenic points** for the local community members as well as the visitors and potentially impacting the tourism industry which has vital economic value for the State of Hawaii and the County of Kauai.
        - Negatively impacting and burdening County of Kauai's budget (tax payer funds) that would be spent in the area, exacerbating the budget strains and limitations for County-wide public resources.

We greatly appreciate your attention to our concerns and comments. We would be more inclined to support the proposed project, if more information would become available to address our concerns.

As outlined in the prepared and filed documents with the LUC by the petitioner, there are several alternatives to the currently proposed plan that may impose fewer unfavorable impacts to the area and its current residents. We hope that the directors at the LUC will take these alternatives into consideration and opt for the options that mitigate the concerns of the community members.

Please do not hesitate to contact us with any questions.
Thank you.

Best regards,

Jirair Saralou
Aderineh Saralou

Jirair and Aderineh Saralou
Kealia Kai Home Owners

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March 15, 2018

Ms. Jirair and Ms. Aderineh Saralou
P.O. Box 687
Kapaʻa, HI, 96746

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 21, 2017

Dear Mr. and Mrs. Saralou:

Thank you for your comment letter to the State of Hawaiʻi Land Use Commission (LUC) dated December 21, 2017. On behalf of the LUC, we offer the following responses to your comments:

- At the present time, the Petitioner has no intention of developing the remaining 2,000 acres of the TMK parcel within which the proposed Keālia Kai Homesites project is located. The owner's intent is to retain the area for agricultural activities.
- The Draft EIS will discuss alternatives to the proposed project, including: 1) an agricultural subdivision; 2) variations in development density (lower density, greater density); 3) variations in project area (larger and smaller); and 4) offering turnkey homes for sale. The alternative for lower density (i.e., larger lot sizes) which you state "appears to fit the area more appropriately" would be more likely to attract out of state residents and offshore investors than the proposed action, according to the Kauaʻi County Planning Director and the project's market and feasibility analysis. As such, it is less effective at accomplishing the owner's objective to provide housing targeted to local Kauaʻi residents.
- The proposed project is located adjacent to an existing residential subdivision, and is complementary to this existing use. The previous plan for a subdivision with fewer homes and larger lots is no longer proposed.
- The Draft EIS will address the characteristics of the area and address the potential project impacts that you reference. These include impacts on agriculture, open space, traffic, public services, historic and scenic points, and economic and fiscal impacts.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

12-18-2017

Hawai'i Management Services, LLC

State of Hawai'I Land Use Commission

HHF Planners

I am a 25 year resident of Kauai, living on Kamole Road since I purchased my home in April, 2000.

The following are some of my concerns regarding the proposal of Kealia Mauka Homesites.

1. The proposed 53 acres to be divided into 235 house lots would be targeted for , but not restricted to, Kauai residents. These parcels could be purchased by anyone, from anywhere. This opens the door to another 1000-1500 people moving to Kauai, thereby stretching our resources even greater than they are stretched presently.
2. It is stated that this project is consistent with typical densities in the islands existing single-family residential communities. Are there any other 53 acres of gorgeous fertile agricultural land on Kauai that presently has 235 lots, ranging from 5600-7300 sf in size, each with a house and probable carport or garage and shed? If so, where is it located? What does it look like?
3. Why choose high rated "B" fertile agricultural land and build a very compact housing project?
4. The proposed housing project is planned to be accessed from Kealia Road. Presently attempting to access Kuhio Highway from Kealia Road is a real challenge. There is the North –South traffic on Kuhio Highway. There is the entrance to and exit from Kealia beach. There are turn lanes for Kealia beach and Kealia Road. There is a pedestrian crosswalk. There is already a high volume of traffic in this 40 mph area. With 235 houses planned, a conservative number of 500 additional cars would be expected to be using this intersection. If this project is granted then access to the subdivision should be considered to be located north of the project, across from Kealia Kai's entrance from Kuhio Highway.
5. The building of 235 houses and other structures would produce a significant amount of noise. It could be even worse if it's over 8 years.
6. An additional 1000-1200 people – adults and children- and their pets will naturally produce noise.
7. An additional 500 or more cars/trucks will add more traffic, more noise.
8. The visual impact will be devastating.
9. Under Section 7. Significant Criteria, this project does impact (although not deemed significant) 1,2,4,6,7,8,and 12.

I am grateful that an Environmental Impact Study has been determined necessary.

Aloha

Karen Gibbons

Karen Gibbons

alohakareng@yahoo.com

HHF PLANNERS
places for people

VIA EMAIL

March 15, 2018

Ms. Karen Gibbons

alohakareng@yahoo.com

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kauaʻi; TMK: (4) 4-7-004: por 001
Your Emailed comments sent December 18, 2017

Dear Ms. Gibbons:

Thank you for your letter dated December 18, 2017 on the above reference EISPN. We offer the following responses to your comments.

1. You are correct that although the proposed Keālia Mauka house lots are intended for Kauaʻi residents, they could be purchased by anyone from anywhere. While possible, the lot sizes are smaller than those typically marketed to off-island second home buyers and investors.
2. According to the 2010 U.S. Census data, the average household size in the Kapaʻa area is 3.15 residents. Assuming a similar household size for the 235 lots, this would result in approximately 740 residents. The majority are expected to be existing Kauaʻi families.
3. The project area is designated in the Kauaʻi General Plan Land Use Map for residential use. It is also adjacent to an existing residential subdivision and appropriate for housing.
4. The project access via the existing Keālia Road is proposed to minimize traffic impacts to Kūhiō Highway, and is preferable to adding another point of entry. In its comments to the EISPN, the State of Hawaiʻi Department of Transportation indicated that no direct access shall be permitted from the site onto Kūhiō Highway. The Traffic Impact Analysis Report (TIAR) will look at the Keālia Road-Kūhiō Highway intersection and recommend any necessary traffic mitigation measures.
5. Noise impacts of the building of 235 houses will be discussed in the Draft EIS.
6. Noise impacts generated by new subdivision residents will be discussed in the Draft EIS.
7. Noise and traffic impacts from cars and trucks will be discussed in the Draft EIS.
8. Visual impact from Kūhiō Highway, Keālia Beach and the multi-use path will be addressed in the Draft EIS.
9. The Draft EIS will fully address the Chapter 343 HRS significance criteria.

Your letter and this response will be reproduced in the Draft EIS. We appreciate your input on the EISPN.

Sincerely,

Scott Ezer
Principal

cc: Moana Palama, Hawaiʻi Management Services LLC
Daniel Orodenker, State of Hawaiʻi Land Use Commission

Ross-boy and Cindi Link
2306 Orrington Ave., Evanston IL 60201
Kealia Kai Lots 1A/1B and 3A
Ross-boy's mobile phone: (847) 420-0704
Ross-boy's email: RossLink@outlook.com

December 26, 2017

Attn: Mr. Daniel Orodenker
State Land Use Commission
P. O. Box 2359
Honolulu, HI 96804

SUBJECT: **Petition filed by Kealia Properties LLC, Docket No: A17-803**
For the proposed project identified as Kealia Mauka Homesites on Kauai

Dear Mr. Orodenker,

We own Lots 1A/1B and 3A (formerly 2 & 3), comprising 3 of the 35 home sites in the Kealia Kai subdivision across the street from the proposed Kealia Mauka location. Following is our feedback regarding the petition filed with the LUC by Kealia Properties LLC proposing to build 235 home sites on 53.4 acres of land in Kealia on the Island of Kauai, with TMK: (4) 4-7-004:001. We provided input to a feedback letter you may have received from our HOA, but our personal view is a little less negative than that of our HOA's, so we're providing our personal view here.

We are not opposed to this project, but we have concerns about it, most but not all of which were raised in the Kealia Mauka October 2017 Environmental Impact Statement (EIS) Preparation Notice. We believe we could be supportive of the project if our concerns are addressed, so we are raising them with you and also plan to discuss them with the Developer.

Concern #1 - Traffic: First and foremost, there is no doubt the project will increase traffic in the already congested area on the north end of Kapaa.
Potential Solution(s): An additional traffic light would almost certainly be necessary. Other actions to mitigate traffic buildups may also be needed.

Concern #2 - Density: An additional 235 homes on the north side of Kapaa is not ideal from our personal vantage points, but from the overall island's perspective, it is probably an acceptable tradeoff in order to provide needed, more affordable housing. Having said that, 235 additional homes in that area is probably enough.
Potential Solution(s): We would ask that the Developer agree no further subdivision will occur in TMK 4-7-004:001.

Concern #3 – View from Kuhio Highway: The Kealia Mauka homes on Kuhio Highway as planned will be somewhat of an eyesore both from the highway and from some homes at Kealia Kai.
Potential Solution(s): We at Kealia Kai are required to maintain a 100' to 300' setback from Kuhio Highway, planted with a Hau and Bougainvillea berm to minimize views of our homes. We would ask something similar from Kealia Mauka. Specifically, we would ask that the 22 homes adjacent to Kuhio Highway (less than 10% of the total) be deleted and replaced with green area, Hau, and Bougainvillea. This would provide about a 120' setback to Kealia Mauka and we believe everyone on the island would prefer that to having 22 homes right on the highway with what appears to be zero setback.

Other Concerns: Other concerns we have are not as problematic in our view, but given the relatively short notice we have had of this planned development, we would like to better understand them and look forward to doing so both through review of the EIS when complete and discussions with the Developer. Such additional concerns include:

- Any potential adverse impact on the availability of **public services** (fire, police, paramedics, etc.), public facilities, drainage, waste water, and other public services provided to the area (medical care, etc).
- Any potential adverse impact on **potable water** availability (private water sources serve the area), though our preliminary analysis suggests this is not a concern provided no further demands are made on the system (see Concern #2 above).
- Any potential adverse impact on **agricultural water** quantity, allocation, easements, and interference with the infrastructure currently in place, for the Kealia Kai Subdivision which is agriculturally zoned and relies on irrigation water.
- Excessive potential adverse impact on **property values** in our subdivision. We do not expect Kealia Mauka to have a positive impact on our property values, and in fact expect it to be at least somewhat negative. We just want some more time to ensure it would not be expected to have an excessive negative impact.

Thank you for your consideration of our concerns and suggestions for mitigating the most serious of them. We look forward to discussions with the Developer. Please feel free to contact us to discuss this matter further.

Sincerely,

Ross-boy Cindi Link

Ross-boy and Cindi Link

HHF PLANNERS
places for people

March 15, 2018

Mr. Ross-boy Link and Ms. Cindi Link
2306 Orrington Ave.
Evanston, IL 60201

SUBJECT: Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice (EISPN)
Kawaihau District, Kaua'i; TMK: (4) 4-7-004: por 001
Your Comment letter dated December 26, 2017

Dear Mr. and Ms. Link:

Thank you for your comment letter to the State of Hawai'i Land Use Commission (LUC) dated December 26, 2017. On behalf of the LUC, we offer the following responses to your comments:

Concern #1--Traffic
The Draft EIS will include a Traffic Impact Analysis Report (TIAR) which will estimate vehicle trips generated by the project and evaluate impacts on a number of roadway segments in the project vicinity. The TIAR will include recommended roadway improvements to mitigate the project-related increase in traffic.

Concern #2—Density
The project proponent has no plans for further development in TMK 4-7-004:001.

Concern #3—View from Kūhiō Highway
The construction of a residential subdivision at the proposed site will alter the visual landscape and be visible from Kūhiō Highway and possibly from areas of Keālia Kai. There will be a setback from Kūhiō Highway, and we will investigate including a landscape buffer to mitigate visual impacts.

Other Concerns
The Draft EIS will address the project's impact on public services (fire, police, schools etc.) and utilities (water, sewer etc.). An economic and market study is being conducted and will be included in the Draft EIS.

Your letter and this response will be reproduced in the Draft EIS. Thank you for your input.

Sincerely,

Scott Ezer

Scott Ezer
Principal

cc: Moana Palama, Hawai'i Management Services LLC
Daniel Orodenker, State of Hawai'i Land Use Commission

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APPENDICES

Appendix A

County's General Plan Boundary Interpretation

- Kaua'i County Planning Department Departmental Determination DD-2016-70, July 5, 2016

Bernard P. Carvalho, Jr.
Mayor

Nadine K. Nakamura
Managing Director

Michael A. Dahilig
Director of Planning

Ka'āina S. Hull
Deputy Director of Planning

PLANNING DEPARTMENT
County of Kaua'i, State of Hawai'i
4444 Rice Street, Suite A-473, Līhu'e, Hawai'i 96766
TEL (808) 241-4050 FAX (808) 241-6699

JUL 05 2016

Management Services – Kauai
Managing Agents
P.O. Box 1630
Koloa, Hawaii 96756

RE: **Departmental Determination DD-2016-70**
Boundary Interpretation for General Plan Designation
TMK: (4) 4-7-004:001
Kealia, Kaua'i

Dear Ms. Palama:

The Department has received and reviewed your request for a determination regarding the subject parcel, as reflected in your email correspondence on June 29, 2016.

As I understand, you are inquiring whether moving forward with entitling a conceptual residential subdivision, as described in the transmittal documents, are consistent with the 2000 General Plan Land Use Map.

Given the review conducted by our Department, there is clear intent in the 2000 General Plan, along with previous iterations of the plan, that the area generally is earmarked for "Residential Community" growth adjacent to the existing subdivision in Kealia above the Kealia General Store.

General Plan land use maps are not regulatory in nature; rather, they spatially guide areas for further entitlement via zoning boundary amendments at the state and county level. The proposed Conceptual Kealia Subdivision would generally be in alignment with the General Plan's land use maps and texts.

Should you have further questions regarding this matter, please do not hesitate to contact me at the information above.

MICHAEL A. DAHILIG
Director of Planning

DEPARTMENT OF PLANNING | COUNTY OF KAUA'I

DEPARTMENTAL DETERMINATION REQUEST FORM

Fill out and e-mail this form plus supporting documentation in Adobe PDF format to: planningdeterminations@kauai.gov

FOR DEPARTMENTAL USE ONLY

DD# 2016-70

INTAKE BY S DATE 7/1/16

PAU ________ BY ________

TMK NUMBER:	(4) 4-7-004:001
NAME OF OWNER*:	Kealia Properties, LLC
PHYSICAL ADDRESS OF PROPERTY:	Kealia, Kauai, Hawaii
CONTACT PHONE:	(808) 742-9784
CONTACT E-MAIL:	moana@mskauai.com

TYPE OF DETERMINATION REQUESTED (Please Check Applicable):

- ○ A. Clarification or interpretation of enforcement relating existing permitting conditions imposed either by the Planning Director or Planning Commission
- ○ B. Confirmation of Additional Dwelling Unit availability on a parcel
- ○ C. Voluntary Cancellation or Withdrawal of Permits and Permit Applications
- ○ D. Confirmation of Non-conformities or Pre-CZO status for a parcel
- ○ E. Confirmation or Clarification of previous Director or Departmental Determinations
- ◉ F. Boundary interpretation for General Plan Designation
- ○ G. Confirmation of any open violations on the property
- ○ H. Applicability of Special Management Area "Development" definition to a proposed use

* I am the legal title holder to the property and have 75% or more legal or equitable interest in the parcel of record, have written authorization to act as an agent for the property owner with 75% or more legal or equitable interest in the parcel of record or am leasing the property (please attach proper authorization documents). By signing below I understand a determination is only a regulatory interpretation by a government official which could be subject to appeal or challenge. I further understand a determination does not necessarily bind the County to specifically perform in such a manner if relied upon by the applicant in the course of its development or construction activities. **I further understand that reliance on a determination is at my own risk and recognize I must rely on my own due diligence.**

MOANA KINIMAKA PALAMA

Print Name and Signature

06/29/16

DATE

Management Services- Kaua'i
Managing Agents

TO: Michael Dahilig
Planning Director
County Of Kauai
4444 Rice St.
Lihue, HI 96766

June 28, 2016

RE: Agency Authorization: Kealia Properties, LLC dba Kealanani

Dear Mr. Dahilig,

The authorization and signature below shall serve to provide approval of agency for:

Authorized Agent:

Moana L.K. Palama, Principal Agent
Management Services – Kauai
PO Box 1630
Koloa, HI 96756

FOR THE PURPOSE OF APPLYING FOR, COMMUNICATING, PROCESSING AND SECURING INFORMATION AND PERMITS RELATED TO DEVELOPMENT AND REGULATORY INTERESTS OF THE OWNER IN THE COUNTY OF KAUAI.

Property Owner:

Peter Nolan, Manager
Kealia Properties, LLC dba Kealanani
58 11th Street,
Hermosa Beach, CA 90254

Agency Designated:

Peter Nolan, Manager

Date: 6/28/2016

Agency Accepted:

Moana L.K. Palama, Agent

Date: 6/28/2016

PO Box 1630, Koloa, Kauai, Hawaii 96756 | E-mail: moana@mskauai.com
Office (808) 742-9784 | Fax (866) 593-6751

Kealia Properties, LLC ("KP") is the owner of certain land at Kumukumu, Kaua'i identified by Tax Map Key 4-7-004:001 ("Parcel 1"), encompassing 1,072.619 acres. This request for a Department Determination asks whether the 2000 General Plan Land Use Map for the Kawaihau Planning District can be interpreted to be consistent with an approximate 50-acre Conceptual Residential Subdivision proposed for the Kumukumu parcel.

The proposed subdivision is part of the larger Parcel 1 owned by KP on the mauka side of Kūhiō Highway, north of Keālia Road (see Figure 1, Location Map). The area proposed for residential subdivision is immediately north of Ka'ao Road. Ka'ao Road currently provides access to an existing 36-lot subdivision with parcels ranging in size from about 7,500 square feet to about 20,000 square feet.

The Land Use Map for the Kawaihau Planning District shows a large yellow area that straddles both sides of Kūhiō Highway (see Figure 2). The yellow area is designated as "Residential Community" by the legend for the map. Because the Land Use Map does not show parcels lines, the specific area that could be considered to be consistent with this designation is open to interpretation.

Consistent with its title, the *"2000 Kaua'i General Plan"* is intended to be a general policy document that guides development within the County. The following excerpts from the General Plan emphasize this point:

> ***1.2.2 Setting a Direction***
> *The General Plan states the County's 20-year vision for Kaua'i and sets policies for achieving that vision. The General Plan is a direction-setting,* ***policy*** *document. It is not intended to be regulatory in the sense of a zoning code or other land use regulation.*
>
> **1.4.1 Policy**
> *The planning system of the County of Kaua'i is composed of the following elements and functions:*
> *(a) The General Plan is the primary policy directing long-range development, conservation, and the use and allocation of land and water resources in the County of Kaua'i.*
>
> > *(1) The General Plan establishes through maps and text geographic areas of the County which are intended to be used for various general purposes such as agriculture, resorts, urban communities, and preservation of natural, cultural and scenic resources.*

Clearly, the policy for the land identified in yellow on the Kawaihau Planning District Land Use Map in the vicinity of Ka'ao Road is intended as a general guideline to establish a larger pattern of residential development than currently exists. We believe the proposed subdivision on about 50 acres (see Figure 3), which includes about 230 lots that average about 6,000 square feet in size, is consistent with the intent of the General Plan, due to its location in relation to the Residential Community designation on the Land Use Map.

It is worthy to note, that as far back as the 1930s, the area was used at a higher residential density during the operation of the Makee Sugar Plantation (later absorbed by Lihue Sugar Company). The attached aerial photo from 1950 (Figure 4) shows the area around Kaao Road with a residential development pattern and additional residential development to the northwest.

The *2000 Kaua'i General Plan* also provides guidance on appropriate locations for future growth and Residential Communities. The proposed subdivision is consistent with the following General Plan language:

> ***5.1.2 Policy for Future Growth***
> *Following are policies to provide for growth and development while preserving rural character.*
> *(e) Expansion contiguous to an existing town or residential community is preferred over a new residential community.*
>
> ***5.4.3 Residential Community***
> ***5.4.3.1 Policy***
> *(a) Lands included within the Residential Community designation shall be used predominantly for low- to high-density housing in towns and other residential areas. Density shall be one to 20 units per acre. Residential Community areas may also be used for commercial and industrial businesses, government facilities, and institutions.*

The General Plan also includes language which provides guidance on target markets for new housing and the importance of increasing the number of housing units that are affordable to Kaua'i residents, in order to meet the projected demand of new housing units. According to the General Plan, the projected demand was based on a potential resident population between 65,300 and 74,300 in 2020, which will translate into a need for up to 23,000 individual housing units. According to recent U.S Census Bureau data, the population Kaua'i reached 71,000 residents in 2015, well on its way to achieve the higher end of the 2000 General Plan projections.

Because the average lot size of the subdivision is approximately 6,000 square feet, sales prices can (and will) be geared to meet the needs of Kaua'i residents, and as such, will be consistent with the following language from the *2000 Kaua'i General Plan.*

> ***8.1.1.1*** *In reviewing the supply of units and land for resident housing, it is important to consider the price profile of each location. Communities with lots and homes in the upper price categories will serve a relatively limited segment of the local market and have a proportionately larger share of off-island buyers.*

8.1.2 Affordability

The cost of housing, including both owner-occupied and rental units, continues to be one of the biggest economic obstacles facing most Kaua'i residents.

8.1.4 Projected Housing Demand to 2020

According to the Planning Department's Economic and Population Projections, Kaua'i is projected to have a resident population of between 65,300 and 74,300 in 2020. In order to support the 2020 resident population, Kaua'i is projected to need a total of 20,400 to 23,300 additional housing units

In summary, we believe this request is appropriate for the following reasons:

- The proposed subdivision is consistent with the location of a "Residential Community" designation on the Kawaihau Planning District Land Use Map
- The proposed subdivision is located adjacent to an existing residential subdivision
- The vicinity was used for expanded residential purposes to support the Makee Sugar Plantation (later absorbed by the Lihue Sugar Plantation) through the 1960s
- The average lot size of the proposed subdivision is targeted for local residents, addressing a need identified in the General Plan to provide a mix of housing opportunities on Kaua'i
- The additional housing inventory partially satisfies a shortfall in needed housing units recognized by the General Plan.

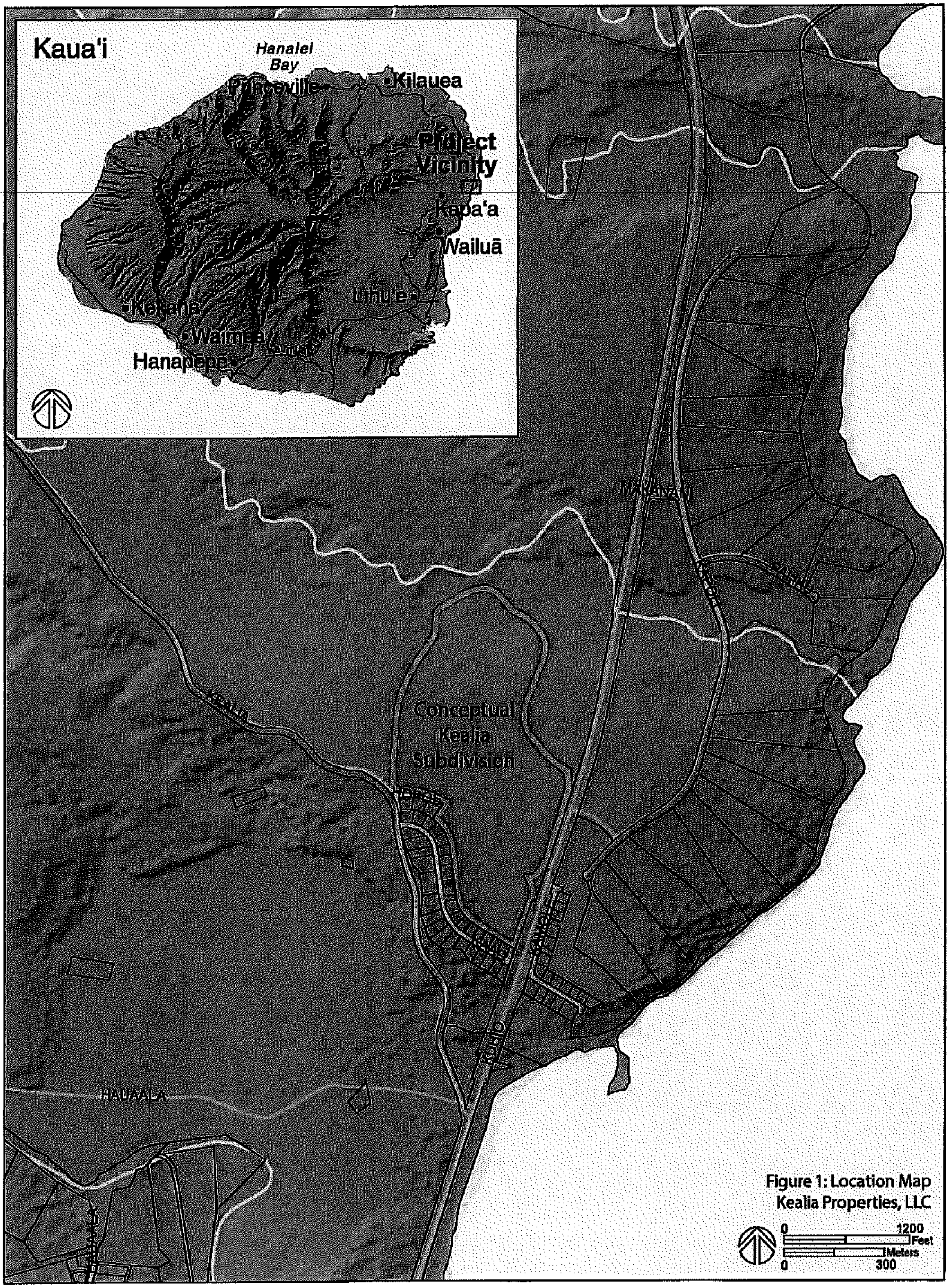

Figure 1: Location Map
Kealia Properties, LLC

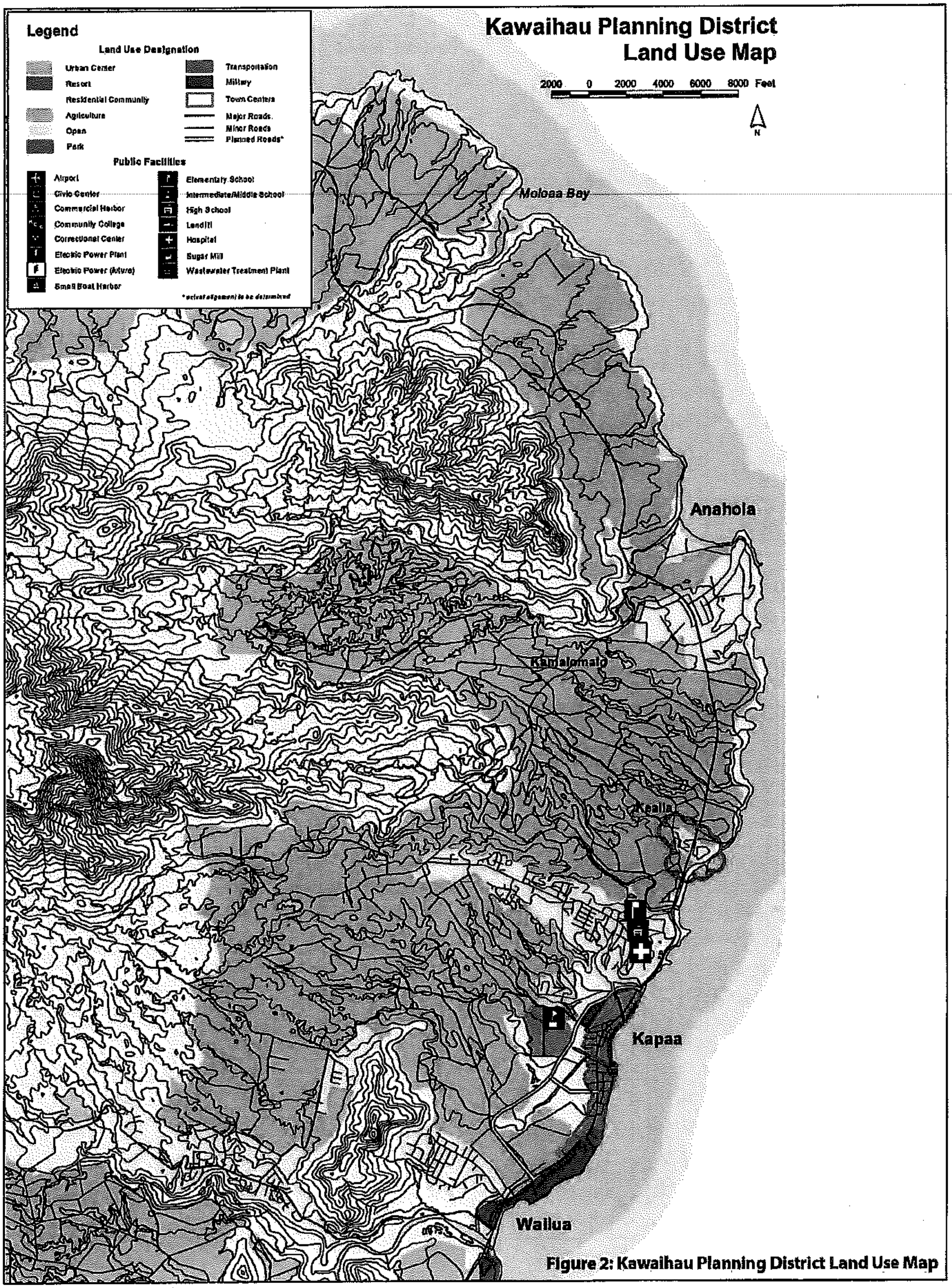

Figure 2: Kawaihau Planning District Land Use Map

Source: 2000 Kauai General Plan

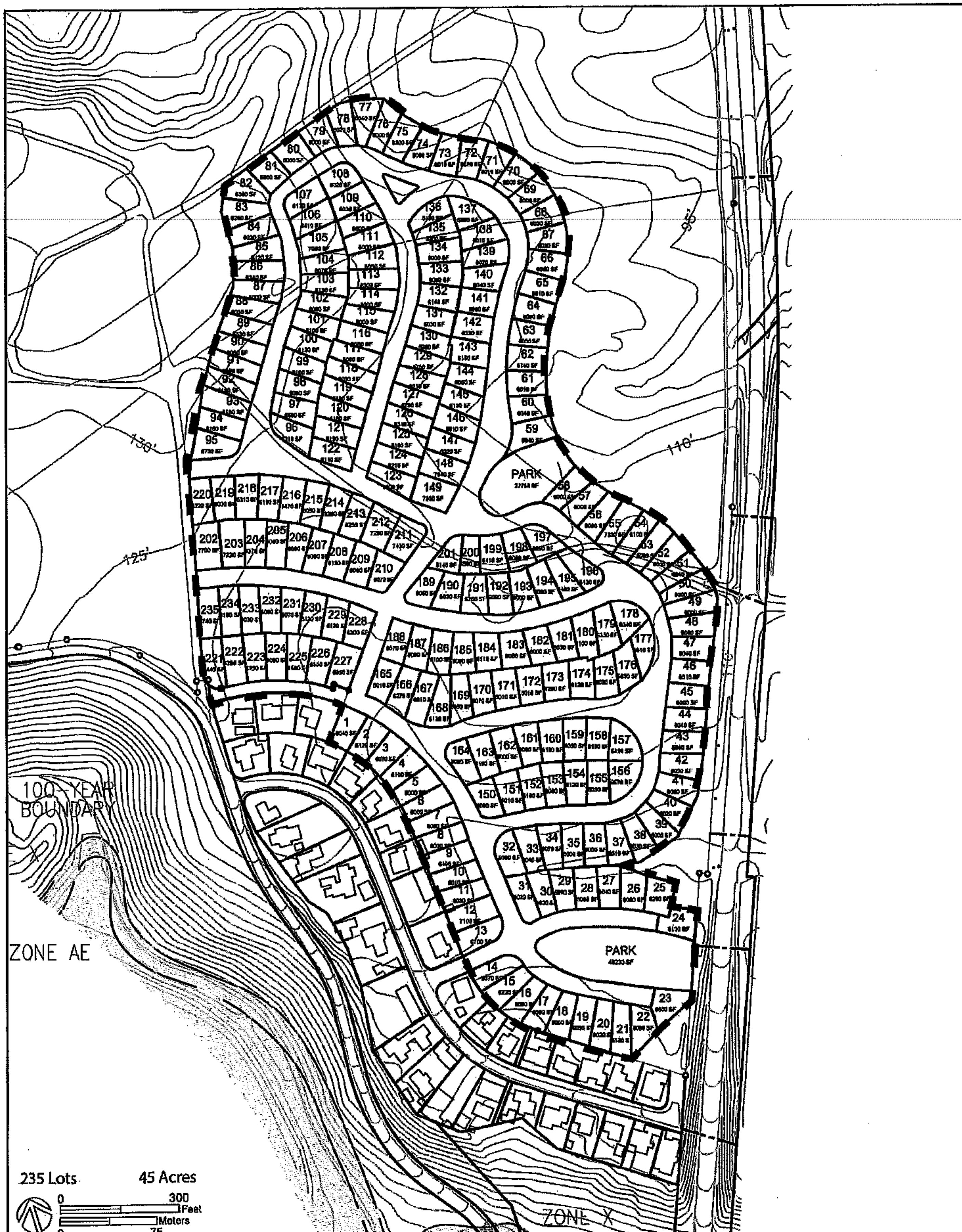

Figure 3: Proposed Conceptual Kealia Subdivision
Kealia Properties, LLC

May 31, 2016

Figure 4: Portion of Former Makee Sugar Plantation circa 1950

Source: U.S. Geological Survey

Shanlee Jimenez

From:	Julie Mararagan <JGM@Kauai-law.com>
Sent:	Wednesday, June 29, 2016 2:54 PM
To:	Planning Determinations
Cc:	Scott Ezer (sezer@hhf.com); Moana Palama (moana@mskauai.com); Michael Belles
Subject:	Kealia Properties, LLC ***Departmental Determination Request***
Attachments:	Departmental Determination Request Form.pdf
Importance:	High

To whom it may concern:

Attached please find the Departmental Determination Request Form dated June 29, 2016, together with its supporting documentation, for the above-mentioned project.

Please contact Mr. Michael Belles at 246-6961 if you have any questions.

Thank you,
Julie

Julieta Ganotisi Mararagan
Belles Graham Proudfoot Wilson & Chun, LLP
4334 Rice Street, Suite 202
Lihue, Kauai, Hawaii 96766
Phone: (808) 246-6962
Fax: (808) 245-3277
Email: jgm@kauai-law.com

Appendix B

Botanical Resources Assessment for the Proposed Residential Subdivision, Keālia, Kaua‘i, Hawai‘i
LeGrande Biological Surveys Inc.

April 2017

BOTANICAL RESOURCES ASSESSMENT FOR THE PROPOSED RESIDENTIAL SUBDIVISION KEALIA, KAUAI, HAWAII

Prepared by:

Maya LeGrande
LeGrande Biological Surveys Inc.
2243 Mohala Way
Honolulu HI 96822

Prepared for:

Helber Hastert & Fee, Planners, Inc.
Pacific Guardian Center, Makai Tower
733 Bishop Street, Suite 2590
Honolulu HI 96813

April 2017

Table of Contents

Appendices

INTRODUCTION

This report includes the findings of a plant inventory conducted for the proposed residential subdivision in Kealia. The project is described as a 235-lot residential subdivision, with lots ranging from 5,600 square feet to 7,300 square feet. Total project area is about 50 acres (including two drainage detention basins). The proposed subdivision will be adjacent to an existing 36-lot subdivision at Kealia, Kaua`i. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval. LeGrande Biological Surveys Inc. carried out a botanical field survey of the above location on April 1, 2017. The primary objectives of the field studies were to:

1) inventory the flora;
2) provide a general description of the vegetation on the project site;
3) search for threatened and endangered species as well as species of concern; and
4) provide recommendations regarding potential impacts to the plant resources of the area in regards to the proposed project.

Federal and State of Hawaii listed species status follows U.S. Fish and Wildlife (USFWS, 2015).

SITE DESCRIPTION

The survey area is located on the east shore of Kauai Island in the Kealia district north of Lihue. The project area includes portions of TMK: 4709001. The survey area has historically been utilized for various agricultural, including sugar cane production and livestock grazing. As with most urban areas in the Hawaiian Islands, the natural habitat has been altered and is characterized by introduced plant species and dominated by Guinea grassland.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps were examined to determine terrain characteristics, access, boundaries, and reference points.

A pedestrian survey was carried out where the investigator walked transects and boundaries of the subject property. Notes were made on plant associations and distribution, disturbances, topography, substrate types, exposure, drainage, etc. Plant identifications were made in the field; plants that could not be positively identified were photo documented for comparison with the recent taxonomic literature.

DESCRIPTION OF VEGETATION

The survey area is typified by an open alien dominated Guinea grassland with infrequently scattered shrubs and tree species. There are a total of 63 plant species observed within the survey sites. 62 are alien (introduced) and 1 is indigenous (native to the Hawaiian Islands and elsewhere). An inventory of all the plants observed within the survey area is presented in the species list (Appendix B) at the end of the report.

The entire survey area has been highly altered from the native biological ecosystem over time. Non-native plant species dominate the entire survey area, with only one native species observed. No Threatened and or Endangered species were observed during the survey. The following are descriptions of the dominant vegetation divided into two main areas within the proposed project area:

GUINEA GRASSLAND

The majority of the project area is dominated by a Guinea grassland (*Panicum maximum*) with scattered shrub and tree species as well as areas where smaller weedy species dominate such as in dirt roadways and along fence lines. Besides the guinea grass that the resident cattle are grazing on, smaller weedy species growing mixed in with the grass clumps include, false ragweed (*Parthenium hysterophorus*), castor bean (*Ricinus communis*), spiny amaranth (*Amaranthus spinosus*), owi (*Stachytarpheta australis*), lantana (*Lantana camara*), Mexican poppy (*Argemone mexicana*), and slender mimosa (*Desmanthus pernambucanus*), Tree species observed included, Koa Haole (*Leucaena leucocephala*), African tulip (*Spathodea campanulata*), and Christmas berry (*Schinus terebinthifolius*). Dirt roadways were dominated by weedy grass species and smaller weeds such as owi, false ragweed, and *Sida* spp.

The main water trough for the cattle was full and overflowing, causing a rivulet of water running from a higher point of elevation at the western end near the middle of the property downslope eastward. Plant species adapted to a wetter habitat were observed growing in and at the edges of the water including, primrose willow (*Ludwigia octovalvis*), mosquito fern (*Azolla filliculoides*), and sedges such as kaluha (*Kyllinga brevifolia*), *Fimbristylis littoralis*, and *Cyperus difformis*.

Both areas planned for drainage basins (1 & 2) are dominated by Guinea grass and koa haole. Along the boundary in the southeastern corner along Kuhio Highway, larger stands of koa haole were observed with the non-native maunaloa vine (*Canavalia cathartica*) growing in the branches.

JAVA PLUM/CHRISTMAS BERRY STANDS

This vegetation type was only observed in small stands of trees along fence lines. Java plum (*Syzygium cuminii*) trees were mixed with smaller species such as African tulip, Christmas berry and Koa Haole with a few coconut (*Cocos nucifera*) palms in some locations. Understory included weedy grass species such as fimbriate paspalum (*Paspalum fimbriatum*) and radiate fingergrass (*Chloris radiata*).

DISCUSSION

The results of our fieldwork represent a one-time snapshot of the plants inhabiting the survey area. However, when considered together with the results of historical surveys, we can compile a reasonably accurate description of the environment and vegetation of the project area. Native plant habitat within the proposed project area has been highly modified by human activities, such as agricultural activities, road building, residential construction, and the intentional and accidental introduction of alien species. The overwhelming abundance of non-native plant species throughout the project area is in direct correlation to disturbance over the last several hundred years. A concerted effort was made to locate native plants within the survey area.

The nature of the land and its present and historical disturbances very much limit the natural botanical resources anticipated to occur here. The results of our survey substantiate this prediction. The rare frequency of native plant species is an indication that because of constant disturbances (geological, vehicular, invasive plant species, feral ungulates), only species adapted to such conditions can survive, with few exceptions. Uhaloa (*Waltheria indica*), was the only indigenous (native to the Hawaiian Islands and elsewhere) plant species observed infrequently during the survey. There is no federally delineated Critical Habitat for any plant species present on or adjacent to the project area.

LITERATURE CITED

Evehuis, N.L. and L.G. Eldredge, editors. 1999-2002. Records of the Hawaii Biological Survey. Bishop Museum Occasional Papers Nos. 58-70.

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APPENDIX A
SITE PHOTOGRAPHS

Figure 1. View of property looking west from eastern boundary, Guinea grassland.

Figure 2. A small stand of Java plum trees with other weedy species at southwest corner of property.


Figure 3. General area for proposed roundabout to connect new subdivision to existing road.

Figure 4. Southern boundary along existing residential subdivision.


Figure 6. Watery rivulet from overflowing water trough running west to east.

Figure 7. Vegetation varies between pasture (upper part of picture) and dirt roadways (lower part of picture)

APPENDIX B
PLANT SPECIES LIST

The following checklist is an inventory of naturalized plant species observed within the survey areas of the proposed Kealia Residential Subdivision. The plant names are arranged alphabetically by family and then by species into each of three groups: Pteridophytes, Monocots and Dicots. The taxonomy and nomenclature of the Ferns and Fern Allies follow Palmer (2002), flowering plants (Monocots and Dicots) are in accordance with Wagner *et al*. (1990), Wagner and Herbst (1999) and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evehuis and Eldredge, eds., 1999-2002).

For each species, the following name is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

A = Alien species introduced to the Hawaiian Islands by humans, intentionally or accidentally.
I = Indigenous species native to the Hawaiian Islands and also found elsewhere in the world.

SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
PTERIDOPHYTES		
AZOLLACEAE		
Azolla filliculoides Lam.	Mosquito fern	A
MONOCOTS		
ARECACEAE		
Cocos nucifera L.	coconut	A
CYPERACEAE		
Cyperus difformis L.	cyperus sedge	A
Fimbristylis littoralis Gaudich.		A
Kyllinga brevifolia Rottb.	Kaluha	A
MUSACEAE		
Musa xparadisica L.	bananana, mai`a	A
POACEAE		
Andropogon virginicus L. var. *virginicus*	broomsedge	A
Cenchrus echinatus L.	common sandbur	A
Chloris barbata Sw.	swollen fingergrass	A

SCIENTIFIC NAME	COMMON NAME	STATUS
Chloris radiata (L.) Sw.	radiate fingergrass	A
Cynodon dactylon (L.) Pers	manienie	A
Digitaria insularis (L.) Mez ex Ekman	sourgrass	A
Eragrostis amabilis (L.) Wight&Arn. Ex Nees	lovegrass	A
Melinis minutiflora P.Beauv.	molasses grass	A
Panicum maximum L.	Guinea grass	A
Paspalum fimbriatum Kunth	fimbriate paspalum	A
DICOTS		
ACANTHACEAE		
Thunbergia fragrans Roxb.	white thunbergia	A
AMARANTHACEAE		
Achyranthes aspera L.		A
Amaranthus spinosus L.	spiny amaranth	A
ANACARDIACEAE		
Schinus terebinthifolius Raddi	Christmas berry	A
ASTERACEAE		
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex Melchert	beggar tick	A
Bidens pilosa L.	Spanish needle	A
Conyza bonariensis (L.) Cronq.	hairy horseweed	A
Eclipta prostrate (L.) L.	false daisy	A
Emilia sonchifolia (L.) DC.	Flora’s paintbrush	A
Parthenium hysterophorus L.	false ragweed	A
Synedrella nodiflora (L.) Gaertn.	nodeweed	A
Tridax procumbens L.	coat buttons	A
BIGNONIACEAE		
Spathodea campanulata P.Beauv.	African tulip tree	A
BORAGINACEAE		
Heliotropium procumbens var. *depressum* Fosberg.		A
BRASSICACEAE		
Lepidium virginicum L.	pepperwort	A

SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
CHENOPODIACEAE		
Chenopodium murale L.	goosefoot	A
CONVOLVULACEAE		
Ipomoea obscura (L.) Ker Gawl.		A
Ipomoea triloba L.	little bell	A
EUPHORBIACEAE		
Chamaesyce prostrata (Aiton) Small		A
Ricinus communis L.	castor bean	A
FABACEAE		
Caesalpinia decapetala (Roth) Aiston	mysore thorn	A
Canavalia cathartica Thouars	maunaloa	A
Chamaecrista nictitans (L.) Moench	partridge pea	A
Crotalaria incana L.	fuzzy rattlepod	A
Crotalaria pallida Aiton	smooth rattlepod	A
Desmanthus pernambucanus (L.) Thell.	slender mimosa	A
Desmodium triflorum (L.) DC.	tick clover	A
Indigofera suffruticosa Mill.	indigo	A
Leucaena leucocephala (Lam.) de Wit	koa haole	A
Macroptilium lathyroides (L.) Urb.	wild bean	A
Melilotus indica (L.) All.	sweet clover	A
Mimosa pudica L. var. *unijuga* (Duchass. & Walp.) Griseb.	sleeping grass, sensitive plant	A
LAMIACEAE		
Leonotis nepetifolia (L.) R.Br.	lion’s ear	A
MALVACEAE		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	A
Sida acuta subsp. *carpinifolia* (L.f.) Borss.		A
Sida ciliaris L.		A
Sida cordifolia L.		A
MYRTACEAE		
Syzygium cuminii (L.) Skeels	Java plum	A

SCIENTIFIC NAME	COMMON NAME	STATUS
NYCTAGINACEAE		
Bougainvillea sp.	bougainvillea	A
ONAGRACEAE		
Ludwigia octovalvis (Jacq.) P.H.Raven	primrose willow	A
OXALIDACEAE		
Oxalis corniculata L.	yellow wood sorrel	A
PAPAVERACEAE		
Argemone mexicana L.	Mexican poppy	A
PLANTAGINACEAE		
Plantago lanceolata L.	narrow-leaved plantain	A
RUBIACEAE		
Spermacoce assurgens Ruiz&Pav.	buttonweed	A
STERCULIACEAE		
Waltheria indica L.	uhaloa	I
VERBENACEAE		
Lanatana camara L.	lantana	A
Stachytarpheta australis Moldenke	owi	A
Verbena littoralis Kunth	vervain	A

Appendix C

Faunal Surveys Conducted for the Keālia Properties Project
Rana Biological Consulting

April 5, 2017

Faunal Surveys Conducted for the Keālia Properties Project, (TMK # (4) 4-7-004 por.1.), Līhu‘e District, Island of Kaua‘i, Hawai‘i

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April 5, 2017

Table of Contents

Introduction and Background

Kealia Properties, LLC is proposing to develop a 235-lot residential subdivision, with lots ranging from 5,600 square feet to 7,300 square feet. Total project area is about 50 acres (including drainage detention basins). The proposed subdivision will be adjacent to an existing 36-lot subdivision at Keālia, Kaua'i. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval. The parcel of land identified as, Tax Map Key (TMK):(4) 4-7-004 por. 1. (Figure 1).

This report describes the methods used and the results of the avian and terrestrial mammalian surveys conducted on the project site as part of the environmental disclosure process associated with the proposed project.

The primary purpose of the surveys was to determine if there are any avian or terrestrial mammalian species currently listed, or proposed for listing under either federal or State of Hawai'i endangered species statutes within or adjacent to the study area. We were also asked to evaluate the potential impacts that the development of the project might pose to any sensitive or protected native avian or mammalian species, and to propose appropriate minimization measures that could be implemented to reduce or eliminate any such impacts. The federal and State of Hawai'i listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR) 1998, U. S. Fish & Wildlife Service (USFWS) 2016). Fieldwork was conducted on April 1, 2017.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document are included at the end of the narrative text.

General Project and Site Description

The proposed Project will be located on an approximately 50-acre portion of a larger lot. Kūhio Highway abuts the site to the east, and Ka'ao Subdivision to the south. Undeveloped lands abut the site to the north and west (Figure 1).

The project area was historically used for sugar cane production. Since the cessation of sugar cane production in the general Līhu'e area the project site has been leased to various tenants for ranching and diversified agricultural operations, most recently those activities have been centered on pasturage for cows.

Vegetation on the site is best categorized as an alien dominated, Guinea grass (*Megathyrsus maximus*) pasture with denser woody vegetation abutting two sides of the property and an existing subdivision on the south side of the property (Figures 2 &3). For a detailed description of the floristic make up of the site please see LeGrande, 2017.

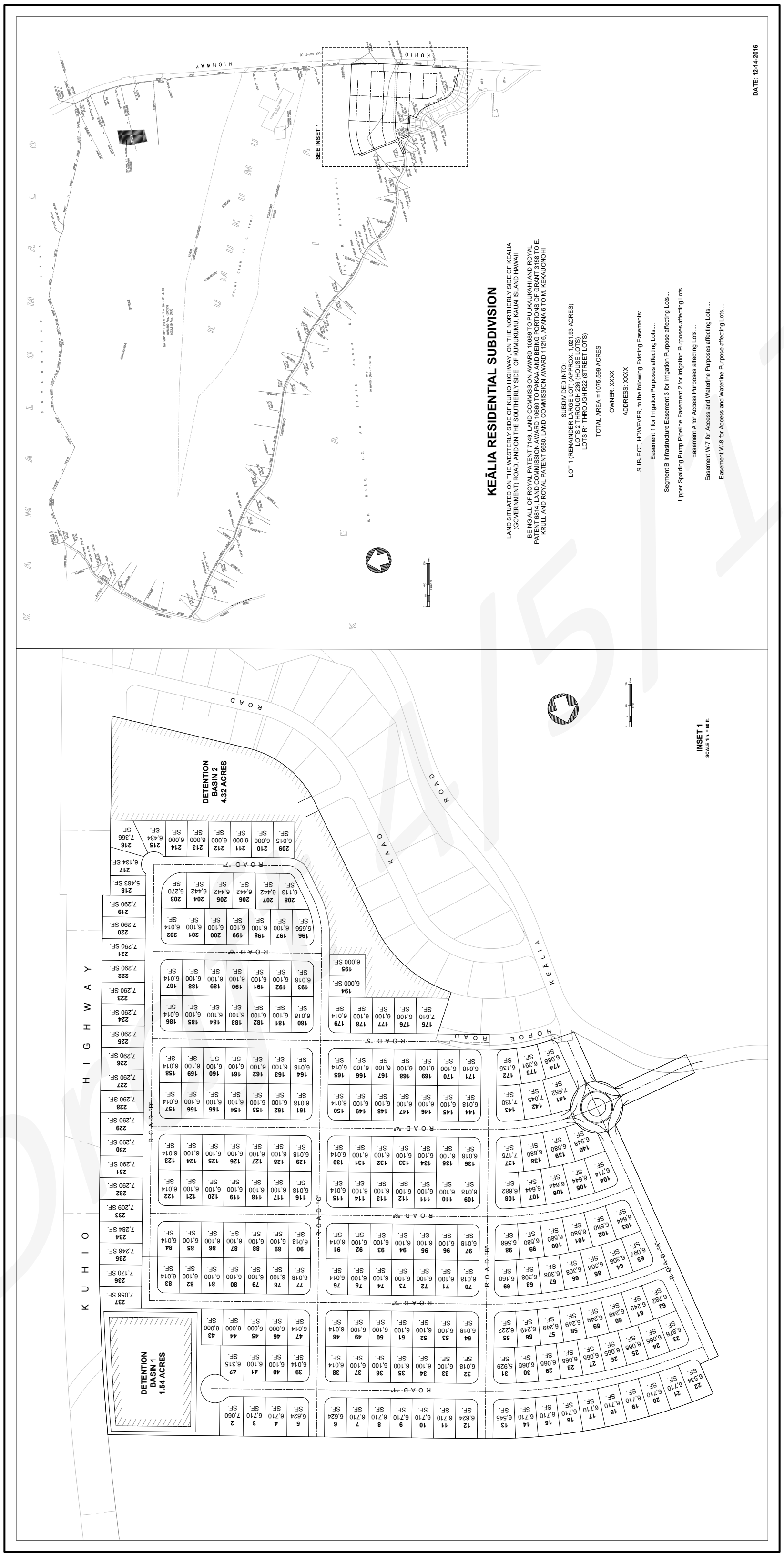

Figure 1 – Location Map Kealia Properties

Figure 2 – Typical view of the Guinea grass pasture covering most of the site, looking northwest from the southwest corner of the site

Figure 3 – Project site looking southeast showing heavily grazed vegetation typical of a about a half of the site as well as the existing Ka'ao Road Subdivision to the right of the frame

Methods

Avian Survey Methods

A total of five avian point count stations were sited approximately equidistant from each other within the project site. Eight-minute point counts were made at each of the count stations. Each station was counted once. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. Point counts were concentrated during the early morning hours, the peak of daily bird activity. Time not spent counting point count stations was used to search the remainder of the project site for species and habitats that were not detected during count sessions.

The avian phylogenetic nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 57th supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chaser et al., 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016). Place names follow (Pukui et al., 1976).

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻōpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Kauaʻi are alien species, and most are ubiquitous. The survey for terrestrial mammalian species was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area during time spent within the project site. Mammalian species scientific names follow (Wilson and Reeder, 2005).

Results

Avian Survey Results

A total of 250 individual birds of 15 species, representing 12 separate families, were recorded during station counts (Table 1). All 15 avian species recorded on the property are alien to the Hawaiian Islands (Table 1).

No avian species currently proposed for listed, or listed as endangered or threatened under either federal or state of Hawaiʻi endangered species statutes, was recorded during the course of this survey (DLNR 1998; USFWS 2016).

Avian diversity was in keeping with the location of the property, and the degraded habitat present on the site. Three species, Cattle Egret (*Bubulcus ibis*), Red Junglefowl (*Gallus gallus*) and Western Meadowlark (*Sturnella neglecta*), accounted for 54% of all birds recorded during station counts. The most commonly recorded species was Cattle Egret, which accounted for 28 percent of the total number of individual birds recorded.

Table 1 – Avian Species Detected Keālia Properties Site April 2017			
Common Name	***Scientific Name***	***ST***	***RA***
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Red Junglefowl	*Gallus gallus*	A	8.00
Ring-necked Pheasant	*Phasianus colchicus*	A	0.40
	PELECANIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	14.20
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	1.40
Zebra Dove	*Geopelia striata*	A	3.80
	PSITTACIFORMES		
	PSITTACULIDAE - Lories, Lovebirds, and Indomalayan and Papua-Australasian Parrots		
Rose-ringed Parakeet	Psittacula krameri	A	0.60
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	3.00
	TIMALIIDAE - Babblers		
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	*Mimus polyglottos*	A	1.40
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	2.80
	THRAUPIDAE - Tanagers		
	Thraupinae - Core Tanagers		
Red-crested Cardinal	*Paroaria coronata*	A	2.40
	CARDINALIDAE - Cardinals & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.20
	ICTERIDAE - Blackbirds		
Western Meadowlark	*Sturnella neglecta*	A	5.00
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches and Hawaiian Honeycreepers		
House Finch	*Haemorhous mexicanus*	A	3.40
	ESTRILDIDAE - Estrildid Finches		
Red Avadavat	*Amandava amandava*	A	2.00
Chestnut Munia	*Lonchura atricapilla*	A	1.40

Legend to Table 2

ST = Status
A = Alien – Introduced to the Hawaiian Islands by humans
RA = Relative Abundance - Number of birds detected divided by the number of count stations (5)

Mammalian Survey Results

We recorded three terrestrial mammalian species while on the site. There was a herd of ≥ cattle (*Bos taurus*) on the site including one large Black Angus bull. Tracks and scat of pigs (*Sus scrofa*) were encountered along dirt roads within and adjacent to the project site. Dogs (*Canis familiaris*) were heard barking from sites to the west and south of the site, additionally; tracks of this species were also encountered along dirt roads within the site.

No mammalian species proposed for listing, or listed as endangered or threatened under either federal or state of Hawaiʻi endangered species statutes, was recorded during the course of this survey (DLNR 1998; USFWS 2016).

Discussion

Avian Resources

The findings of the avian survey are consistent with the location of the property, and the heavily degraded nature of the vegetation on the site. The findings of this survey were similar to results of at least one other faunal survey conducted in the general project area in recent years (David and Guinther, 2005).

During the course of this survey we recorded 15 avian species during point counts, no additional species were recorded during the time we were present on the site. All of the avian species detected are alien to the Hawaiian Islands (Table 2).

No avian species currently proposed for listed, or listed as endangered or threatened under either federal or state of Hawaiʻi endangered species statutes, was recorded during the course of this survey (DLNR 1998; USFWS 2016).

Although not detected during this survey, the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic Newell's Shearwater (*Puffinus newelli*) have been recorded over-flying the general project area between April and the end of November each year (David, 1995, 2014; Morgan et al., 2003, 2004; David and Planning Solutions 2008). Additionally, the Save Our Shearwaters Program has recovered both species from the general Keālia area over the past three decades (Morgan et al., 2003, 2004; David and Planning Solutions, 2008; Save our Shearwater Program, 2016).

The petrel is listed as endangered, and the shearwater as threatened under both Federal and State of Hawaiʻi endangered species statutes. The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983, Simons and Hodges 1998, Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds can collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al. 1998; Ainley et al., 2001; Hue et al., 2001; Day et al 2003).

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the property and the habitat currently present on the site. We did not record Hawaiian hoary bats overflying the site. Hawaiian hoary bats are widely distributed in the low to mid-elevation areas on the Island of Kauaʻi, and have been documented in and around almost all areas that still have some dense vegetation (Tomich, 1986; USFWS 1998, David, 2016).

No rodent species were detected during this survey it is probable that one or more of four established alien muridae found on Kauaʻi, European house mice (*Mus musculus domesticus*), roof rat (*Rattus rattus*), brown rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use various resources found within the general project area. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent on them

Potential Impacts to Protected Species

Nēnē

Although no Nēnē were recorded during the course of the avian surveys conducted on the property, there is the potential depending on how tall the grass is that Nēnē could use resources on the site on a seasonal basis. The principal potential impact that construction of the proposed subdivision poses to Nēnē would be during clearing and grubbing phases of the project, clearing vegetation, has the potential to disturb nesting Nēnē nests, eggs and young. Nēnē disturbed when nesting may abandon their nest, eggs and to a lesser degree chicks. Increased vehicular traffic associated with construction activities also increases the risk of birds being run over or hit by vehicles, within the project site.

Seabirds

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

Hawaiian hoary bats

It is likely that Hawaiian hoary bats overfly the project area on a seasonal basis. The principal potential impact that the development of the site poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project site has the potential to temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing. With that said, there are no suitable roost trees within the proposed project site, thus it is not expected that the project will result in deleterious impacts to this listed mammalian species.

Recommendations

During the construction phase of the project we recommend the following minimization measures and training be implemented to ensure that construction activities do not result in deleterious impacts to the listed faunal species that may be encountered during construction.

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

At the time that the subdivision is operational we recommend the following.

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).

Critical Habitat

There is no federally delineated Critical Habitat for any species present on, or adjacent to the project area. Thus the development and operation of the proposed project will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

Glossary

Alien – Introduced to Hawaiʻi by humans

Commensal – Animals that share human's food and lodgings, such as rats and mice.

Crepuscular – Twilight hours

Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species

Endemic – Native to the Hawaiian Islands and unique to Hawaiʻi

Muridae – Rodents, including rats, mice and voles, one of the most diverse families of mammals

Nocturnal – Night-time, after dark

ʻŌpeʻapeʻa – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)

Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young

Phylogenetic – The evolutionary order that organisms are arranged by

Sign – Biological term referring to tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected

Threatened – Listed and protected under the ESA as a threatened species.

DLNR – Hawaiʻi State Department of Land & Natural Resources

DOFAW – Division of Forestry and Wildlife

ESA – Endangered Species Act of 1973, as amended

TMK – Tax Map Key

USFWS – United State Fish & Wildlife Service

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Appendix D

Revised Draft Archaeological Literature Review and Field Inspection Report for the Keālia Subdivision Project
Cultural Surveys Hawaiʻi
April 2018

Letter from State of Hawaiʻi Land Use Commission to DLNR State Historic Preservation Division, dated February 27, 2018

DAVID Y. IGE
Governor

LUIS P. SALAVERIA
Director
MARY ALICE EVANS
Deputy Director

LAND USE COMMISSION
Department of Business, Economic Development & Tourism
State of Hawai`i

DANIEL E. ORODENKER
Executive Officer

February 27, 2018

Dr. Alan S. Downer, Administrator
State Historic Preservation Division
Department Land and Natural Resources
Kākuhihewa Bldg., Suite 555
601 Kamōkila Boulevard
Kapolei, Hawai`i 96707

Subject: Docket No. A17-803/Kealia Properties, LLC
Keālia Mauka Homesites, Keālia Ahupua`a, Kawaihau District, Kaua`i
Tax Map Key: (4) 4-7-004: por. 001

Dear Dr. Downer:

On October 16, 2017, Keālia Properties, LLC, filed a Petition for Land Use District Boundary Amendment to reclassify approximately 53.361 acres of land from the State Land Use Agricultural District to the State Land Use Urban District for the Keālia Mauka Homesites project at Keālia Ahupua`a, Kawaihau District, Kaua`i, Tax Map Key: (4) 4-7-004: por 001 (Petition Area).

We understand that State Historic Preservation Division (SHPD) Archaeology Branch Chief Dr. Susan Lebo has been involved in a relatively recent review of the Petition Area.

As you may know, the Petition Area was part of a prior archaeological inventory survey (AIS) (Drennan et al. 2006) that recommended no further archaeological work. At this time, we request confirmation from the SHPD that the 53.361-acre Petition Area has been reasonably addressed in the prior AIS, and that the requirements of Hawai`i Revised Statutes Section 6E have been met. To assist you in your review, we have enclosed the document entitled *Draft Archaeological Literature Review and Field Inspection Report for the Keālia Subdivsion Project, Keālia Ahupua`a, Kawaihau District, Kaua`i, TMKs: [4] 4-7-004: por. 001* (Kamai and Hammatt 2017).

Thank you for your assistance in this matter. Should you have any questions or require further clarification, please call our office at 587-3822.

Sincerely,

Daniel E. Orodenker
Executive Officer

c: Benjamin M. Matsubara, Esq. (w/o enclosure)
Leslie Kurisaki (w/o enclosure)

Enclosure

Revised Draft
Archaeological Literature Review and Field Inspection Report for the Keālia Mauka Homesites Project, Keālia Ahupua‘a, Kawaihau District, Kaua‘i
TMKs: [4] 4-7-004:001.

Prepared for
HHF Planners

Prepared by
Nancine “Missy” Kamai, B.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: KEALIA 2)

April 2018

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Management Summary

Reference	Archaeological Literature Review and Field Inspection Report for the Keālia Mauka Homesites Project, Keālia Ahupua‘a, Kawaihau District, Kaua‘i, TMKs: [4] 4-7-004:001 (Kamai and Hammatt 2018)
Date	April 2018
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: KEALIA 2
Investigation Permit Number	CSH completed the fieldwork component of this study under archaeological fieldwork permit number 17-08, issued by the Hawai‘i State Historic Preservation Division (SHPD) per Hawai‘i Administrative Rules (HAR) §13-282.
Agencies	SHPD
Land Jurisdiction	Private
Project Proponent	Keālia Properties, LLC
Project Location	The Keālia Mauka Homesites project area is bounded by Kūhiō Highway to the east, residential homes on both Ka‘ao Road and Hōpoe Road as well as Keālia Road to the south, Kumukumu Ahupua‘a to the north, located in old cane lands. The project area is depicted on a portion of the 1996 Kapaa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.
Project Description	The Keālia Mauka Homesites project is a residential community development that will include the construction of 235 single-family house lots and a park.
Project Acreage	Approximately 53.4 acres (18 hectares)
Area of Potential Effect (APE) and Inspection Area Acreage	The Keālia Mauka Homesites project APE is the same as the project area. The inspection area for the current project includes the entire 53.4-acre (18-hectare) APE/project area.
Document Purpose	This investigation was designed—through detailed historical, cultural, and archaeological background research and a field inspection of the project area—to determine the likelihood that historic properties may be affected by the project and, based on findings, consider cultural resource management recommendations. This document is intended to facilitate the project's planning and support the project's historic preservation review compliance. This investigation does not fulfill the requirements of an archaeological inventory survey investigation, per HAR §13-276. Consequently, this report cannot be used to make formal recommendations for SHPD review and acceptance.

Fieldwork Effort	Fieldwork was accomplished on 1 May 2017 by Johnny Dudoit, B.A., and Missy Kamai, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. This work required approximately 2 person-days to complete.
Results Summary	The fieldwork component of the study reported all historic properties related to the plantation era (culverts, post, and concrete slabs), located within and along State Inventory of Historic Places (SIHP) # 50-30-08-07013, "New Kumukumu Camp."
Recommendations	Consultation with SHPD is recommended to gain clarity regarding state requirements prior to development based on the presently proposed plans.

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

1.1 Project Background

At the request of Mr. Scott Ezer of HHF Planners, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this literature review and field inspection report (LRFI) for the Keālia Mauka Homesites project, Keālia Ahupua‘a, Kawaihau District, Kaua‘i, TMK: [4] 4-7-004:001. The Keālia Mauka Homesites project area is bounded by Kūhiō Highway to the east, residential homes on both Ka‘ao Road and Hōpoe Road as well as Keālia Road to the south, Kumukumu Ahupua‘a to the north, located in old cane lands. The project area is depicted on a portion of the 1996 Kapaa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), a tax map plat (Figure 2), a 2013 aerial photograph (Figure 3), and a client-provided layout of the proposed project (Figure 4).

The approximately 53.4 acres (18 hectares) is understood to be privately owned. The Keālia Mauka Homesites project is a residential community development that will include the construction of27 units and a park.

In 1998, CSH conducted an archaeological reconnaissance survey and assessment of approximately 6,690.9 acres, which comprised the majority of the Keālia Ahupua‘a. Although not specifically mentioned in the reconnaissance and assessment report, field notes and various figures and maps revealed the 1998 project area was part of this subdivision project. Correlation of map to photo, “area 15” shows the current project area. Based on the photo, cane cultivation was evident and as part of the reconnaissance, “[t]he cane field areas of the property were covered by vehicle, with spot checking of unplanted areas on foot . . .” (Hammatt and Chiogi 1998:13). No significant findings were mentioned within the current project area.

In 2006, the Keālia Mauka Homesites project area was subject to a systematic archaeological inventory survey (AIS) conducted by Scientific Consultant Services, Inc. (SCS) as part of a 450-acre portion of a 2,008-acre property located in the *ahupua‘a* of Keālia and Kumukumu, Kaua‘i, referred to as “Phase I” (Drennan et al. 2006:2). The project area stretched from Kūhiō Highway on the southeast inland to the northwest. The project area’s location is described with the following:

> The Makai (seaward) property runs along the eastern boundary of Kūhiō Highway (1100 m at, north-south [19°-199°], elevation 75 to 100 feet). The southern border of the property traverses along sections of Keālia Road and meanders along a southwesterly path touching upon Haua‘ala road at various junctures (4424 m at 124°-304° [east-west], extending in elevation of 208 to 335 feet, until it connects back to Keālia Road; the northernmost extent is situated along the northern banks of the North Fork of Kumukumu Stream and extends for 2620 m, east-west [110°-290°] from elevations of 80 to 30 feet. [Drennan et al. 2006:4]

A total of 15 historic properties comprising 21 features were identified and documented. Subsurface testing included four stratigraphic trenches and one test unit. The current proposed project is located within survey area conducted by SCS in 2006. Based on a map showing historic properties and subsurface testing locations (Drennan et al. 2006:30), no archaeological sites or features were observed and no subsurface testing has been conducted in current project area at the

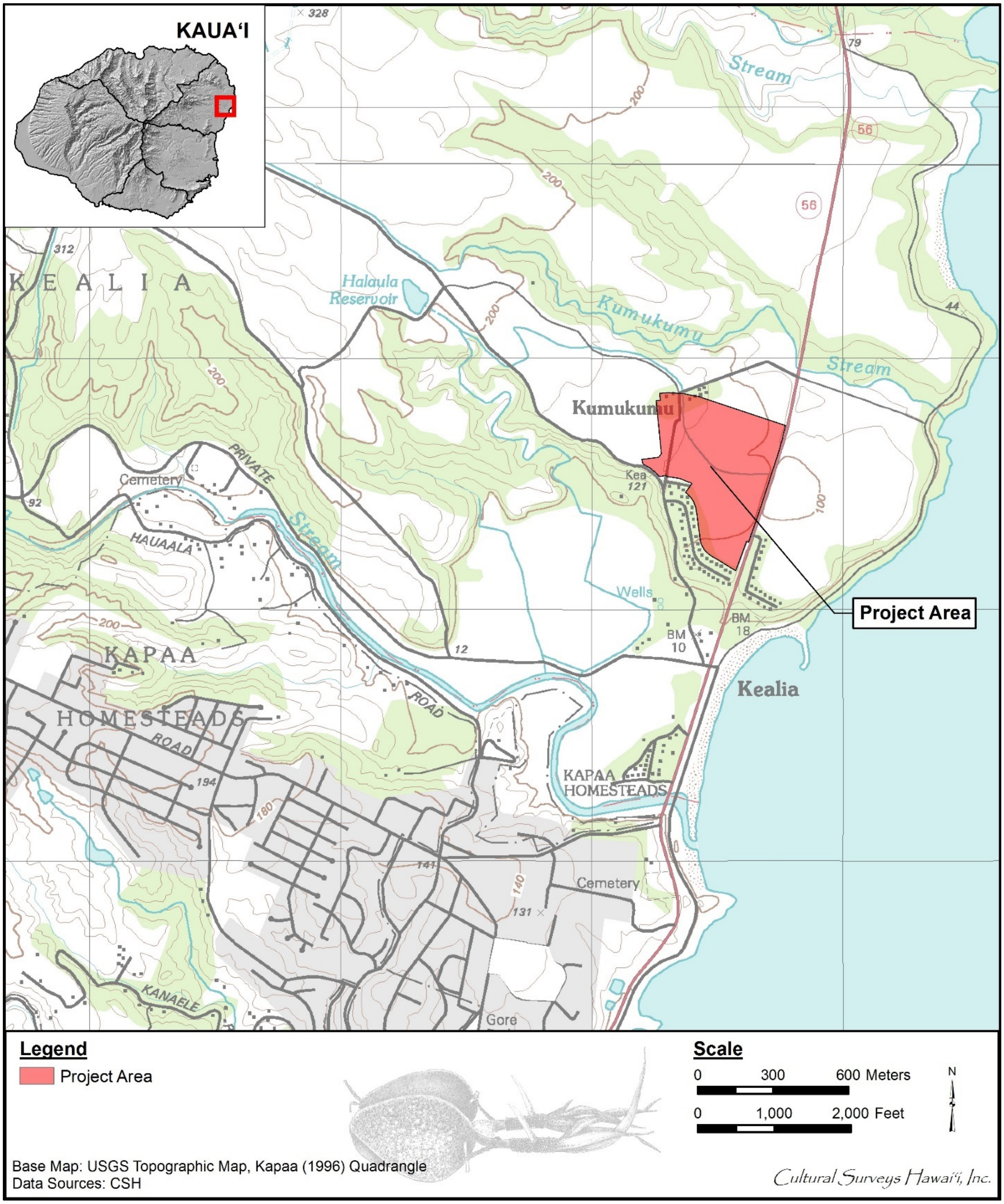

Figure 1. Portion of the 1996 Kapaa USGS 7.5-minute topographic quadrangle showing the location of the project area

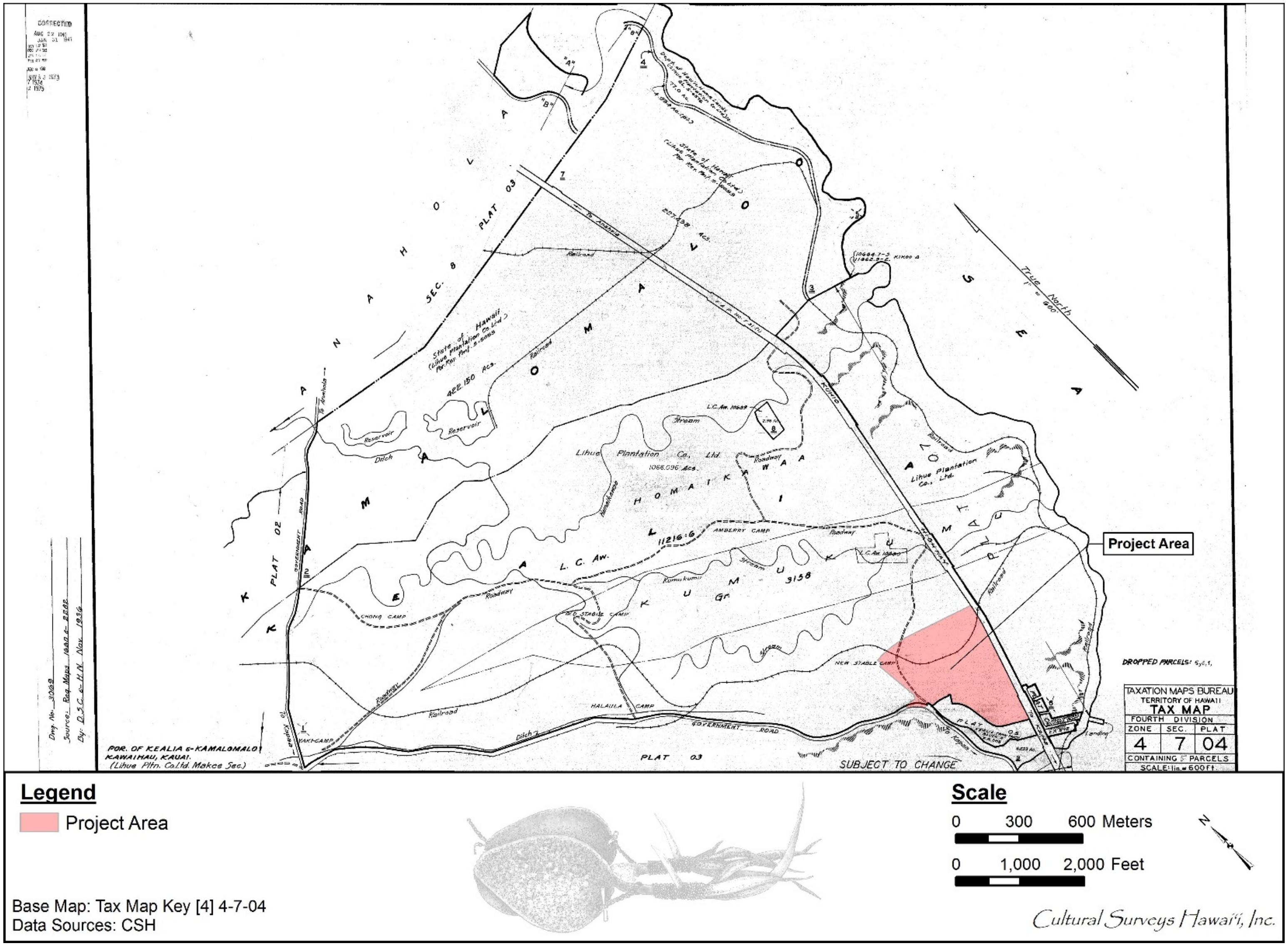

Figure 2. Tax Map Key (TMK) [4] 4-7-04 showing the project area (Hawai'i Service 2014)

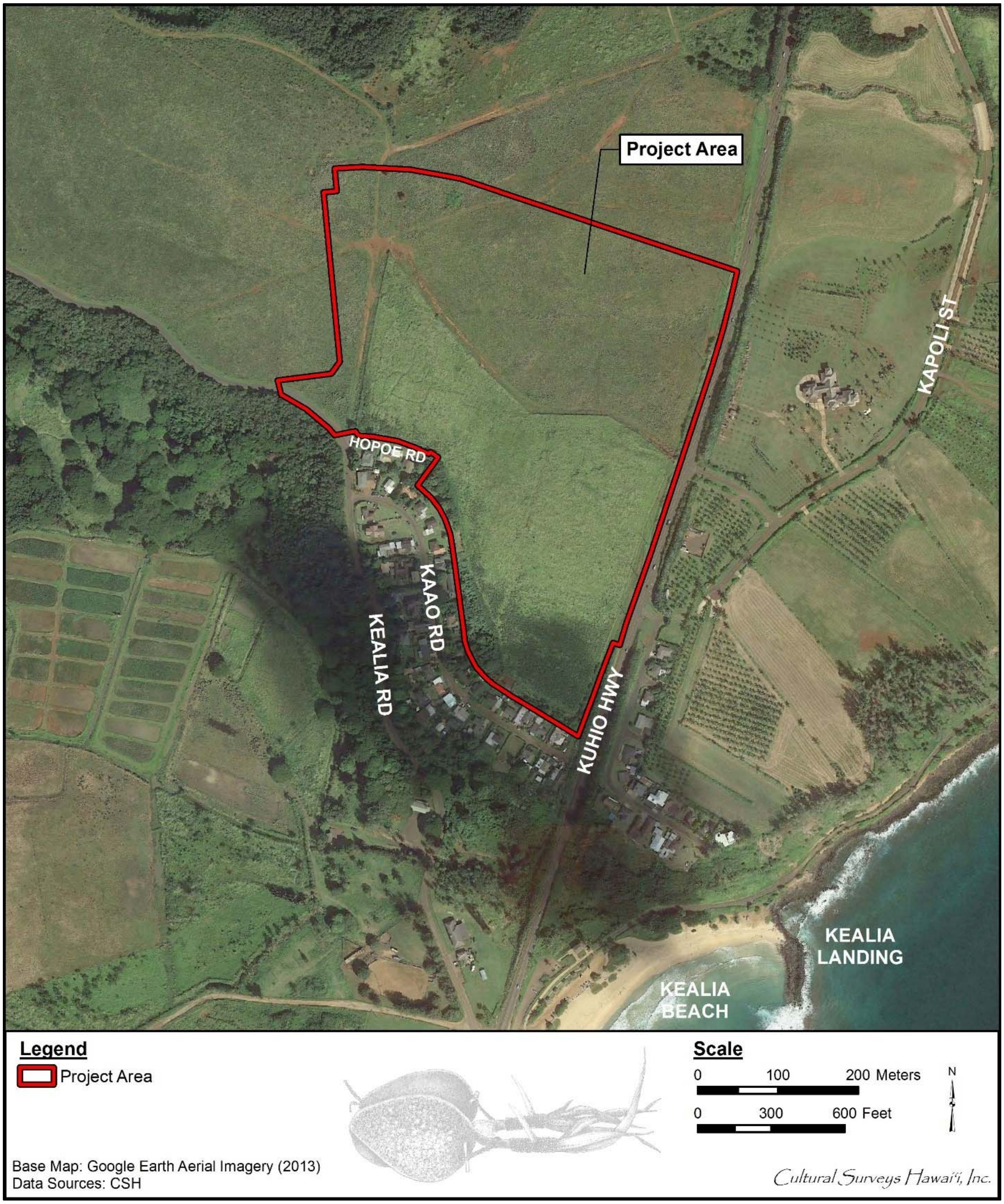

Figure 3. Aerial photograph showing the location of the project area (Google Earth 2013)

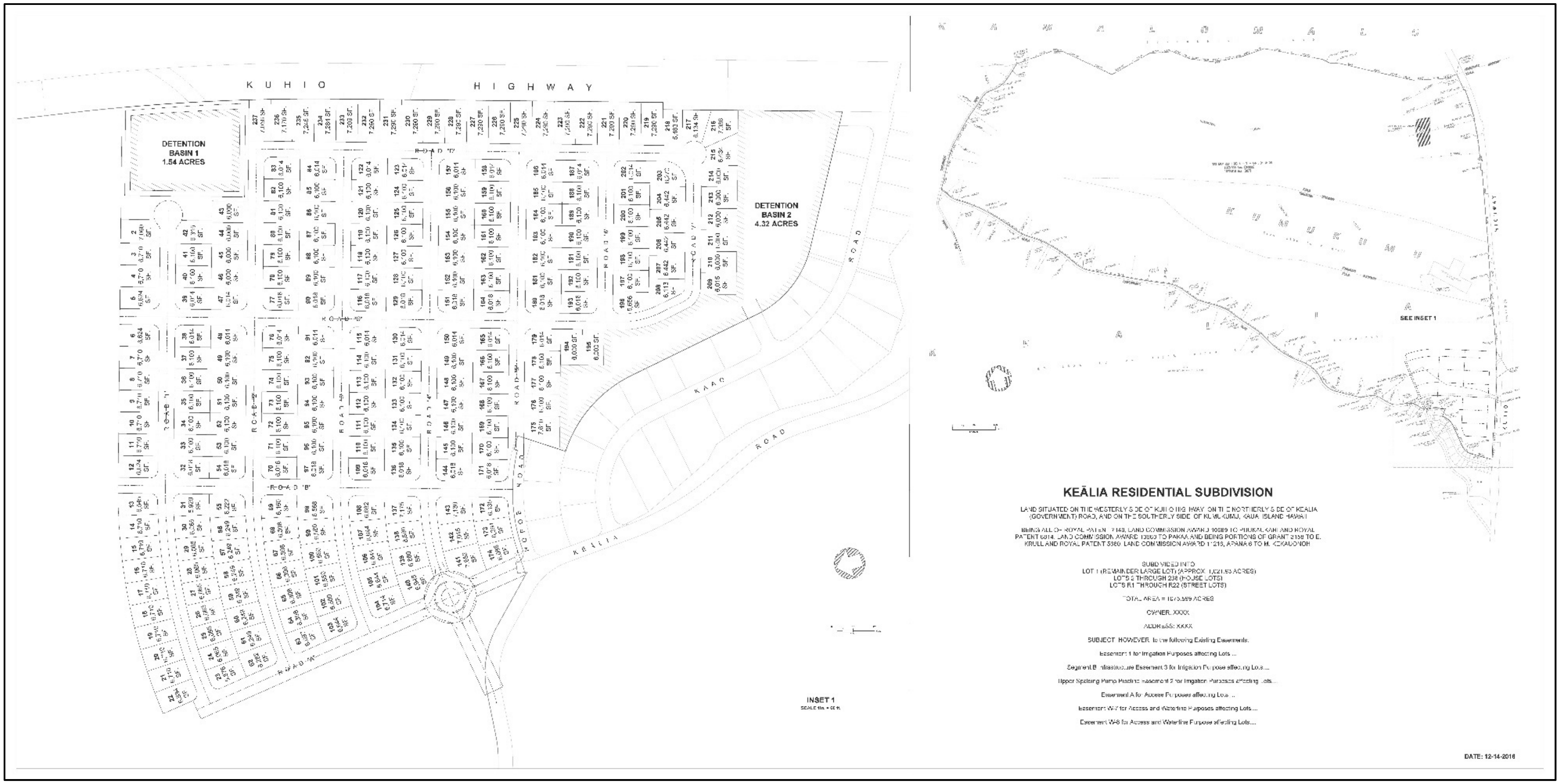

Figure 4. Layout of the proposed Keālia Mauka Homesites (courtesy of client)

time of Phase I’s survey. However, during the inventory survey of Phase II, conducted by SCS in 2007, State Inventory of Historic Places (SIHP) # 50-30-08-7013 (“New Kumukumu Plantation Camp” remnant) and SIHP # -7016 (transportation complex of four features) were identified and documented in the current project area (Drennan and Dega 2007:51–56).

1.2 Scope of Work

The following scope of work for this project is based on information provided by the client:

1. Historical research to include study of archival sources, historic maps, Land Commission Awards, and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.
2. Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.
3. Preparation of a report to include the results of the historical research with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration.
4. Consultation with State Historic Preservation Division (SHPD) to procure a determination of the proposed project’s historic preservation requirements as regulated by the SHPD. Present summary documents to the SHPD in a meeting or by telephone to obtain a determination of the project’s historic preservation requirements.

This investigation does not fulfill the requirements of an archaeological inventory survey investigation, per Hawai‘i Administrative Rules (HAR) §13-276. Consequently, this report cannot be used to make formal recommendations for SHPD review and acceptance.

1.3 Environmental Setting

1.3.1 Natural Environment

The project area, within Keālia Ahupua‘a, is located on the windward side of Kaua‘i and is exposed to the prevailing tradewinds and their associated weather patterns. Rainfall on the coastal plains and plateaus of Keālia averages approximately 40 inches per year (Juvik and Juvik, 1998:56). Keālia can be characterized as flat, with irregularly shaped gulches and small valleys in the uplands, through which small tributary streams run from Kapa‘a including Kapahi, Makaleha and Moalepe. While some of these streams combine with other tributaries in Keālia to form Kapa‘a Stream (often referred to as Keālia River) which empties into the ocean at the southern border of the *ahupua‘a.* Keālia Ahupua‘a shows more characteristics of a typical stream valley with a good sized alluvial plain dissected by a major stream, the Kapa‘a Stream (Keālia River) in addition to a plateau land dissected by a few small drainages including Kumukumu and Hōmaikawa‘a streams.

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), soils within the project area include Ioleau silty clay loam, 2 to 6% slope in the northern half of the project area (IoB); Ioleau silty clay loam, 6 to 12% slope (IoC) in the northeastern portion; a small portion of Ioleau silty clay loam, 12 to 20% slope at the northeast corner (IoD2), and the majority of the project containing Lihue silty clay, 0 to 8% slope (LhB) (Figure 5).

Soils of the Ioleau Series are described as follows:

> This series consists of well-drained soils on uplands on the island of Kauai. These soils developed in material weathered from basic igneous rock, probably mixed with volcanic ash. They are gently sloping to steep. Elevations range from 100 to 750 feet. The annual rainfall amounts to 40 to 70 inches. The mean annual soil temperature is 72° F. Ioleau soils are geographically associated with Lihue and Puhi soils.
>
> These soils are used for irrigated sugarcane, pasture, pineapple, irrigated orchards, irrigated truck crops, wildlife habitat, and woodland. The natural vegetation consists of lantana, koa haole, guava, and associated shrubs and grasses. [Foote et al. 1972:47]

Soils of the Lihue Series are described as follows:

> This series consists of well-drained soils on uplands on the island of Kauai. These soils developed in material weathered from basic igneous rock. They are gently sloping to steep. Elevations range from nearly sea level to 800 feet. The annual rainfall amount to 40 to 60 inches. The mean annual soil temperature is 73° F. Lihue soils are geographically associated with Ioleau and Puhi soils.
>
> These soils are used for irrigated sugarcane, pineapple, pasture, truck crops, orchards, wildlife habitat, woodland, and homesites. The natural vegetation consists of lantana, guava, koa haole, joee, kikuyugrass, molassesgrass, guineagrass, bermudagrass, and Java plum. [Foote et al. 1972:82]

1.3.2 Built Environment

As a comparison study seen in Figure 6 and Figure 3, the project area’s built environment includes a large portion of former cane lands and the “New Kumukumu Camp” that no longer exist. At the present the current project area is leased for cattle raising. A very small portion of Route 56 (Kūhiō Highway) and Hōpoe Road are also located within the project area. Residential housing along Ka‘ao Road abuts the southern portion of the project area.

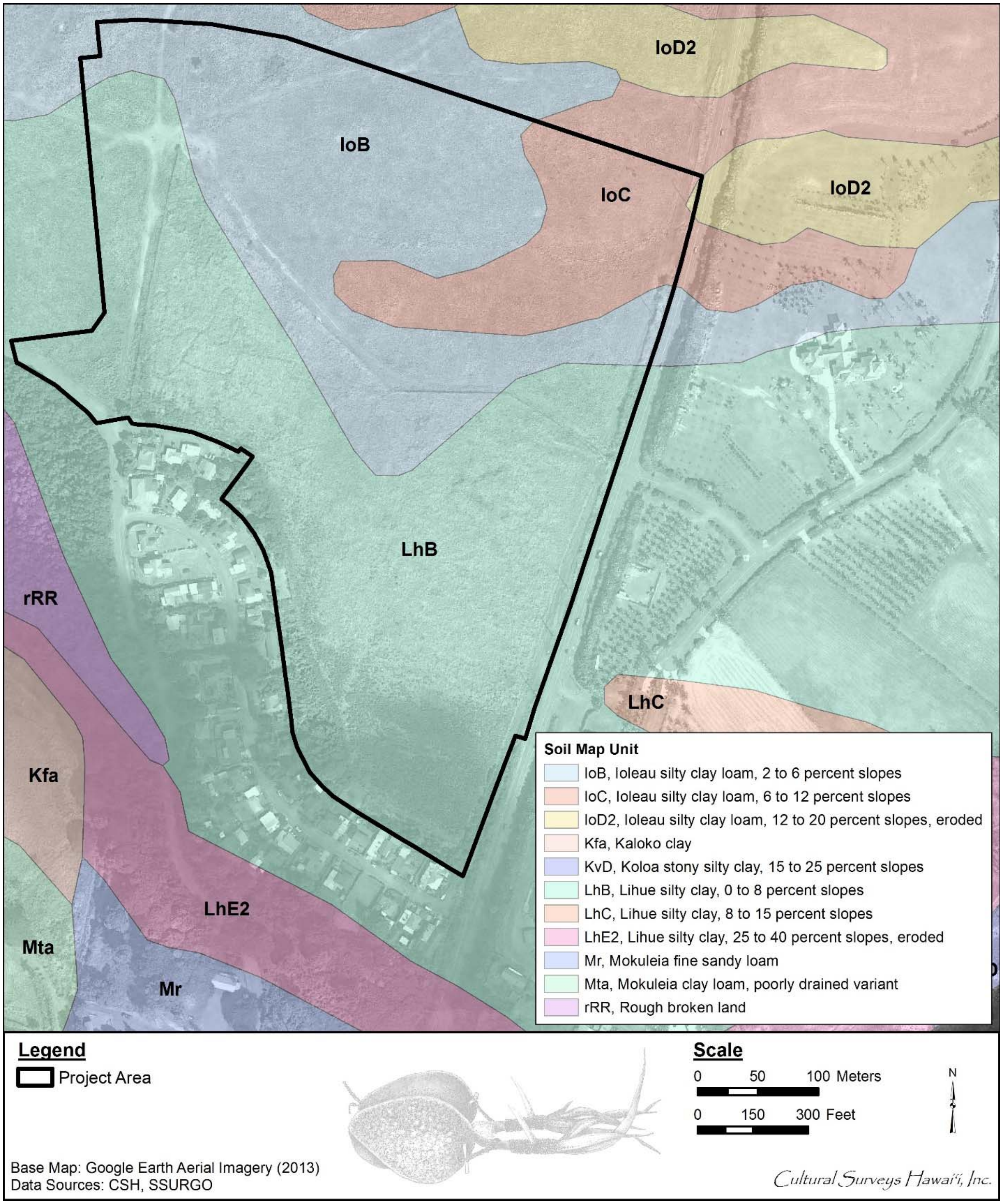

Figure 5. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972), indicating soil types within and surrounding the project area (U.S. Department of Agriculture Soils Survey Geographic Database [SSURGO] 2001)

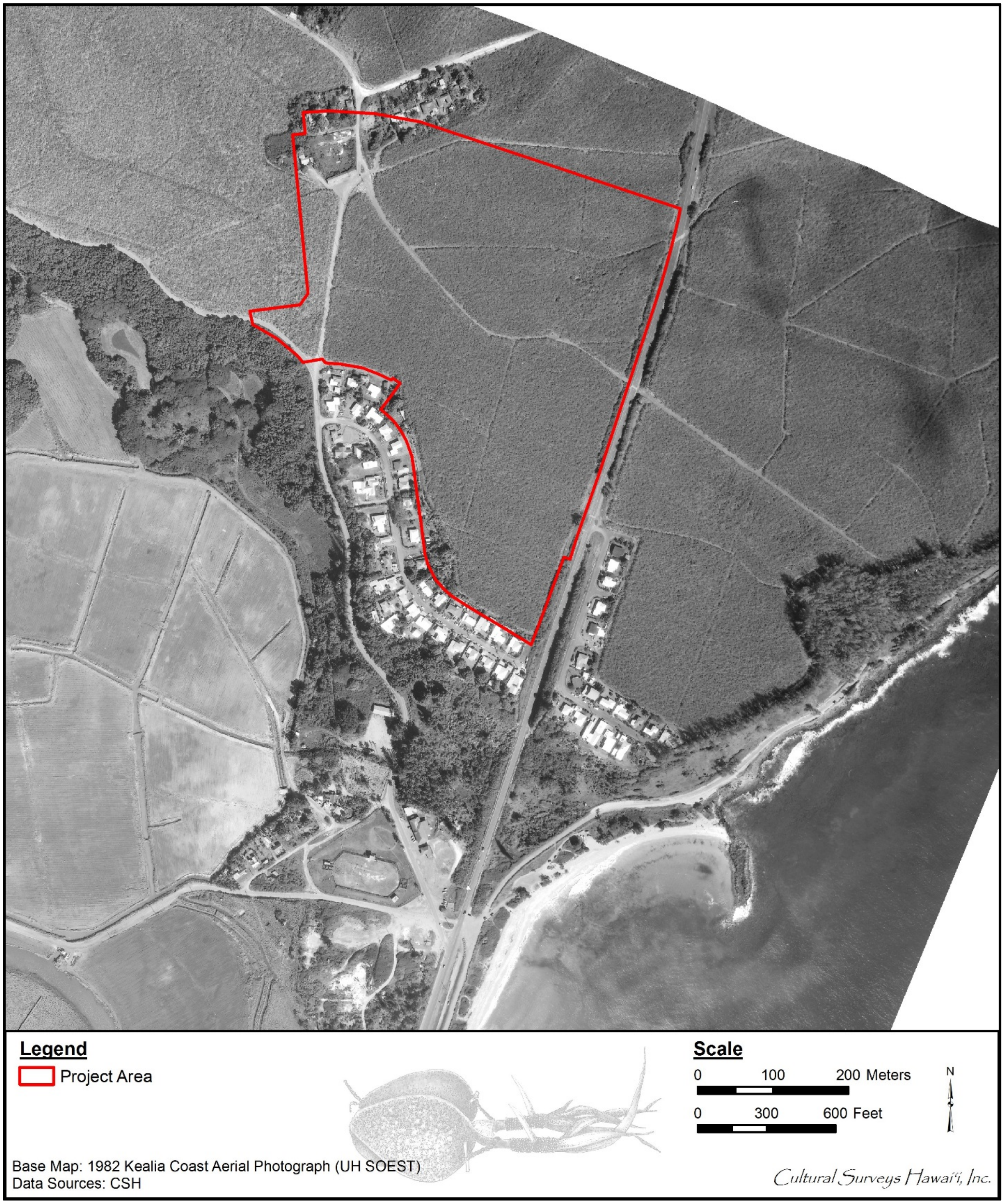

Figure 6. 1982 area photo (UH SOEST) showing cane lands in majority of the project area, “New Kumukumu Camp” in the north corner, residential housing along Ka‘ao and Hōpoe roads to the south, and Kūhiō Highway to the east

Section 2 Methods

2.1 Field Methods

CSH completed the fieldwork component of this study under archaeological fieldwork permit number 17-08, issued by the SHPD pursuant to HAR §13-282, under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator).

The fieldwork component of the archaeological literature review and field inspection was conducted on 1 May 2017 by CSH archaeologists Johnny Dudoit, B.A., and Missy Kamai, B.A. This fieldwork required approximately 2 person-days to complete. In general, the purpose of the field inspection was to develop data on the nature, density, and distribution of archaeological sites within the project area, specifically within the areas of proposed subdivision developments. Archaeological sites or site areas were noted with brief written descriptions and photographs. The project's background file was loaded in the Garmin GPSmap 60CSx survey technology (accuracy 3-5 m) to locate the project's route.

In general, fieldwork included 100% pedestrian inspection of the project area, GPS data collection, and photo documentation.

2.1.1 Pedestrian Survey

A 100%-coverage pedestrian inspection of the project area was undertaken for the purpose of historic property identification and documentation. The pedestrian survey was accomplished through systematic sweeps spaced 10-15 m apart due to the low vegetation.

2.2 Literature Review

The literature review included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawaiʻi, the Hawaiʻi State Archives, the Mission Houses Museum Library, the Hawaiʻi Public Library, and the Bishop Museum Archives; study of historic photographs at the Kauaʻi Historical Society, Hawaiʻi State Archives, and the Bishop Museum Archives, digital collections; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ʻAina database (Waihona ʻAina 2000).

This research provided the environmental, cultural, historic, and archaeological background for the project area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the project area.

Section 3 Background Research

3.1 Traditional and Historical Background

The project area is located in the *ahupuaʻa* (traditional land division) of Keālia in the ancient district of Puna, one of five ancient districts on Kauaʻi (King 1935:228) (Figure 7). For taxation, educational, and judicial reasons, new districts were created in the 1840s. The Puna District, with the same boundaries, became the Līhuʻe District, named for an important town in that district. In 1878, by act of King Kalākaua in securing a future and name for the new Hui Kawaihau, the new district of Kawaihau was created. This new district encompassed the *ahupuaʻa* ranging from Olohena on the south to Kīlauea on the north. Subsequent alterations to district boundaries in the 1920s left Kawaihau District with Olohena as its southernmost boundary and Moloaʻa as its northernmost boundary (King 1935:222).

3.2 Traditional and Legendary Accounts of Keālia

3.2.1 Place Names and *Wahi Pana* (Celebrated Places)

"In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there which has meaning for the people of that time" (McGuire 2000:17). *Wahi pana* were passed on through the oral tradition, preserving the unique significance of each place. Hawaiians named all sorts of objects, places, and points of interest. In the following sentences and paragraphs, the place names (*wahi pana*) are in bold. Although the legendary accounts and celebrated places (*wahi pana*) of Keālia pale in comparison to that of nearby Wailua, there are still several accounts that refer to the area.

ʻĀhihi Point, in Kamalomaloʻo, what some consider to be the northernmost *ahupuaʻa* of Puna, is another *wahi pana*, ʻĀhihi. ʻĀhihi is a headland that juts out into the ocean between what is now known as Keālia and Anahola. Wichman (1998:87) retells a story about ʻAʻaka, the name of the plain *mauka* (inland; toward the mountains) of ʻĀhihi and the name of a *menehune* (small, mythical people), Hōmaikawaʻa, the valley adjacent to ʻAʻaka, and ʻĀhihi, a plant with long runners. One of ʻAʻaka's favorite pastimes was to throw a stone into the ocean from ʻĀhihi Point and then jump in after it. Once, when a large white shark almost swallowed him whole, ʻAʻaka, devised a plan to fabricate a net made from *āhihi* to catch the shark. After ordering the canoe, "Hōmaikawaʻa," he and his companions were able to catch the shark and tow it to the reef at ʻAliomanu, near Anahola.

Akiana is the name of a land, possibly an *ʻili* (land division smaller than an *ahupuaʻa*) in Keālia (LCA 10907).

Awikiwili is the name of a land, possibly an *ʻili* in Keālia (LCA 10907).

Halaʻula is a name associated in the Hanalei and Kawaihau districts. The literal meaning is "red panadanus" (Soehren 2002:12; Pukui et al. 1984:36). This name was also given to a historic plantation camp associated with Makee Sugar Company at Keālia. As seen in Figure 1, Halaʻula is also the name of a reservoir.

Haleki is the name of a land, possibly an *ʻili* in Keālia (LCA 7966).

Haulei is the name of a land, possibly an *ʻili* in Keālia (LCA 8060, 1980).

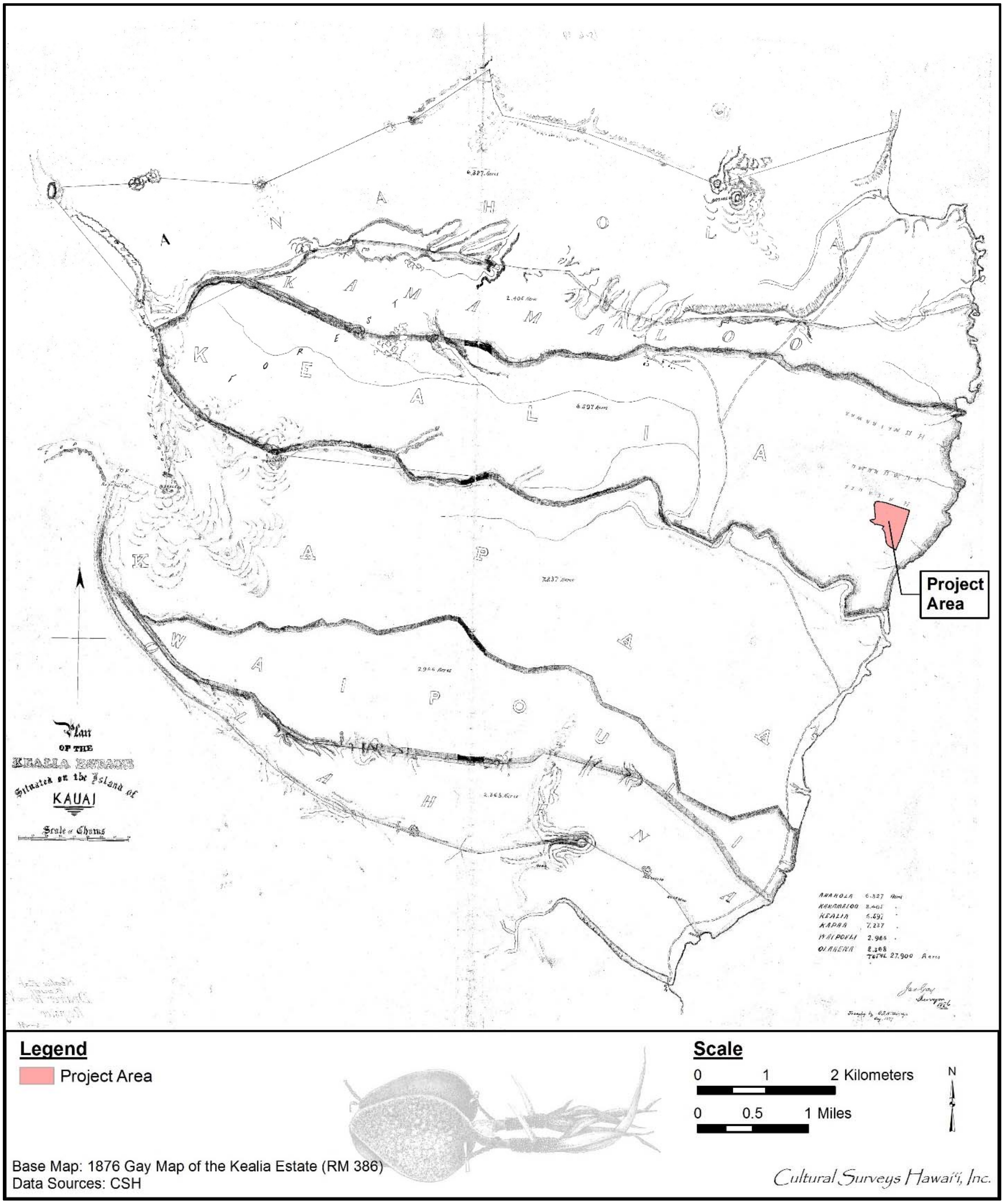

Figure 7. 1876 Gay map showing the *ahupuaʻa* of Keālia

Hawaipahea is the name of a land, possibly an *‘ili* in Keālia (LCA 8060, 1980).

Hōmaikawa‘a means “give me the canoe” (Soehren 2002:22; Pukui et al. 1984:48). The name also refers to a stream and land division.

Hulilua is the name of the wind at Hanaikawaa (*sic*. Hōmaikawa‘a) (Fornander 1916-1919:5:96, 97).

Kaea is a *wahi pana* associated with Palila and his banana grove located in the *mauka* region of the Kawaihau district.

Ka‘ele‘ele is the name of a land, possibly an *‘ili* in Keālia (LCA 10473, 1980).

Kahue is the name of a land, possibly an *‘ili* in Keālia (LCA 8834).

Kalualihilihi is the name of the area where Krull Dairy was located near Waipahe‘e in Keālia in the mid-1800s (Kapa‘a Elementary School 1983); name of a fishing grounds in Puna district famed in chant (HEN:215).

Kapalua is a place in the Puna district famed in chant for its “broad-backed shrimp” (HEN: *Kuokoa*, May 1913).

Kapuka is a place in the Puna district famed in chant for its sea urchins (HEN:215).

Kapuna is the name of a land, possibly an *‘ili* in Keālia (LCA 8061).

Kapunakai is the name of a land, possibly an *‘ili* in Keālia (LCA 3413).

Kapuahola/Kapuaahole is the name of a land, possibly an *‘ili* in Hōmaikawa‘a (LCA 10689).

Kauaha/Kanaha/Kaha is the name of a land, possibly an *‘ili* in Keālia (LCA 8842).

Kaukuolono is the name of a land, possibly an *‘ili* in Keālia (LCA 10906).

Kaunakakai is the name of a land, possibly an *‘ili* in Keālia (LCA 10628).

Keahapana is a place in the traditional Puna district famed in chant for its “heavy taro” (HEN: *Kuokoa*, May 1913). In an interview conducted by CSH in 2002, Keahapana was also name for an area located up the Keālia River where Hawaiians continue to live and where taro was grown until the late 1990s.

Keālia is the name of an *ahupua‘a* in the ancient Puna District, which was changed to the historic district of Kawaihau during the reign of Kalākaua. Rice (1974:14) tells the story of Hi‘iaka and Wahine‘ōma‘o in Keālia. On their way to Hā‘ena, Hi‘iaka and Wahine‘ōma‘o stopped near Keālia to help a man cook his *lū‘au* (taro leaves) to eat with his *poi.* Noticing an ailing woman in the man’s house, Hi‘iaka said a prayer which brought the woman back to health. All the *kahuna* (priest) in the region had been unable to help the woman previously.

Kealohipaa is the name of a land, possibly an *‘ili* in Keālia (LCA 10149, 8060).

Kuaiula is the name of a land, possibly an *‘ili* in Keālia (LCA 10628).

Kuakahi/Kuahaki/Makuahaki is the name of a land, possibly an *‘ili* in Keālia (LCA 10473).

Kulehaole/Kulehale/Kulihaele is the name of a land, possibly an *‘ili* in Keālia (LCA 8833).

Kumukumu is a name associated in the Kawaihau district and possibly an old ahupua‘a name in the ancient Puna District. The literal meaning is “stubs” (Soehren 2002:112; Pukui et al. 1984:124). This name was also given to a historic plantation camp associated with Makee Sugar Company at Keālia, located in the northwest corner of the project area (see Figure 1 and Figure 6). As seen in Figure 1, Kumukumu is also the name of a stream north of the project area.

Kuna is the Hawaiian name to a place referred to as “Donkey Beach” (Bushnell et al. 2002:36).

Mahuaku/Mahuali is the name of a land, possibly an *‘ili* in Keālia (LCA 7966).

Makapono/Makahono is the name of a land, possibly an *‘ili* in Keālia (LCA 8842).

Malamalamaiki is a wind name of Keālia (Fornander 1916-1919:5:96, 97).

Moalepi/Moalepe is the name of a *pu‘u* (hill) in the *mauka* region of Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Naapakukui is the name of a land, possibly an *‘ili* in Kumukumu (LCA 10660).

Niau is the name of the northern side of Keālia Bay and location of Keālia Landing; name of a place in Puna district famed in chant for its short, breaking surf (HEN:215).

Opeka is the name for a tributary in the *mauka* region of Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Palikū is the name of a seaside cliff on the southern end of Kuna Bay, which is noted for fishing (Bushnell et al. 2002:37).

Pauahi is the name of a land, possibly an *‘ili* in Keālia (LCA 10473).

Pohakuomanu is the name of a low hillock in Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Pohakupili is the name of a mountain in Puna district famed in chant for a place where clouds gather (HEN:211–216). It is also the name of a mountain peak in Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Pualani is the name of a mountain peak in Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Puhokea is the name of a land, possibly an *‘ili* in Keālia (LCA 10473).

Pukahulu is the name of a *pu‘u* in the *mauka* region of Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Waipahe‘e means “slippery water” in Hawaiian (PEM:227). In the *mauka* areas of Keālia is a place called Waipahe‘e, a slippery slide used for recreation up until recent times. This *wahi pana* is associated with Kaweloleimākua and Kauahoa, who one day traveled to this place with their companion ‘Aikanaka (Wichman 1998:86). Here the two boys engaged in a contest of who could make the best *lei* for their chief. Kauahoa won this contest by making his *lei* of *liko lehua* while Kaweloleimākua made his of fern. The boys then held a contest *na‘ina‘i mimi* to see who could urinate the longest, but because Kauahoa was much bigger than Kawelo, he also won this contest. Later, when the two were men engaged in war, Kawelo reminds Kauahoa of this boyhood excursion in an attempt to avoid bloodshed between them, however, he was unsuccessful.

Waipunaula is the name of a land, possibly an *ʻili* as well as a fishpond in Keālia (LCA 08833).

3.2.2 *Heiau* of Keālia

During their expeditions around Hawaiʻi in the 1880s collecting stories from *ka poʻe kahiko* (elders), Lahainaluna students stopped in Keālia and gathered information regarding *heiau* (temples, non-Christian places of worship) of the region (Hawaiian Ethnological Notes 1885). Ten *heiau* were named, suggesting Keālia as well as Kapaʻa *ahupuaʻa* were probably more politically significant in ancient times. Table 1 lists the names of the *heiau,* their location if known, their type, associated chief and priest, any comments, and the reference. The exact locations of these *heiau* are unknown.

Table 1. List of *heiau* in Keālia (source: Bushnell, Shideler, and Hammatt 2003)

Name	Location	Type	Associated Chief/Priest
Pahua	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Kumalae	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Waiehumalama	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Napuupaakai	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Noemakalii	Kapaʻa/Keālia	"Heiau for birth of Kauai Chiefs, like Holoholokū"	Unknown
Puukoa	Kapaʻa/Keālia	"Unu" (*heiau* for fishermen or an agricultural *heiau*)	Unknown
Piouka	Kapaʻa/Keālia	"Unu-type heiau"	Unknown
Una	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Mano	Kapaʻa/Keālia	Unknown	Kiha/ Lukahakona
Makanalimu	Upland of Kawaihau	Unknown	Kaumualiʻi

3.2.1 The Māhele and the Kuleana Act

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848 the crown and the *aliʻi* received their lands. The common people received their *kuleana* in 1850. It is through records for Land Commission Awards (LCA) generated during the Māhele that specific documentation of traditional life in Keālia Ahupuaʻa comes to light.

Keālia was granted to the *aliʻi* Miriam Keʻahikuni Kekauʻonohi (LCA 11216; Royal Patent 6071). Kekauʻonohi was a granddaughter of Kamehameha, one of Liholiho's wives and served as Kauaʻi governor from 1842 to 1844.

Eighteen *kuleana* land claims were made (Table 2 and Figure 8). One claimant, Lono (LCA 09973) relinquished his Keālia land to the *konohiki* (land supervisor) and went to live in Waiʻoli. Of the 17 claims registered, 15 were awarded. The great majority of claims were made on lands adjacent to Keālia River, a good-sized stream capable of supporting large scale irrigation projects. Other *kuleana* lands were situated adjacent to smaller streams or *ʻauwai* (ditch) north of Keālia

Table 2. Keālia Ahupuaʻa Land Commission Awards

LCA	Claimant	*ʻIli*	Claims	Award
01980	Puali	Haulei, Kaeleele	House lot, four *loʻi*, *kula*	One parcel
02381	Kekoowai		Five *loʻi*, two ponds, two orange trees, one *kahe ʻoʻopu* (fish trap), *kula* (pasture)	Not awarded
03413	Kaaki	Kapunakai	House lot, *kula*, 11 *loʻi*, two orange trees	One parcel
07966	Keaonui and Paekaia	Mahuaku, Haleki	Five *loʻi*, *kula*, house lot	One parcel
08060	Hulialo	Haulei, Kalohipa	House lot, two *loʻi*, *kula*	One parcel
08833	Kiaipa	Waipunaula, Kiohale	Five *loʻi*, *kula*, house lot	Two parcels
08834	Kalawaia	Lapanui, Kahue	House lot, two *loʻi*, *kula*	Two parcels
08842	Kaawapupuole	Kauaha, Makapono	House lot, four *loʻi*, *kula*	Two parcels
08061	Hainau	Kapuna	House lot, four *loʻi*, *kula*	One parcel
09973	Lono		*Loʻi* and *kula*	Relinquished land to *konohiki*
10148	Mamaki	Lapanui	House lot, two *loʻi*, *kula*	Two parcels
10149	Makuahine	Kealohipaa	Three *loʻi*, *kula*	One parcel
10451	Naawa		Ten *kihapai* (garden), goat enclosure	not awarded
10473	Nahi	Pauahi, Kuakahi, Kaeleele	House lot, 15 *loʻi*, *kula,* orange trees	Three parcels
10628	Puhi	Kaunakakai, Kuaiula	House lot, one *loʻi*	Two parcels
10906	Umiumi	Kaukuolono	*House lot, two loʻi, kula*	Two parcels
10907	Umiumi	Akiana, Hawaipahea, Awikiwili	Two *loʻi*, one *kula,* house lot	Two parcels
11216 K	Kekauonohi	Keālia Ahupuaʻa		6,500 acres

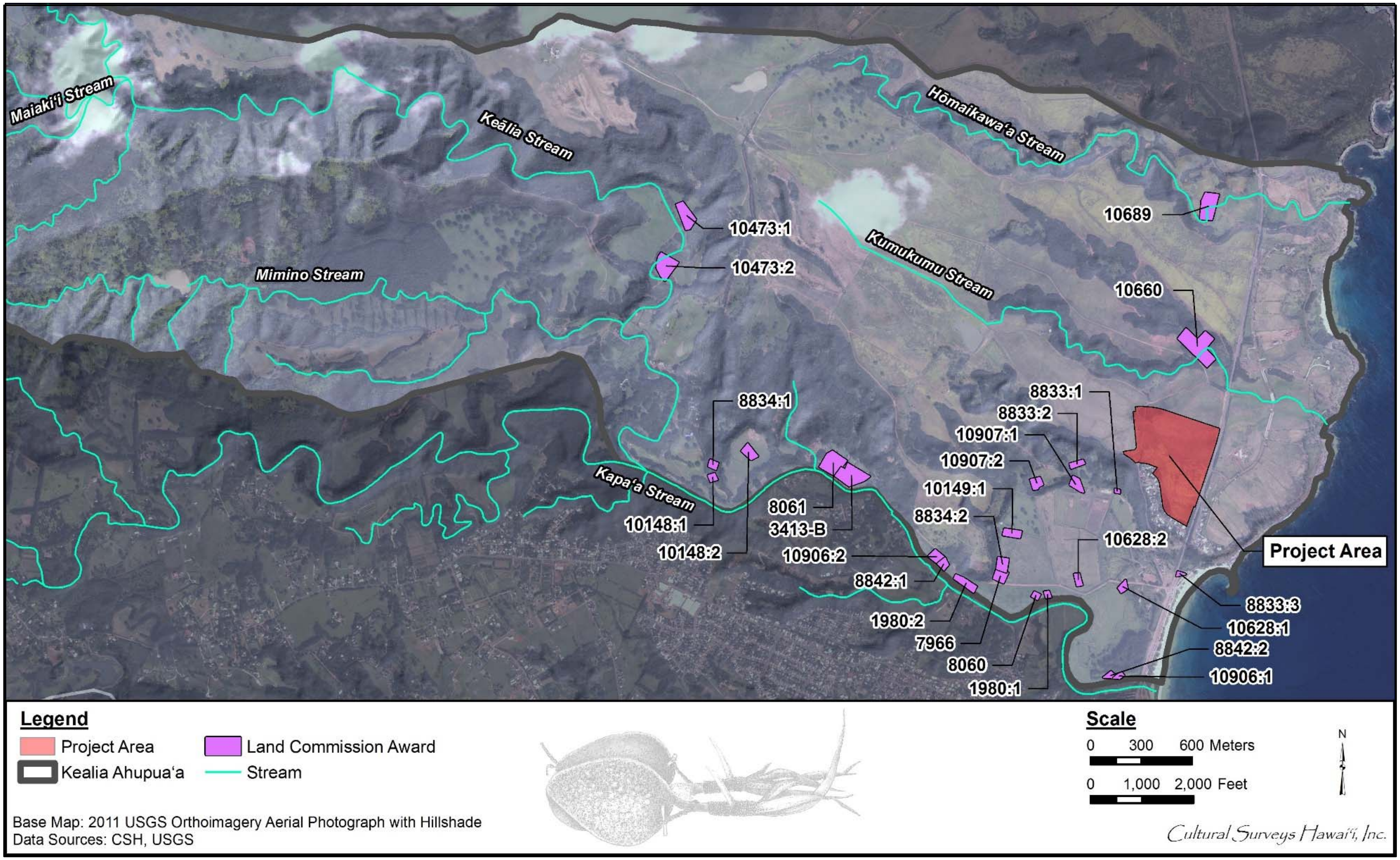

Figure 8. 2011 aerial photo (USGS Orthoimagery) showing LCA parcels in the *ahupua‘a* of Keālia

River. Sixty-seven cultivated *loʻi* (taro terrace) are claimed in the *kuleana*, with reference to numerous uncultivated *loʻi* and boundaries of other cultivated *loʻi* that were not claimed. In the Māhele documents, individual *loʻi* are referred to with their personal names in ten instances. Two ditches or *ʻauwai* are recorded, Kaauwaelalo (LCA 01980) and Kahaukua (LCA 10148). Keālia River and Keahapuna (Keahapana) River were also named as boundaries, although they may refer to the same river. This information suggests taro farming continued to be central to Keālia. In addition, four *kōʻele* (land cultivated by the tenant for a local chief) are named in the Keālia documents. This suggests the *konohiki* of Keālia maintained a fair amount of power and played an active role in land and water distribution even as population was declining and foreign powers were beginning to trickle in.

Another noteworthy resource in Keālia were ponds or *loko*. Four ponds were mentioned, though no reference to location is given for two. Akiana Pond (LCA 8060) is thought to be in the *ʻili* of Akiana and Loko Waipunaula (LCA 8833) is thought to be in Waipunaula ʻIli. In addition to the fishponds providing fresh fish, the Keālia records indicate freshwater fish were also caught in the rivers and streams. One individual claims a *kahe ʻoʻopu* or *ʻoʻopu* fish trap (LCA 2381). Māhele documents for Keālia indicate people were raising turkeys, goats, and pigs. One individual (LCA 8061) claimed a *mauka* parcel of land with *noni*, a useful medicinal plant and *wauke,* a plant used in making *kapa* and cordage. There were several disputes over orange trees (LCAs 3413B, 2381, 10473). In one case, the *konohiki* affirmed he himself had taken away two orange trees belonging to a claimant.

3.2.2 Early Historic Period of Keālia (1800s–1900s)

Captain George Vancouver, sailing off the east coast of Kauaʻi during his third voyage to the Hawaiian Islands in 1793, proclaimed it the "most fertile and pleasant district of the island." Vancouver only confirmed the qualities that must have much earlier attracted the Hawaiians living within the *ahupuaʻa* of that coast. Wailua Ahupuaʻa, where its river enters the sea, was home to the island's high chiefs. Kapaʻa Ahupuaʻa, north of Wailua, "in legendary history . . . is famous as the home of the great *aliʻi* Moikeha who lived there in his later years" (Handy and Handy 1972:424). Hanalei Ahupuaʻa, further northwest, was celebrated in numerous legends. The *ahupuaʻa* of Keālia, though located amidst these residences of the *aliʻi* and legendary places, did not attain a similar repute; a twentieth century description of the *ahupuaʻa* only noted

> Two small *ahupuaʻa*, Kamalomaloʻo (Dry Kamalo) and Kealia are rather dry, with small streams and gulches and only a few *loʻi* areas. Where Kealia and Kapaʻa Streams join inland there are wide flats that were terraced. Seaward there were formerly many terraced areas. There are clumps of coconut and mango trees where formerly were *kuleana* with their *loʻi*. Inland there were a number of small streams which doubtless once had small *loʻi* developments. [Handy and Handy 1972:423]

While traditional sources record little about Keālia Ahupuaʻa during the years preceding Western Contact in the late eighteenth century, the presence of *loʻi* and terraces on wide flats suggest it could have supported a stable population.

The earliest written documentation of life in the *ahupuaʻa* appears in the 1830s when missionary censuses recorded a total population of 283, comprising 265 adults and 18 children within Keālia (Schmitt 1973:25). Other Protestant missionary records focused more specifically on areas where mission stations were established. An 1847 census of 23 land divisions in the

Hanalei and Kawaihau districts gives population figures for Keālia (Schmitt 1969). Most notable is the decline in population in Keālia, from 283 in the 1830s to 143, a reduction of almost half (Schmitt 1969:229). Accounting for the high death toll caused by the introduction of foreign disease, this still seems like an extremely high death rate. A population distribution map by Coulter (1931) (Figure 9) indicates the population of Kauaʻi ca. 1853 "was concentrated chiefly on the lower flood plains and delta plains of rivers where wet land taro was raised on the rich alluvial soil" (Coulter 1971:14).

Although most of the historic documents for Kauaʻi in this period revolve around missionary activities and the missions themselves, there was indication the Kapaʻa area was being considered for new sugarcane experiments, similar to those occurring in Kōloa. In a historic move, Ladd and Company received a 50-year lease on land in Kōloa from Kamehameha III and Kauaʻi Governor Kaikioʻewa of Kauaʻi. The terms of the lease gave the new sugar company "the right of someone other than a chief to control land" and had profound effects on "traditional notions of land tenure dominated by the chiefly hierarchy" (Donohugh 2001:88). In 1837, a very similar lease with similar terms was granted to Wilama Ferani, a merchant and U.S. citizen based in Honolulu (Hawaiʻi State Archives, Interior Department, Letters, August 1837). The lease was granted by Kauikeaouli (Kamehameha III) for the lands of Kapaʻa, Keālia, and Waipouli for 20 years for the following purpose:

> [F]or the cultivation of sugar cane and anything else that may grow on said land, with all of the right for some place to graze animals, and the forest land above to the top of the mountains and the people who are living on said lands, it is to them whether they stay or not, and if they stay, it shall be as follows: They may cultivate the land according to the instructions of Wilama Ferani and his heirs and those he may designate under him. [Hawaiʻi State Archives, Interior Department, Letters, August 1837]

Unlike Ladd & Company, which eventually became the Koloa Sugar Company, there is no further reference to Wilama Ferani and his lease for lands in Kapaʻa, Keālia, and Waipouli. In a brief search for information on Honolulu merchant Wilama Ferani, nothing was found. It is thought that perhaps Wilama Ferani may be another name for William French, a well-known Honolulu merchant who is documented as having experimented with grinding sugarcane in Waimea, Kauaʻi at about the same time the 1837 lease for lands in Kapaʻa, Keālia, and Waipouli was signed (Joesting 1984:152).

In 1849, William P. Alexander, son of a Waiʻoli missionary, recorded a trip he took around Kauaʻi. Although, he focuses on the larger mission settlements like Kōloa and Hanalei, he does mention Keālia.

> A few miles from Wailua, near Kapaa we passed the wreck of a schooner on the beach, which once belonged to Capt. Bernard. It was driven in a gale over the reef, and up on the beach, where it now lies. A few miles further we arrived at Keālia. We had some difficulty crossing the river at this place, owing to the restiveness of our horses. The country here near the shore was rather uninviting, except the valley which always contained streams of water. [Alexander 1991:123]

One of the first people to succeed in business in the Keālia area was a German by the name of Ernest Krull. In 1854, a government survey was prepared for Kumukumu, Kauaʻi. In handwritten

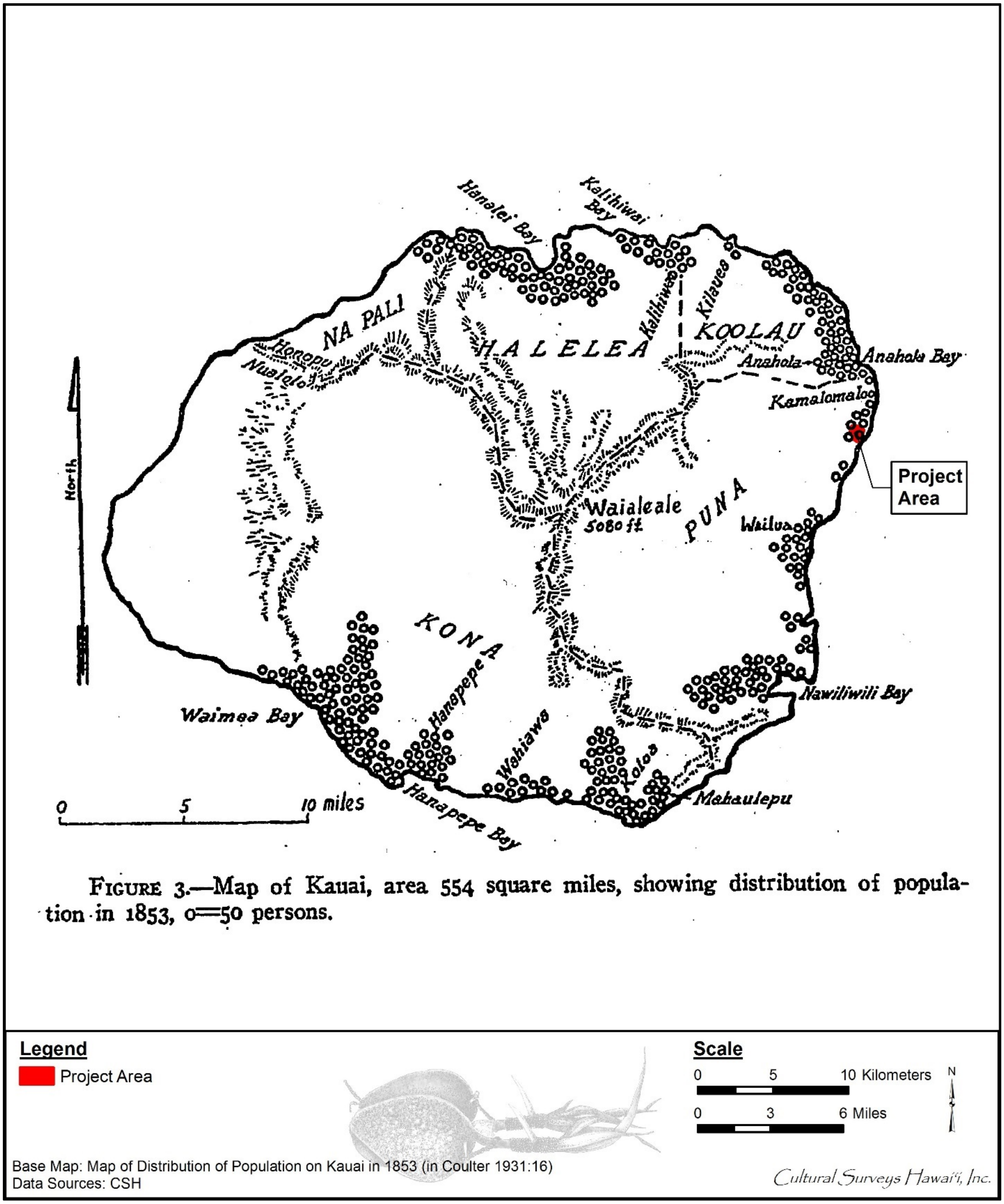

Figure 9. Map showing population estimate for Kaua'i in 1853 (Coulter 1931:16) and the location of the project area

notes of the map, it is indicated that Mr. Krull desired to buy government interest to the land for $200.00. Apparently, Mr. Krull was successful in obtaining Kumukumu because by the early 1860s, he was running a thriving business supplying whaling ships with beef and dairy products (Joesting 1984:171). Mr. Krull’s ranch and dairy were located in the Waipahe‘e area of Kumukumu in a place called Kalualihilihi (Kapa‘a Elementary School 1983:4). By 1870, Krull apparently had purchased the entire *ahupua‘a* of Keālia. In a 22 July 1870 petition to the Commissioner of Boundaries for the Fourth Judicial District, Island of Kaua‘i, Krull states “he is the owner and in possession of the ahupuaas of lands called Kealia Halaaula & Komaikawaa” (Boundary Commission, Kauai:1:ll). *The ahupua‘a* boundaries were decided by the Commissioner on 5 December 1870. The only man-made features noted in the decision were along the Keālia/Kamalomalo‘o boundary—the “Kealia auwai” and the “old mountain road into the forest.” His residence also served as a rest stop for travelers during the 1860s (Lydgate 1991:142). Mr. Krull continued to lease a portion of the tablelands above Keālia until 1876 when he sold his ranch to Colonel Z.S. Spalding and Captain James Makee (Hawai‘i State Archives, Interior Department, Letters, 1879; Kapa‘a Elementary School 1983:4).

Krull was one of a growing number of Germans settling on Kaua‘i in the nineteenth century. (“Of the approximately 1,200 German immigrants to come to the Islands by 1897, all but about 290 went to Kauai” [Joesting 1984:226]). In the 1850s, Hoffschlaeger and Company, a Honolulu firm established by German entrepreneurs, began ranching operations at Wailua (Figure 10). The company also installed a cotton mill at Hanamā‘ulu and, in 1864, sent August Conradt to Keālia to set up a cotton plantation and mill there. The venture was short-lived:

> . . . the absence of marked seasonal changes in the climate and the prodigal hand of Nature in this mid-ocean paradise produced a wealth of blossoms simultaneously mingled with ripe cotton bolls themselves. Picking the mature crop involved destruction to these young blossoms, and harvesting became, therefore, an exceedingly expensive process. The southern states, moreover, were not long in recovering their position as cotton producers after the Civil War, and the market price dropped too low to make it profitable at this geographical distance. [Damon 1931:376]

The first large-scale agricultural enterprise in the Keālia area was begun in 1877 in Kapa‘a by the Makee Sugar Plantation and the Hui Kawaihau (Dole 1916:8). The Hui Kawaihau was originally a choral society begun in Honolulu whose membership consisted of many prominent names, both Hawaiian and *haole* (Caucasian). It was Kalākaua’s thought that the Hui members could join forces with Makee, who had previous sugar plantation experience on Maui, to establish a successful sugar corporation on the east side of Kaua‘i. Captain Makee was given land in Kapa‘a to build a mill and he agreed to grind cane grown by Hui members. Kalākaua declared the land between Wailua and Moloa‘a a fifth district called Kawaihau and for four years the Hui attempted to grow sugarcane at Kapahi, on the plateau lands above Kapa‘a. After a fire destroyed almost one half of the Hui’s second crop of cane and the untimely death of Captain James Makee, one of their principal advocates, the Hui began to disperse and property and leasehold rights passed on to Makee’s son-in-law and the new Makee Plantation owner, Colonel Z.S. Spalding (Dole 1916:14).

As part of the infrastructure of the new plantation, a sugar mill was erected and the Makee Landing was built in Kapa‘a. Following Captain Makee’s death, Colonel Spalding took control of

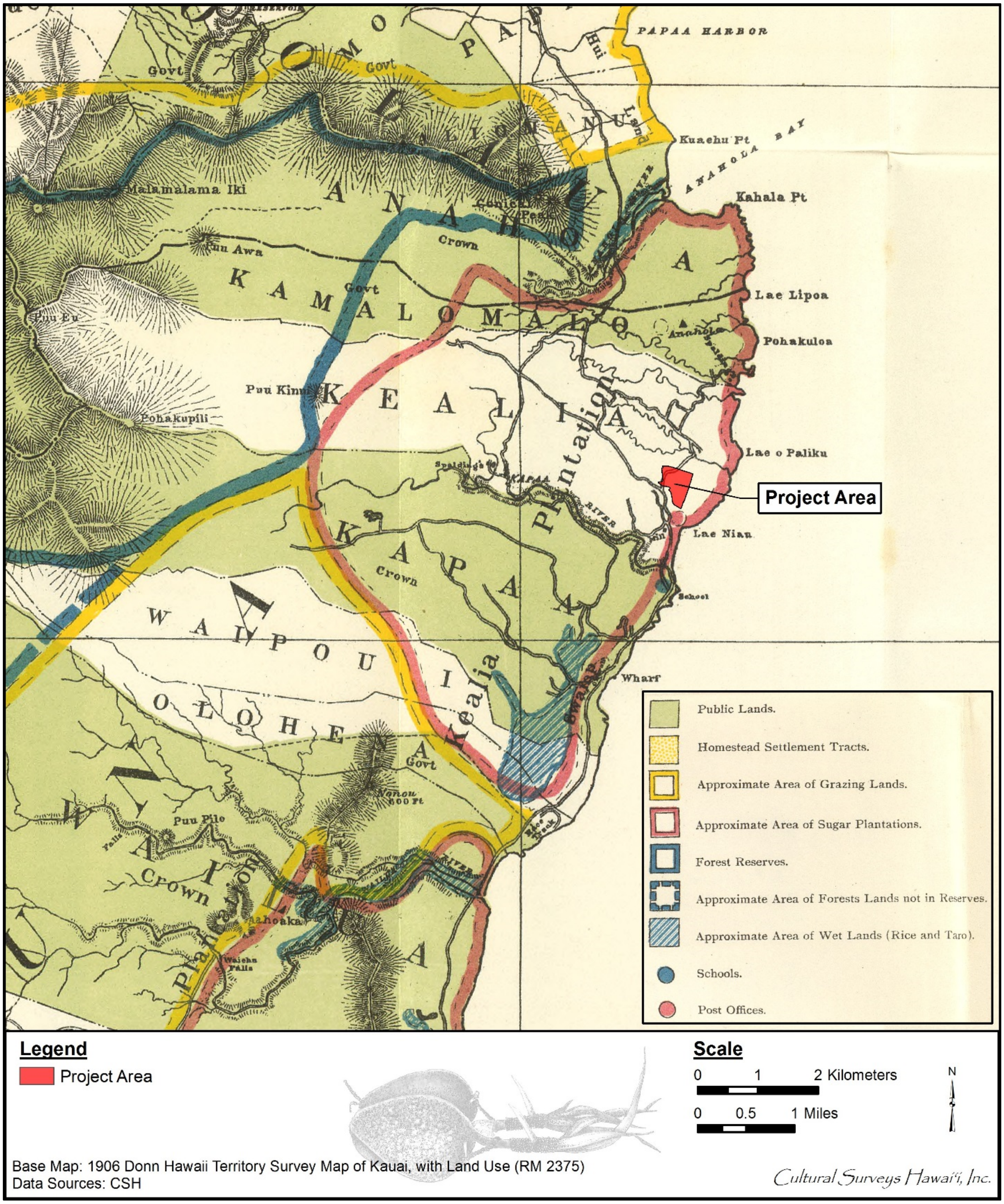

Figure 10. 1906 Donn map showing project area and land use from Wailua at the south to Anahola to the north

the plantation and in 1885 moved the mill to Keālia (Cook 1999:51) (see Figure 10 through Figure 14). The deteriorating stone smokestack and landing were still there well into the 1900s (Damon, 1931:359).

Condé and Best (1973:180) suggest railroad construction for the Makee Plantation started just prior to the mid-1890s. There is one reference to a railroad line leading from the Kapaʻa landing to Keālia in 1891. During Queen Liliʻuokalani's visit to Kauaʻi in the summer of 1891, the royal party was treated to music by a band, probably shipped in from Oʻahu. "The band came by ship to Kapaʻa and then by train to Keālia" (Joesting 1984:252). This line is depicted on a 1910 USGS map that shows it heading south from Keālia Mill (Figure 15). This railroad line was part of a 20-mile network of plantation railroads with some portable track and included a portion of Keālia Valley and the *mauka* regions of the plateau lands north of Keālia (Condé and Best 1973:180).

Narrow wagon roads gave way to macadamized roads in the early part of the twentieth century. This new road was called the Kauaʻi Belt Road and parts of it are thought to have followed the "Old Government Road" (Cook 1999). In Kapaʻa, the present day Kūhiō Highway probably follows the same route as the original Government Road and subsequent Kauaʻi Belt Road.

In Keālia, however, there is evidence of numerous traditional trails leading to Anahola with possibly two principal routes, a *makai* (seaward) route and a *mauka* route. In 1881, Z.S. Spalding, proprietor of the Makee Sugar Plantation, appealed to the Department of the Interior with a formal petition to have the *makai* road (in Keālia) officially closed stating that the natives were breaking through his fences to take short cuts between Keālia and Anahola (Hawaiʻi State Archives, Letter: Z.S. Spalding, 16 May 1881). The exact location of the *makai* road is unknown although it is thought to have been on the plateau lands, somewhat removed from the coastline, in areas fit for sugarcane production. The route of the Old Government Road, also known as the "Mauka road" is described as such, "crossing the Kealia River above the Rice Plantation and passing over the hill near Mr. Spalding's residence" (Hawaiʻi State Archives, Letter: Z.S. Spalding, 21 April 1882). When the Kauaʻi Belt Road was constructed in first two decades of the twentieth century, a portion of the old Government Road route was abandoned. The new route crossed the river at the *makai* end of Keālia Stream, paralleled the ocean and the railroad track, and then turned *mauka* passing through Keālia town and went up the hill to meet up with the "Old Government Road" (see Figure 6). The Keālia Bridge built for the Kauaʻi Belt Road is thought to date to ca. 1912. A traveler writing about their travels in 1913, mentions the bridge: "In the twinkling of an eye we passed on the steel bridge of Kealia. This new bridge is beautiful" (Akina 1913).

3.2.1 Twentieth Century Accounts of Keālia

The Ahukini Terminal & Railway Company was formed in 1920 to establish a railroad to connect Anahola, Keālia, Kapaʻa to Ahukini Landing, and "provide relatively cheap freight rates for the carriage of plantation sugar to a terminal outlet" (Condé and Best 1973:185). This company was responsible for extending the railroad line from the Makee Landing, which was no longer in use, to Ahukini Landing, and constructing the original Waikaʻea Railroad Bridge and the Moikeha Makai Railroad Bridge. In an annual report written in December 1921, the line between Ahukini and Keālia was opened by 7 May 1921 stating, "can run trains from Ahukini to Kealia on twenty four hours notice" (Condé and Best 1973:185) (Figure 15 and Figure 16). The report also specifically mentions a bridge near the Hawaiian Canneries Company which cost $12,000.00 to build and was washed away in a "freshet" in January 1921 and needed to be rebuilt. The Keālia

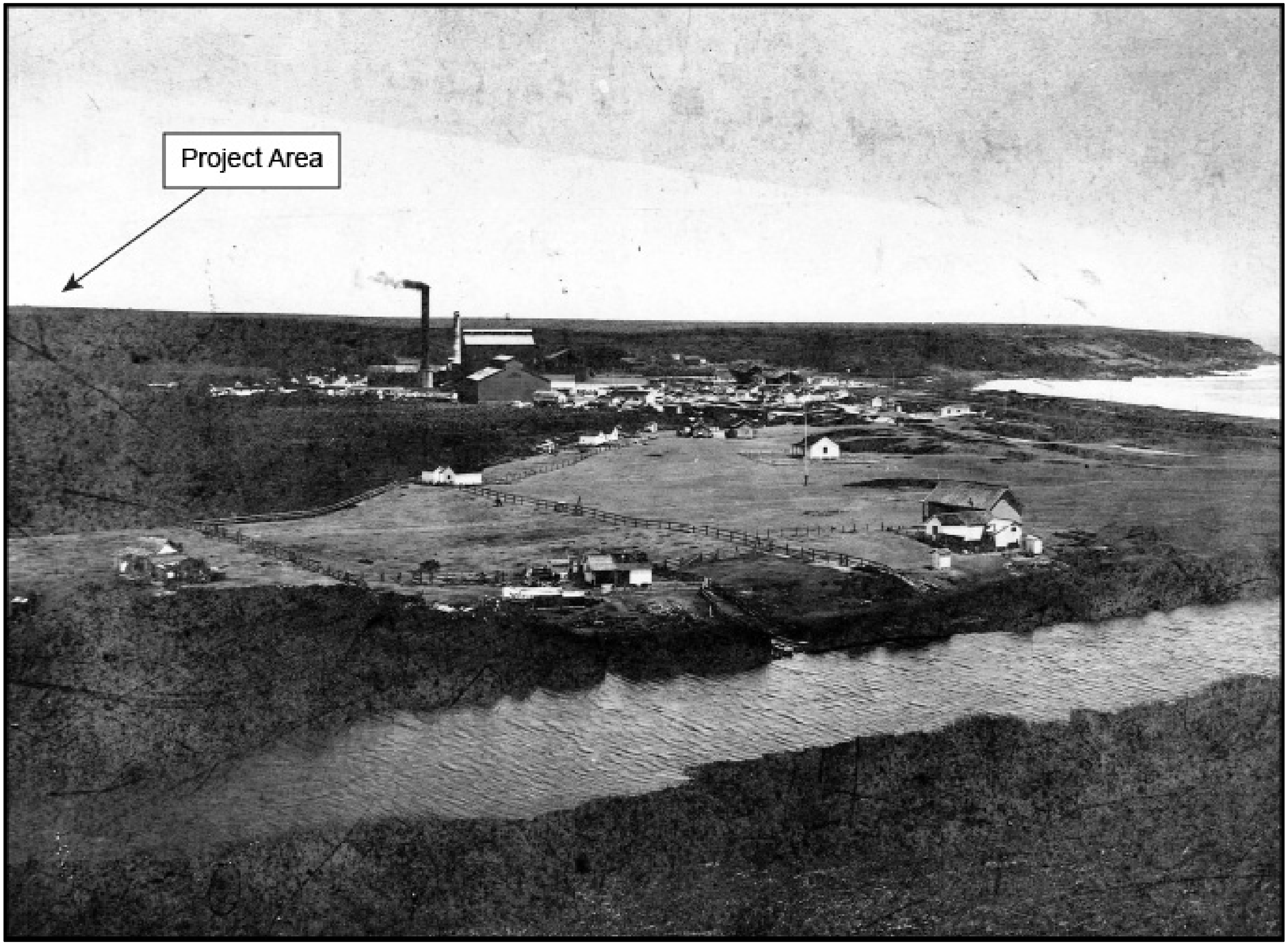

Figure 11. Makee Sugar Company Mill and Camp at Keālia, ca. 1894 (taken from Hammatt and Chiogi 1998:14) showing project area location

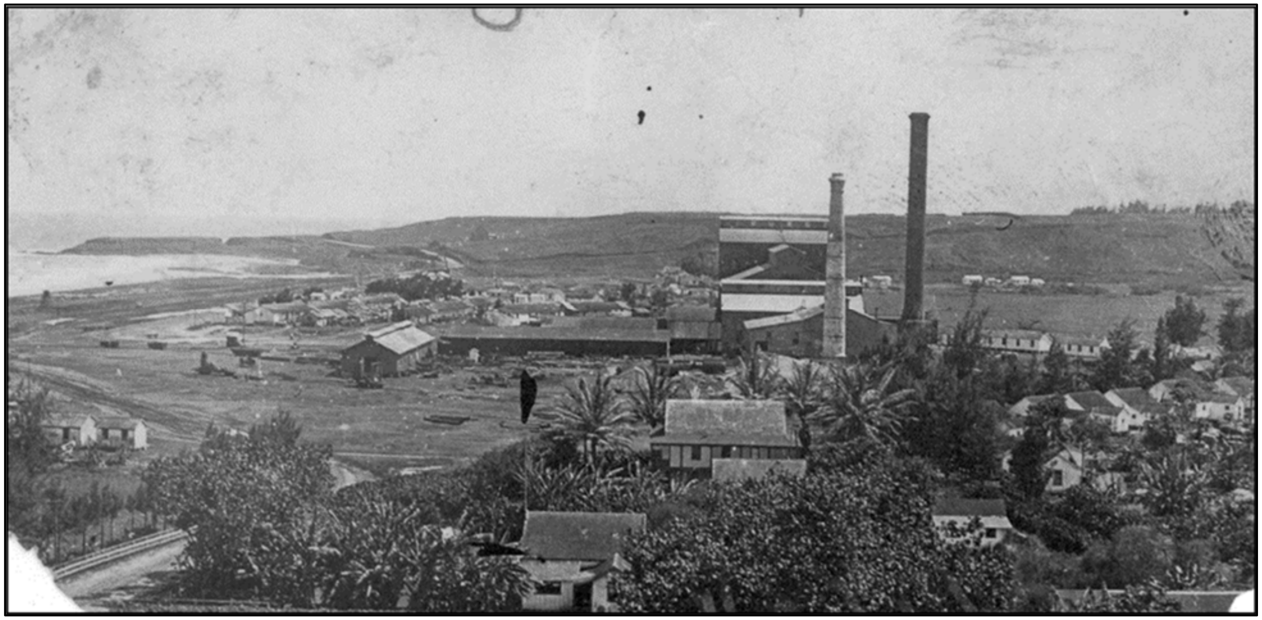

Figure 12. Photograph (date unknown) of Kealia Sugar Mill area (from the collections of Kaua‘i Historical Society)

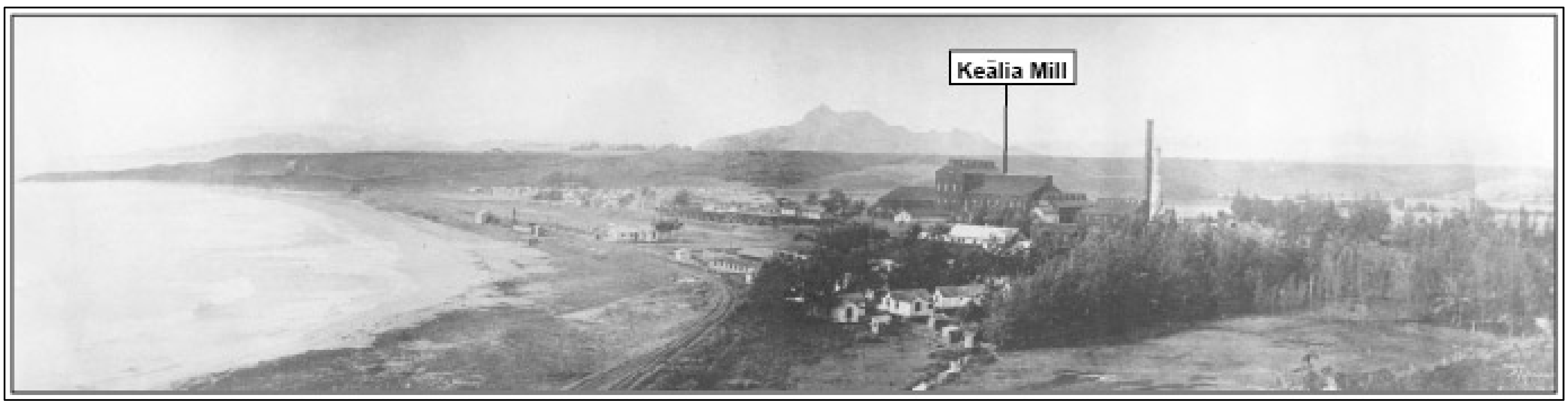

Figure 13. L.E. Edgeworth photo (October 1919) of Makee Sugar Company Mill in Keālia (taken from O’Hare et al. 2003:13)

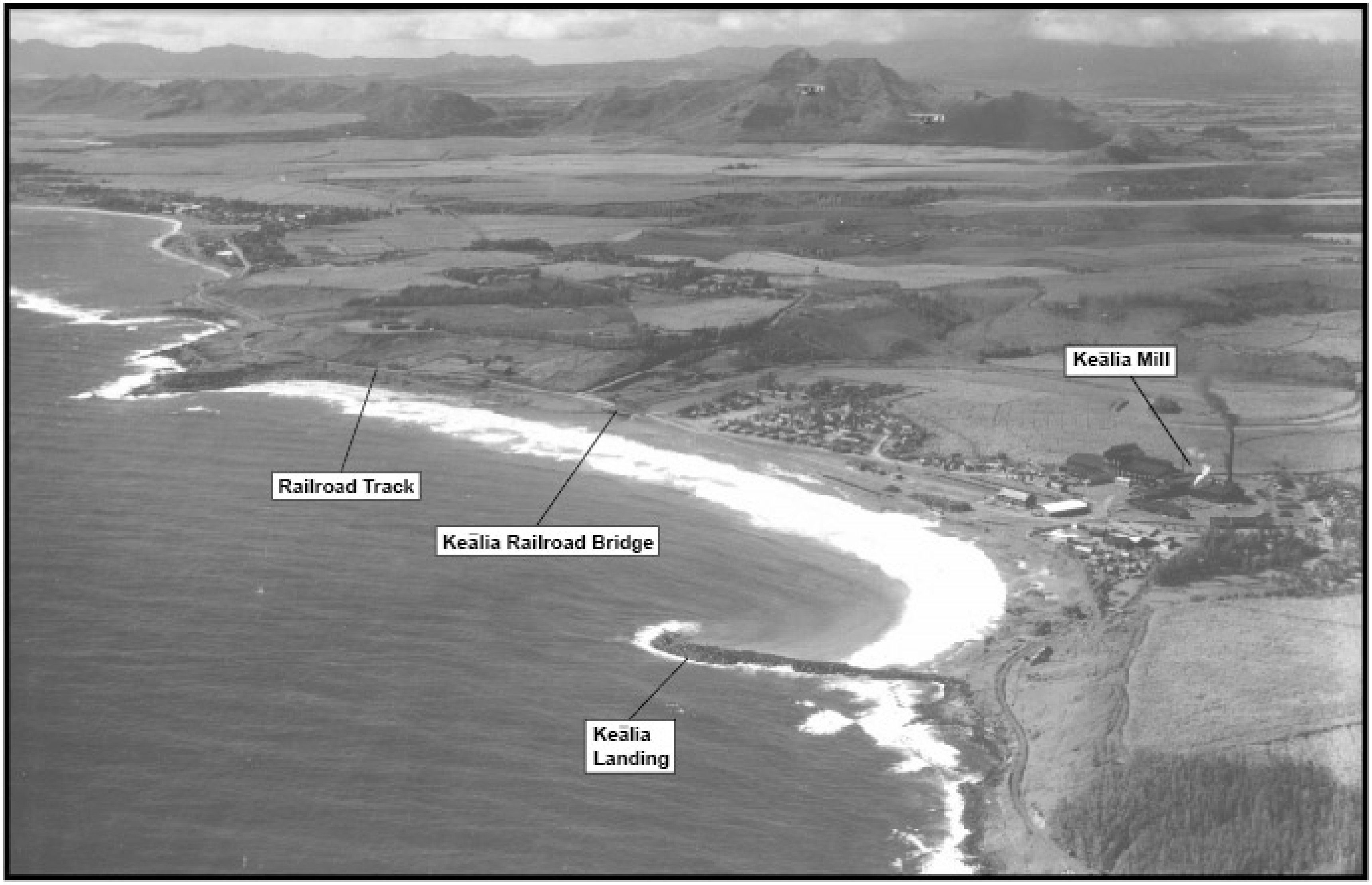

Figure 14. 1933 aerial view of Keālia (taken from O'Hare et al. 2003:14)

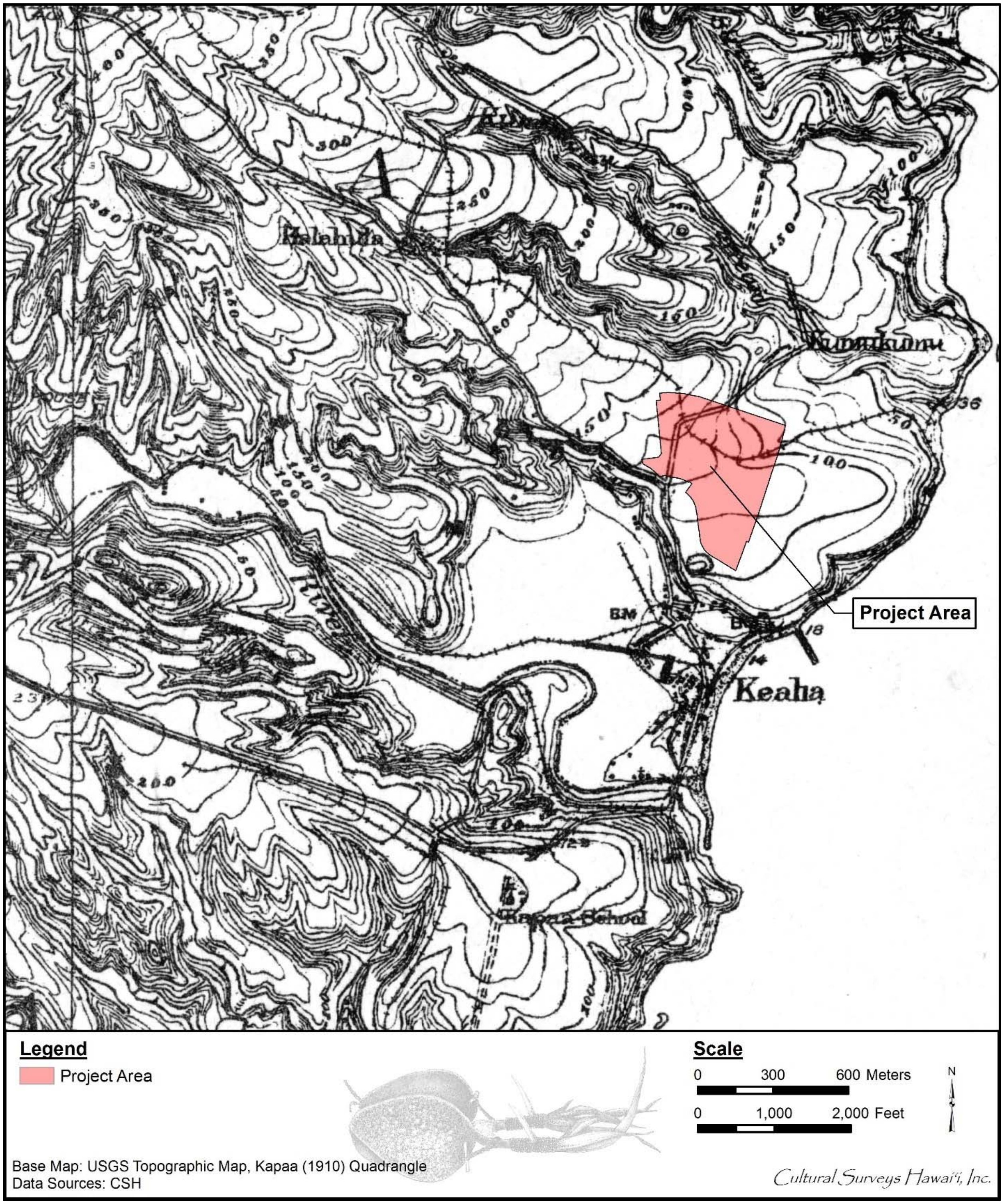

Figure 15. Portion of the 1910 Kapaa USGS topographic map depicting historic road and railroad alignment in the current project area

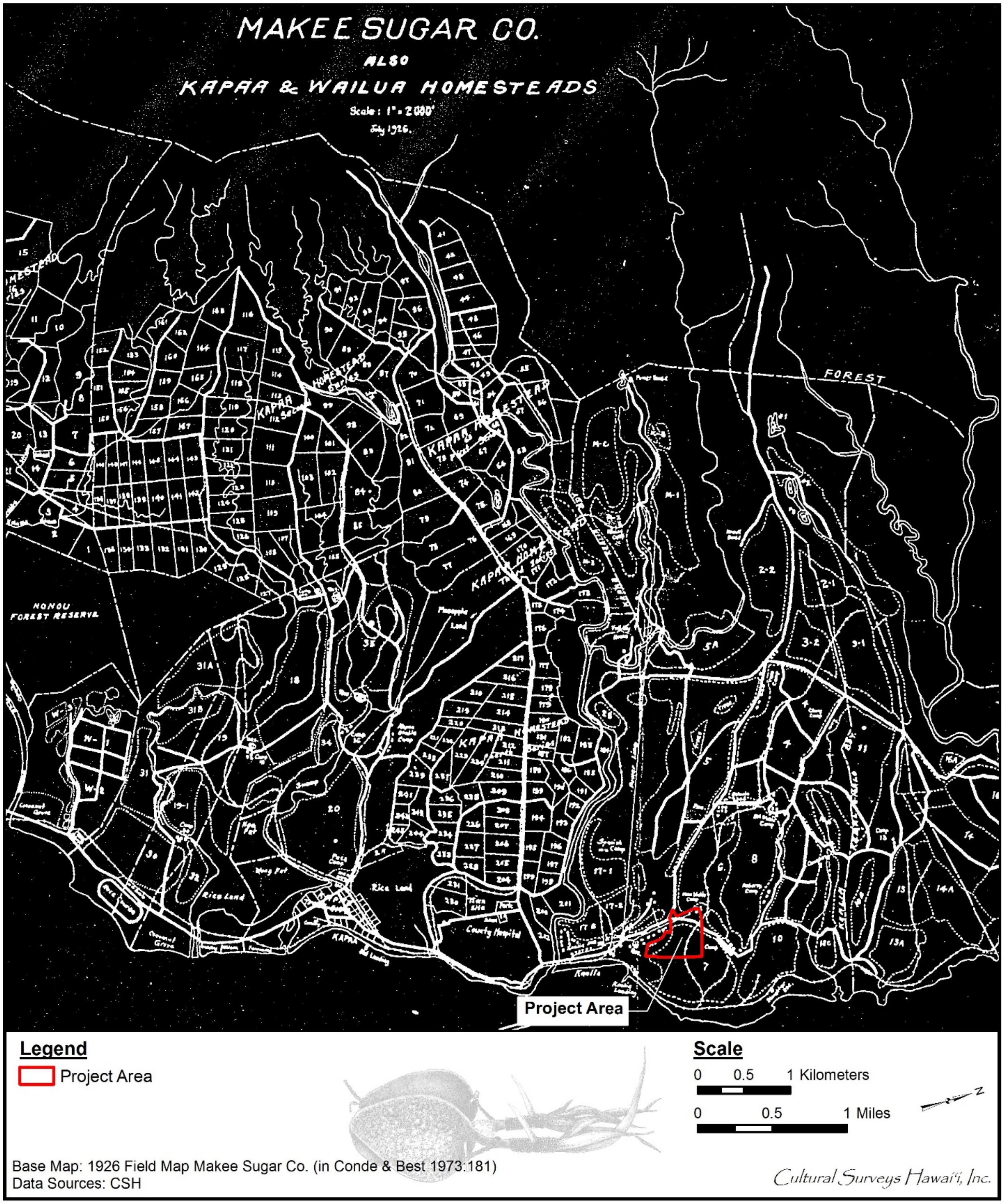

Figure 16. A 1926 field map for Makee Sugar Company (in Condé and Best 1973:181) showing the railroad system running through the western portion of the project area to Anahola

River Railroad Bridge was described as “an old wooden bridge” and was recommended to be replaced with concrete as soon as “finances permitted” (Condé and Best 1973:186).

In 1934, the Lihue Plantation Company absorbed the Ahukini Terminal & Railway Company and Makee Sugar Company (Condé and Best 1973:167) (Figure 17). The railway and rolling stock formerly owned by Makee Sugar Company became the Makee Division of the Lihue Plantation. At this time, besides hauling sugarcane, the railroad was also used to haul plantation freight including “fertilizer, etc. . . . canned pineapple from Hawaiian Canneries to Ahukini and Nawiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd.” (Hawaiian Territorial Planning Board 1940:11). Former plantation workers and *kama‘āina* (native born) growing up in Kapa‘a remember when the cannery would send their waste to the pineapple dump, a concrete pier just north of Kumukumu Stream (SIHP # 50-30-08-789:H) by railroad. The structure is built over the water where the rail cars would dump the pineapple waste. The current would carry the waste to Kapa‘a, which would attract fish and sharks (Bushnell, Shideler, and Hammatt 2003).

Lihue Plantation was the last plantation in Hawai‘i to convert from railroad transport to trucking (Condé and Best 1973:167). “By 1957 the company was salvaging a part of their plantation railroad, which was being supplanted by roads laid out for the most part on or close to the old rail bed” (Condé and Best 1973:167). By 1959, the plantation had completely converted over to trucking. The Cane Haul Road is thought to date to the late 1950s and follows the alignment of the old railroad until just before the end of the bike path near ‘Āhihi Point.

Keālia Town slowly dispersed after the incorporation of Makee Sugar Company into Lihue Plantation in the 1930s. Many of the plantation workers bought property of their own and moved out of plantation camps. The plantation camps that bordered Kūhiō Highway were disbanded in the 1980s. The Lihue Plantation began to phase out in the last part of the twentieth century. In 1997, the entire *ahupua‘a* of Keālia was sold off as an effort to downsize Amfac’s landholdings and because Keālia is the most distant from the Lihue Plantation sugar mill, it was considered the least profitable (*Honolulu Advertiser*, 7 July 1997). The Lihue Plantation completely folded at the end of the twentieth century.

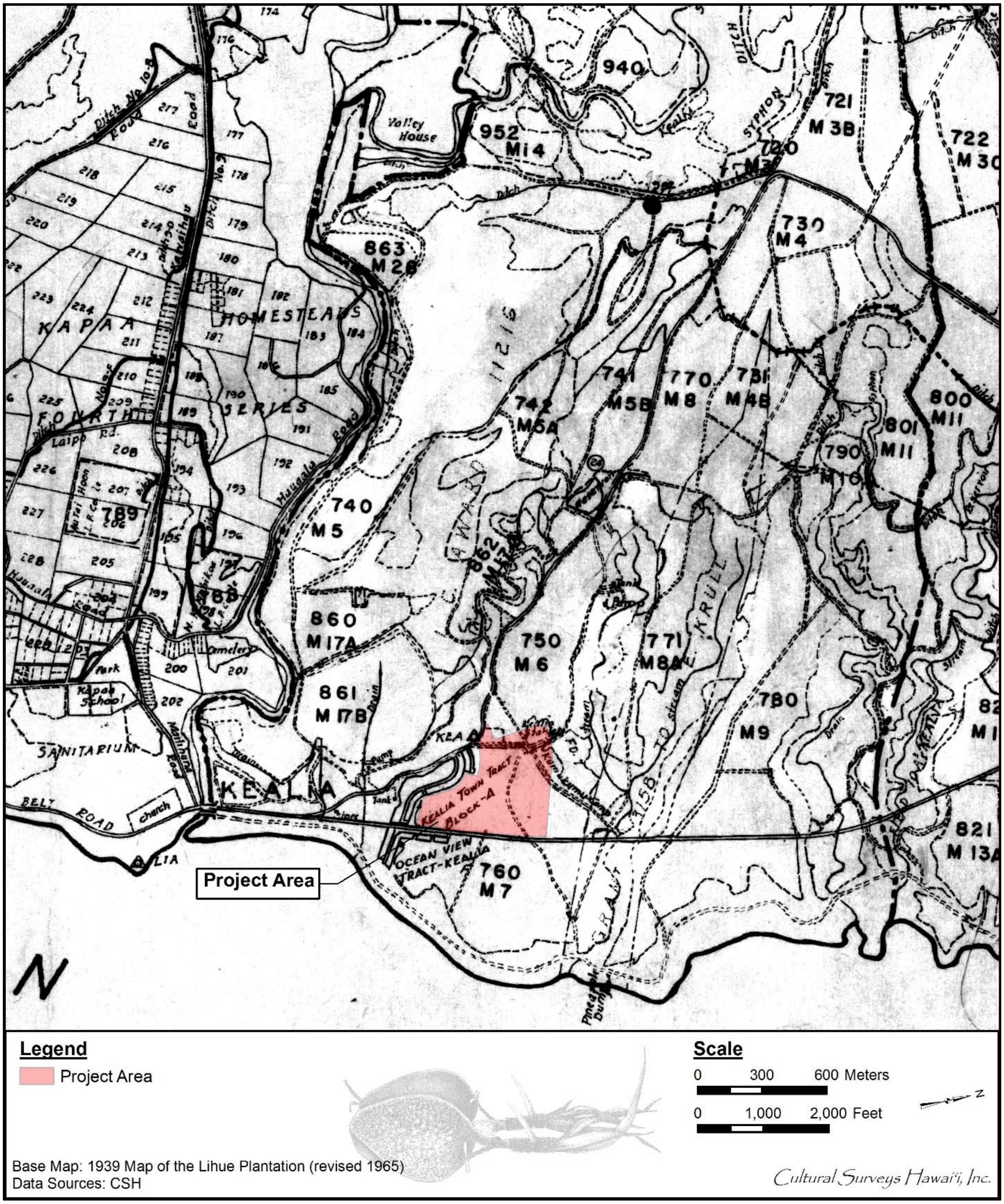

Figure 17. A portion of a 1935 Lihue Plantation field map (revised in 1965) showing "Kumukumu Camp" in the northwest corner of the project area

3.3 Previous Archaeological Research

The following two tables outline the archaeological research (Table 3) and historic properties (Table 4) identified in Keālia Ahupua‘a. These tables are followed by discussion of the research and historic properties. Table 3 provides a list of archaeological research conducted within Keālia Ahupua‘a, including columns for source, location, nature of study, and results. The locations of these archaeological studies are shown in Figure 18. Table 4 is a list of known historic properties within the *ahupua‘a* and includes columns for SIHP numbers, site type, location, and reference. The locations of identified sites within Keālia Ahupua‘a are shown in Figure 19.

The first attempt at comprehensive archaeological survey of Kaua‘i was undertaken by Wendell Bennett of the Bishop Museum during the 1930s. In the vicinity of Keālia Ahupua‘a, Bennett's report identified Site 111, a "ditch, south of the Keālia Valley, inland," described as a "large, simple dirt ditch, about 6 feet in width and of varying depths which is traditionally referred to as a Hawaiian ditch" (Bennett 1931:128). Bennett also noted (but apparently did not locate) Site 112, described as "Kawelomamaia heiau, said to have been located where the Kawelomamaia stream runs into the sea north of Keālia" (Bennett 1931:129). Bennett recorded no sites within Keālia Ahupua‘a itself.

In 1982, Francis Ching conducted an archaeological reconnaissance of three sites for a proposed landfill project. The three sites were Kekaha in the Waimea District of Kaua‘i; Kīpū in the Līhu‘e District; and lastly Kumukumu in the Kawaihau District north of the current project area. In Ching's report, he states, "Of the three study areas, we expected to find archaeological remains at this one" (Ching 1982:2). He concluded due to the proximity of the project area to the sea as well as a running stream, the area was suitable for *lo‘i* cultivation but during the reconnaissance, there were no significant findings. However, he did note the vegetation in the area: wild taro was noted growing near the stream as well as other vegetation (banana, *haole koa*, java plum, lily wai [water lilies], monkey pod, guava, *laua‘e*, swordtail fern, African tulip, *he‘e* ["octopus tree"], and assorted grasses and bushes) (Ching 1982:3).

Folk and Hammatt (1991) documented the first of these inadvertent burial finds from SIHP # 50-30-08-1851 in 1991 and noted the presence of historic artifacts and traditional Hawaiian midden in the vicinity. They also noted the extensive disturbance from sand mining, which was responsible for uncovering the remains. They suggested "it is possible that the burials . . . are directly associated with the Land Commission Awardees" whose parcels were located in the immediate vicinity (Folk and Hammatt 1991:2). They recommended "further activity at the sand mining site should be restricted" and stated the area "should be left to vegetate naturally as is already occurring. . . ". As "all of the human bone observed was fragmented and disarticulated," it was not possible to determine whether the remains were pre-Contact or post-Contact or whether they were Native Hawaiian (Folk and Hammatt 1991:2).

SHPD staff investigated an inadvertent human burial in 1992 (Komori 1993). Located in a sand dune above Kuna or Palikū Beach also known as "Donkey Beach," "where 'recent flooding in the area caused a small gully to form in a sand dune about 4 meters inland of the vegetation line and about 45 meters from the ocean', the burial 'appeared to be over 50 years old', comprising an 'individual . . . placed in a flexed position, lying on its right side, long axis perpendicular to the beach facing into the eroded bank'(*Ibid*). The burial location was subsequently assigned site number 50-30-08-1899" (Perzinski et al. a 2000:17).

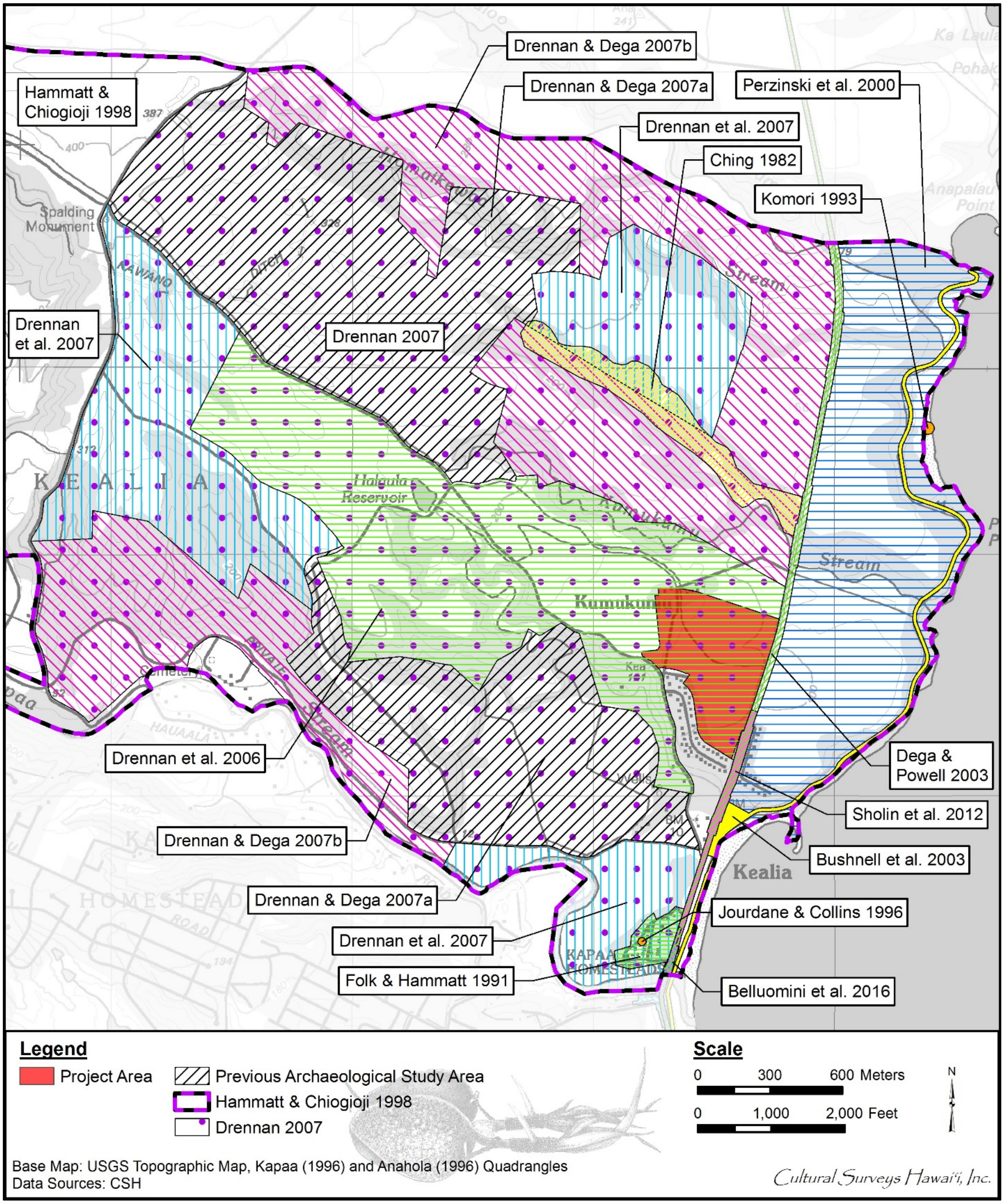

Figure 18. A portion of the 1996 Kapaa and Anahola USGS 7.5-minute topographic quadrangles showing the location of previous archaeological studies in and around the project area

Table 3. Previous archaeological studies in and around the project area

Reference	**Type of Study**	**Location**	**Results (SIHP # 50-30-08 ****)**
Bennett 1931	Archaeology of Kaua‘i	Island-wide	Discusses terracing and irrigation ditches located along Kapa‘a Stream
Handy and Handy 1972	Native planters study	Archipelago-wide	Emphasizes agricultural production rather clumped along Keālia side of Kapa‘a Stream seaward of its confluence with Keālia Stream
Ching 1982	Archaeological reconnaissance	Kekaha, Kīpū, and Kumukumu, TMKs: [4] 1-2-002:001, 009, 021, 040; 3-4-006:012; and 4-7-004:01	No significant findings, however, wild taro noted growing near stream as well as other vegetation (banana, *haole koa*, java plum, lily *wai* [water lilies], monkey pod, guava, *laua‘e*, swordtail fern, African tulip, *he‘e* [“octopus tree”]) and assorted grasses and bushes
Folk and Hammatt 1991	Archaeological inventory survey (recorded as an archaeological assessment)	Bend of Kapa‘a River, just inland of Kūhiō Hwy	Burial finds (SIHP # -1851); noted presence of historic artifacts and traditional Hawaiian midden in vicinity; also noted extensive disturbance from sand mining
Komori 1993	Burial report	Palikū (Kuna) Beach, “Donkey Beach”	Burial find, SIHP # -1899
Jourdane and Collins 1996	Burial report	Bend of Kapa‘a River	Identified additional disarticulated human remains associated with SIHP # -1851
Hammatt and Chiogioji 1998	Archeological reconnaissance survey and assessment	6,690.9 acres within Keālia Ahupua‘a	No cultural resources identified within vicinity of project area
Perzinski et al. 2000a	Archaeological inventory survey	300-acre *makai* parcel at Keālia, TMK: [4] 4-7-004:006	Identified SIHP # -0789 within vicinity of project area including Cane Haul Rd (SIHP # -0789: Feature A), Keālia Landing (SIHP # -0789: Feature B), and a dynamite storage bunker (SIHP # -0789: Feature C)

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler, and Hammatt 2003	Archaeological inventory survey	Proposed Kapaʻa–Keālia bike path, Kapaʻa and Keālia Ahupuaʻa	Identified three new cultural resources within vicinity of project area including a buried cultural layer with an associated human burial (SIHP # -2074), Old Kauai Belt Hwy bridge foundation (SIHP # -2075), and a possibly modern petroglyph (SIHP # -2076); identified a new sub-feature of SIHP # -0789: Feature A, Kapaʻa Stream Cane Haul Rd Bridge (SIHP # -0789: Feature A, Sub-Fea. 1)
Dega and Powell 2003	Archaeological monitoring	Kūhiō Hwy from Moloaʻa through Hanamāʻulu	No cultural resources identified within vicinity of project area
O'Hare et al. 2003	Burial treatment plan	Keālia Ahupuaʻa, TMK: [4] 4-7-004:001	Burial treatment plan for SIHP # -2074 (not included on Fig. 22)
Drennan et al. 2006	Archaeological inventory survey, Phase I	Portion of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	No cultural resources identified within vicinity of project area
Drennan 2007b	Executive summary report on the archaeology	All of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Summary report of Keālananai Development project including all four phases of project; 261 archaeological sites identified within vicinity of project area

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Drennan and Dega 2007a	Archaeological inventory survey, Phase II	Portion of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Six new plantation-era historic properties identified within vicinity of project area including railroad rails and foundations (SIHP # -7015), sugarcane plantation infrastructure including a metal tank, structural supports, cart tracks, and foundations (SIHP # -7017), irrigation ditches, sluice gates, and a bridge (SIHP # -7018), a bridge, foundations, and irrigation pipes (SIHP # -7019), concrete foundations and a culvert (SIHP # -7020), and bridge/transportation infrastructure, a culvert and drainage pipes (SIHP # -7021).
Drennan and Dega 2007b	Archaeological inventory survey, Phase IV	Portion of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Total of 37 new historic properties comprised of 66 features identified within vicinity of project area; historic properties identified consisted of Plantation-era findings and/or historic (SIHP #s -1110 through -1118, and -1120 through -1135 with sub feature designation when needed); SIHP #s -1119 (terrace and upright) and -1136 (traditional petroglyph) are pre-Contact and/or historic
Drennan et al. 2007	Archaeological inventory survey, Phase III	386 acres in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Six historic properties identified within vicinity of project area including plantation era concrete staircase (SIHP # 7034), plantation era staircase (SIHP # -7035), plantation era concrete foundation, and brick and mortar structure (SIHP # -7037), human burials, burial pit outline and fire pit (SIHP # -7040), plantation era red brick and concrete wall/foundation (SIHP # -7041), and Keālia Historic Town Complex (SIHP # -7042)

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Sholin et al. 2012	Archaeological monitoring	Keālia Beach Corridor at Kūhiō Hwy	Reidentified two historic properties: SIHP #s -884, a cultural deposit and -7034, a concrete staircase, and identified five new historic properties: SIHP #s -2161, a secondary deposit with associated human remains; -2162, a secondary and primary deposit with associated human remains; -2163, a fire-pit feature; -2165, a cultural deposit; and -2166, a fire pit feature
Belluomini et al. 2016	Archaeological inventory survey	Kapa‘a Stream Bridge, TMKs: [4] 4-6-014:024 por., 033 por., 090 por., 092 por. Kūhiō Hwy and Mailihuna Rd ROW; TMK: [4] 4-7-003:001 por., and 4-7-008:042 por. Kūhiō Hwy ROW	Historic properties identified included two newly identified historic properties (SIHP # -2278 [Kapa‘a Stream Bridge], and SIHP # -2279 [plantation era water control complex]), as well as two previously documented historic properties (SIHP #s -0789A Sub-Feature 1 [remnant portion of the original Keālia Bridge], and -2075 [historic bridge foundation])

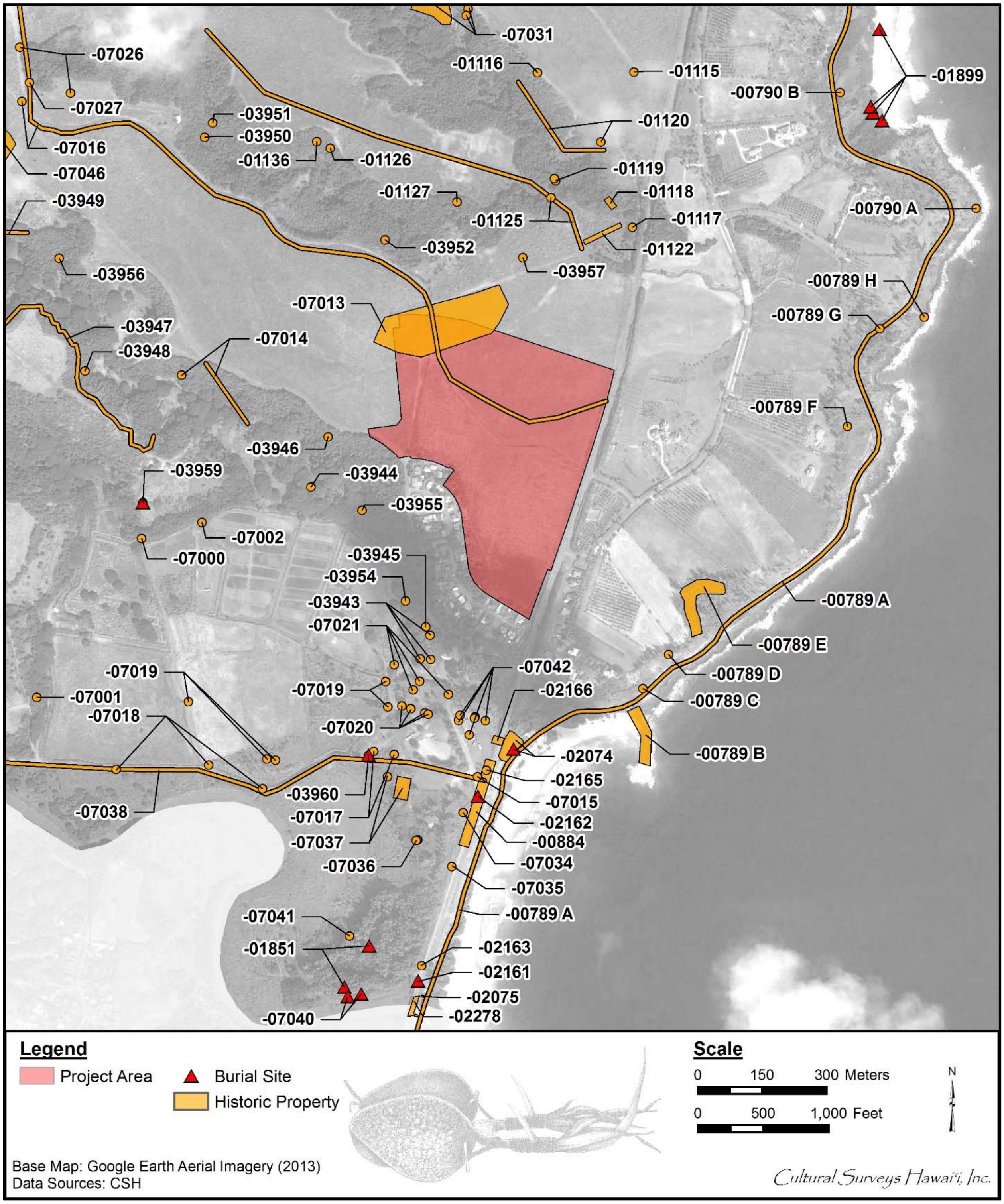

Figure 19. Aerial photograph (2013 Google Earth) showing previously identified archaeological sites in and around the project area

Table 4. Previously identified archaeological sites in and around the project area

SIHP # 50-30-08****	Site Type/Name	Reference
-00789a	Cane Haul Road	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Belloumini et al. 2016
-00789b	Keālia Landing	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789c	Dynamite Storage Bunker	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789d	Sem-circular terrace	Perzinski et al. 2000a
-00789e	Plantation-era terraces	Perzinski et al. 2000a
-00789f	Stone curbed trail segment	Perzinski et al. 2000a
-00789g	Kumukumu Stream Bridge	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789h	Pier	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00790a	Military platform	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00790b	Foxhole	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00884	Pre-Contact human remains	SHPD communication; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Sholin et al. 2012
-01115	Culvert	Drennan and Dega 2007b
-01116	Culvert	Drennan and Dega 2007b
-01117	Bridge	Drennan and Dega 2007b
-01118	Animal husbandry complex of foundations, culverts, and an animal enclosure	Drennan and Dega 2007b
-01119	Terrace and upright stone	Drennan and Dega 2007b
-01120	Earthen ditch and historic petroglyph	Drennan and Dega 2007b

SIHP # 50-30-08****	Site Type/Name	Reference
-01122	Historic trash deposit	Drennan and Dega 2007b
-01125	Plantation road and bridge	Drennan and Dega 2007b
-01126	Linear rock mound	Drennan and Dega 2007b
-01127	Terrace	Drennan and Dega 2007b
-01136	Petroglyph	Drennan and Dega 2007b
-01851	Dune site with human burials, historic artifacts and pre-Contact midden deposit	Jourdane and Collins 1996; Folk and Hammatt 1991
-01899	Burials at Palikū Beach (Donkey Beach)	Komori 1993; Perzinski et al. 2000a, b; O'Hare et al. 2003; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-02074	Buried cultural layer and associated human burial	Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; O'Hare et al. 2003
-02075	Old Kauaʻi Belt Hwy bridge foundation	Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Belloumini et al. 2016
-02161	Cultural deposit with associated human remains	Sholin et al. 2012
-02162	A secondary and primary cultural deposit with associated human remains	Sholin et al. 2012
-02163	Fire pit	Sholin et al. 2012
-02165	Cultural deposit	Sholin et al. 2012
-02166	Fire pit	Sholin et al. 2012
-02278	Bridge (Kapaʻa Stream Bridge)	Belloumini et al. 2016
-02279	Bridge (Kapaʻa Stream Bridge)	Belloumini et al. 2016
-03943	Historic complex of a remnant concrete staircase, concrete telephone pole, and a concrete foundation with a slab walkway	Drennan et al. 2006
-03944	Alignment	Drennan et al. 2006
-03945	Alignment	Drennan et al. 2006
-03946	Well/Cistern	Drennan et al. 2006
-03947	*ʻAuwai*	Drennan et al. 2006

SIHP # 50-30-08****	Site Type/Name	Reference
-03948	Mound, paving	Drennan et al. 2006
-03949	*ʻAuwai*	Drennan et al. 2006
-03950	Concrete foundation (Cistern)	Drennan et al. 2006
-03951	Trash dump	Drennan et al. 2006
-03952	Concrete structure and historic petroglyph	Drennan et al. 2006
-03954	Concrete and basalt boulder bridge	Drennan et al. 2006
-03955	Bridge	Drennan et al. 2006
-03956	Modified stream bank, concrete water diversion	Drennan et al. 2006
-03957	Culvert	Drennan et al. 2006
-03959	Burial	Drennan and Dega 2007a
-03960	Burial	Drennan and Dega 2007a
-07000	Terraces	Drennan and Dega 2007a
-07001	Terrace	Drennan and Dega 2007a
-07002	Wall (cement and basalt cobble)	Drennan and Dega 2007a
-07013	"New Kumukumu Camp" (defunct)	Drennan and Dega 2007a
-07014	Cement column pipe supports and concrete columns	Drennan and Dega 2007a
-07015	Railroad rails and foundation	Drennan and Dega 2007a
-07016	Railroad complex	Drennan and Dega 2007a
-07017	Sugar cane plantation infrastructure including a metal tank, structural supports, cart tracks, and foundations	Drennan and Dega 2007a
-07018	Irrigation ditches and sluice gates, and a plantation era bridge	Drennan and Dega 2007a
-07019	Plantation era bridge, foundations, and irrigation pipes	Drennan and Dega 2007a
-07020	Concrete foundations and culvert	Drennan and Dega 2007a
-07021	Bridge/transportation infrastructure, a culvert, and drainage pipes	Drennan and Dega 2007a
-07026	Historic trash scatter (2 areas)	Drennan and Dega 2007a
-07027	Railroad bridge	Drennan and Dega 2007a
-07031	Mound and two historic trash deposits	Drennan et al. 2007
-07034	Concrete staircase	Drennan et al. 2007; Sholin et al. 2012

SIHP # 50-30-08****	Site Type/Name	Reference
-07035	Staircase	Drennan et al. 2007
-07036	Plantation era concrete block and basalt, mortar and brick structure	Drennan et al. 2007
-07037	Concrete foundation, and brick and mortar structure	Drennan et al. 2007
-07038	Railroad path	Drennan et al. 2007
-07040	Human burials, a burial pit outline, and a fire pit	Drennan et al. 2007
-07041	Red brick and concrete wall/foundation	Drennan et al. 2007
-07042	Keālia historic town complex	Drennan et al. 2007
-07046	Halaula Reservoir	Drennan et al. 2007

In 1996, Jourdane and Collins of the SHPD staff documented the second inadvertent human burial from the same sandy deposits in the bend of the Kapa‘a River (also SIHP # -1851). The remains were apparently discovered by a Mrs. Gaines while she was "walking through the old Kealia Plantation Camp searching for bottles" (Jourdane and Collins 1996:1). The remains were also found in an area disturbed by extensive sand mining, seemingly quite close to the remains reported by Folk and Hammatt (1991). The remains documented by Jourdane and Collins were similarly fragmented and of unknown specific provenience, ethnicity, and age. The report noted

> This area has been extensively disturbed by sand mining after the plantation camp was abandoned. Aerial photos taken in 1971 show that extensive development had occurred in this area and shows the plantation camp housing and associated roads. [Jourdane and Collins, 1996:1]

In 1998, CSH completed an archaeological reconnaissance survey and assessment for a 6,690.6-acre portion of Keālia Ahupua'a. The survey found areas located within floodplains of Kapa‘a and Keālia streams were previously inhabited by traditional Hawaiians. Much of the area surveyed was former plantation land considered to be of little archaeological concern. The study also suggests the area known as Keālia Beach is likely void of archaeological sites associated with traditional Hawaiian activities due to sugarcane being planted up to the shoreline and the shoreline being modified for a cane haul road (Hammatt and Chiogioji 1998). A study of Hawaiian traditional customs and practices for the Keālia Ahupua‘a accompanied the reconnaissance and survey assessment (Hammatt and Shideler 1998).

In 2000, CSH completed an archaeological inventory survey and subsurface testing of the approximately 300-acre Keālia *makai* parcel. A total of three historic properties were identified: SIHP # -0789, plantation era infrastructure and structures; SIHP # -0790, World War II structure and remnants; and SIHP # -1899, burials (Perzinski et al. 2000a). In the same year, CSH was contracted to develop a burial treatment plan for SIHP # -1899 (Perzinski et al. 2000b) for the burials identified during the AIS as well as the SHPD investigation of the inadvertent findings in 1992 (Komori 1993).

In 2003, CSH conducted an AIS for the Kapa‘a–Keālia bike and pedestrian path. A total of five newly identified sites (SIHP #s -2074 through -2078) and a new sub-feature of SIHP # -0789 (Feature A, Sub-Feature 1) were documented (Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler, and Hammatt 2003). SIHP # -0789: Feature A, Sub-Feature 1 is identified as the *makai* Kapa‘a Stream Bridge for the Cane Haul Road and SIHP # -2075 is identified as the highway bridge foundation for the *mauka* Kapa‘a Stream Bridge. SIHP # -2074 included a buried cultural layer and associated human burial. A CIA for the Kapa‘a–Keālia bike and pedestrian path accompanied the AIS (Bushnell, Shideler, and Hammatt 2003). CSH completed a burial treatment plan for SIHP # -2074. The remains were discovered during subsurface testing along the coast where restroom facilities were to be built and a burial treatment plan was recommended for SIHP # -2074 (O'Hare et al. 2003).

In 2003, Scientific Consultant Services (SCS) completed archaeological monitoring during Phase I of the Kaua‘i Rural Fiber-optic Duct Lines project. A portion of the study is located within the vicinity of the current project (Segment 17) extending along the western shoulder of Kūhiō Highway along the hills and plateaus toward Anahola. There were no significant findings (Dega and Powell 2003:25).

In 2007, SCS conducted four phases of an AIS in the Keālia Ahupua‘a, Phase I (Drennan et al. 2006), Phase II (Dennan and Dega 2007a), Phase III (Dennan et al. 2007), and Phase IV (Drennan and Dega 2007b). During Phase I, a total of 15 new sites were identified and documented. Nine were associated with the plantation era, one site appeared to be associated with traditional Hawaiian practices (habitation and/or agriculture), and the remaining five are interpreted as traditional Hawaiian agricultural sites that continued to be used during the plantation era (Drennan et al. 2006:29). The newly identified sites were designated as SIHP #s -3943 through 3957. During Phase II, a total of 30 new historic properties comprising of 82 features were identified. The newly identified sites were designated as SIHP #s -3959 and -3960, human burials, and SIHP #s -7000 through -7027 (Drennan and Dega 2007a:ii). During Phase III, 19 new historic properties were identified comprising of 93 features. The newly identified sites were designated as SIHP #s -7028 through 7046. SIHP #s -7028 and -7040 contained human burials (Drennan et al. 2007:ii). During Phase IV, a total of 37 new historic properties comprising 66 features were identified. The newly identified sites were designated as SIHP #s -1100 through -1136. A report summarizing the archaeology conducted in the four phases of the proposed Keālanani project including subsurface testing was written in 2007 (Drennan 2007b). Using the geomorphic model formulated by Dega and Powell in 2003 during the monitoring work, and later refined in 2005 (Dega et al. 2005), Drennan concluded Zone III was the primary zone of historical utilization based on previous archaeological studies and subsurface testing conducted during the four phases of the project. SCS wrote an advance data recovery plan (DRP) in 2007 specifically to recover further samples for SIHP # -3959, a habitation site and surface documentation of headstones for SIHP # -7028, an historic cemetery (Drennan 2007a). SCS also wrote a preservation plan for multiple historic properties: SIHP #s -7027, a railroad bridge; -7028, a historic cemetery; -7043, Spalding Monument; -1120 Feature 2 is a petroglyph of an English name and an image interpreted as a boat; and lastly -1136, a pre-Contact petroglyph (Drennan and Dega 2007c). The current project area is located in the Phase I.

In 2012, T.S. Dye & Colleagues, Archaeologists, Inc. conducted archaeological monitoring at Keālia Beach corridor transmission line along Kūhiō Highway. During monitoring two historic properties, SIHP #s -884, a cultural deposit, and -7034, a concrete staircase, were reidentified. A total of five new historic properties were discovered and documented: SIHP #s -2161, a secondary deposit with associated human remains; -2162, a secondary and primary deposit with associated human remains; -2163, a fire-pit feature; -2165, a cultural deposit; and -2166, a fire pit feature. The inadvertent human remains were reinterred near the Keālia Beach corridor (Sholin 2012:1).

In 2016, CSH conducted an archaeological inventory survey for the Kapa‘a Stream Bridge Replacement project. During the AIS, two previously documented historic properties: SIHP #s -0789A Sub-Feature 1, the remnant portions of the original Keālia Stream Bridge Crossing, and -2075, the remnant abutments of the former Kaua‘i Belt Road were reidentified. Two new historic properties were discovered and documented: SIHP #s -2278, the Kapa‘a Stream Bridge, and -2279, a water control complex consisting of an earthen ditch (Feature A) and the remnant of a culvert (Feature B) (Belluomini et al. 2016).

3.4 Background Summary and Predictive Model

The Keālia Mauka Homesites project is located in the *ahupuaʻa* of Keālia, part of the ancient Puna District. Legends, traditional accounts and *wahi pana* point to an area rich in pre-Contact history, although it seems much of this history has been lost. Accounts name several *kupua* and known *akua* in reference to places in Keālia such as Wahineʻōmaʻo, Hiʻiaka and ʻAʻaka, the *menehune*. In addition, several persons of high status appear in references to *wahi pana*, and legends associated with Keālia, including Kaweloleimākua. Pakaʻa, son of notable parents and guardian of the wind gourd, is thought to have grown up at Keahiahi, the rocky headland between Kapaʻa and Keālia.

Historic records list a number of *heiau* situated in Keālia suggesting the region was at one time much more significant than is portrayed by the *kuleana* records of the late 1840s and early 1850s. The specific locations of most of these *heiau* are unknown, however, there are a few that carry the same names as *wahi pana* known to be located near the project area. Oral accounts attest to a *heiau* in the vicinity of Kuna Bay, although no further information was available.

The more ample river valley of Keālia hosted a larger population with *kuleana* claims mostly dispersed along the Keālia River. There are no LCAs within the project area but subsurface testing has yielded evidence of human occupation ranging from pre-Contact times to the plantation era. According to historic documents, the plateau areas north of Keālia Valley were sparsely inhabited with areas bordering Kumukumu and Hōmaikawaʻa streams hosting the largest settlements.

The earliest successful economic enterprise by a Westerner in the *ahupuaʻa* was the Krull Ranch and Dairy, which operated in the Kumukumu area in the 1860s. The Krull Dairy was situated near Waipaheʻe, well *mauka* of the project area. In 1877, the Makee Sugar Plantation was established in conjunction with the Hui Kawaihau, a group of prominent men from Honolulu, several of whom were retainers in Kalākaua's court. The Makee Plantation built a mill and landing at Kapaʻa as part of the plantation infrastructure. Following the move of the Kapaʻa mill to Keālia in 1885, a railroad was built from Makee Landing to Keālia with another railroad arm leading across the Moʻikeha drainage up Lehua Street and into the *mauka* regions of Kapaʻa. The Mauka Moikeha Railroad Bridge and the Old Kealia Railroad Bridge/Cane Haul Road (SIHP # -789A, Sub-Feature I) represent a part of the first railroad system constructed ca. 1891 to transport sugarcane.

The Makee Sugar Plantation, operating out of Keālia, attracted hundreds of immigrant workers, first the Portuguese and Japanese and later, Filipinos. Keālia town sprang up around these immigrant groups. In addition, there were several plantation camps in Keālia, including in the plateau lands of Kumukumu and Hōmaikawaʻa. Thus, commercial sugarcane cultivation and milling initiated in the mid- to late 1800s was a primary factor in settlement pattern changes in the Keālia area. Housing patterns were based on plantation camps of mainly immigrant laborers. Subsistence economy was replaced by the market-based economy. Transportation became mechanized, with rail lines from the fields to the mills, and to new landings.

The demise of sugar was concurrent with an increase in tourism and service-oriented economy. Plantation era transportation routes went into disuse or were incorporated into present transportation infrastructure. Modern construction activities in coastal Keālia, however, continue to unearth evidence of pre-Contact, early historic, and plantation era activities.

Based on background information, including previous archaeological studies in the proposed project area, the Keālia Mauka Homesites project has the potential of containing the remnants of the defunct “New Kumukumu Camp” (SIHP # -07013) and associated historic findings (road bisecting SIHP # -07013, SIHP # -07016) (Drennan and Dega 2007a).

Section 4 Results of Fieldwork

4.1 Pedestrian Inspection Results

The inspection focused on the entire 53.4-acre (18-hectare) proposed Keālia Mauka Homesites. The project area was traversed across the entire proposed subdivision starting from the northwest corner. The pedestrian survey was accomplished through systematic sweeps spaced 10 to 15 m apart due to the low vegetation. The proposed project area consists of relatively level areas along the western portion and gentle to moderate slope areas to the east.

Historic properties observed within the northwest corner of the project area are features associated with the “New Kumukumu Camp” (SIHP # 50-30-08-07013 (designated in Drennan and Dega 2007). Regarding SIHP # -07013, the study asserts that: “most above-ground features have been mechanically removed” (Drennan and Dega (2007:51), suggesting that some above-ground features were still in situ, but none of the remnants of “New Kumukumu Camp” (SIHP # -07013) are described or designated as features in the Drennan and Dega (2007) archaeological inventory survey.

A total of five newly identified features were given feature numbers (SIHP # 50-30-08-07013 Feature 1 through SIHP # -07013 Feature 5) (Figure 20). The designated Feature 1 through Feature 5 appear to have been associated with SIHP # -07013 as seen in Figure 20. The five features within the project area are associated with the plantation as seen in previous archaeological studies as well as the similar style of construction associated with water control in sugar plantation systems on Kaua‘i. A portion of a 1950 aerial photo of the Keālia Coast (Figure 21) shows the “New Kumukumu Camp” overlaid with the temporary CSH numbers to show the correlation. During the current inspection, SIHP # -07016 could not be reidentified (note the difficulty in discerning the alignment of SIHP # -07016 in a contemporary aerial, Figure 20). Descriptions for the identified historic properties follow in Section 4.2.

Table 5. Historic features identified within the project area

SIHP #	Feature Type	Function	Age	Notes
50-30-08-07013 Feature 1	Alignment	Transportation	Plantation era	Abandoned
50-30-08-07013 Feature 2	Concrete slab	Indeterminate	Plantation era	Abandoned
50-30-08-07013 Features 3A and 3B	Concrete posts	Communication	Plantation era	Abandoned
50-30-08-07013 Features 4A and 4B	Culverts	Water Control	Plantation era	Abandoned
50-30-08-07013 Feature 5	Concrete	Indeterminate	Plantation era	Abandoned

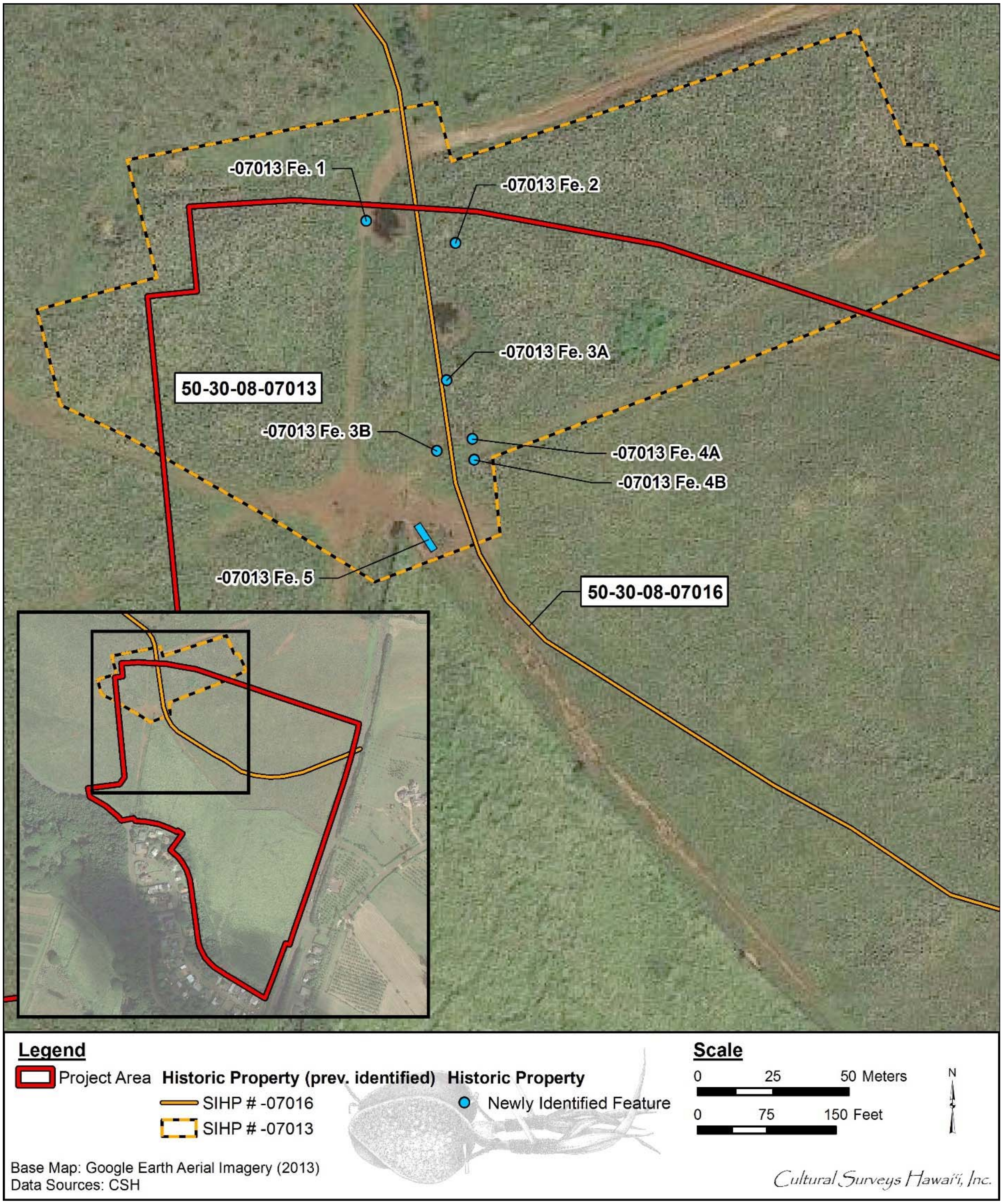

Figure 20. Aerial photograph showing the northwest portion of the proposed project area (Google Earth 2013) with feature designations for SIHP # 50-30-08-07013 (“New Kumukumu Camp”) Feature 1 through Feature 5

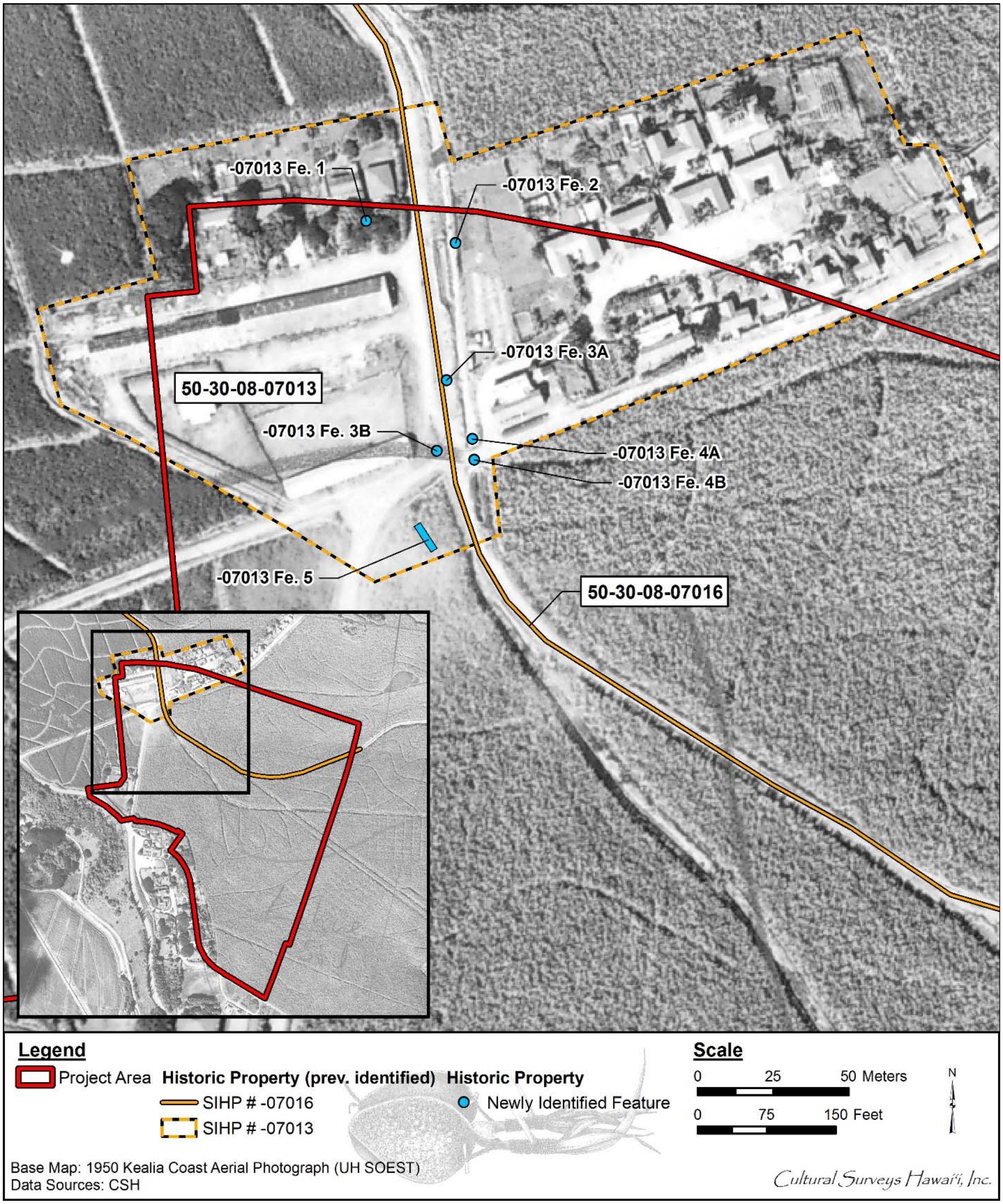

Figure 21. A portion of a 1950 aerial photo of Keālia Coast showing a portion of the "New Kumukumu Camp" with new feature designations for SIHP # 50-30-08-07013 ("New Kumukumu Camp") Feature 1 through Feature 5

4.2 SIHP # 50-30-08-07013 Feature Descriptions

4.2.1 SIHP # 50-30-08-07013 Feature 1

FORMAL TYPE:	Alignment
FUNCTION:	Indeterminate
NUMBER OF FEATURES:	0
AGE:	Plantation
CONDITION:	Remnant

SIHP # 50-30-08-07013 Feature 1 is a remnant alignment of concrete, brick, and metal that measures 2.1 m in length by 0.30 m in width and runs in a rough north/south direction (Figure 22). The alignment is in extremely poor condition and the function of the historic property could not be determined. It parallels a dirt road currently in use.

Figure 22. Overall photo of alignment of metal, concrete, and brick (SIHP # 50-30-08-07013 Feature 1), view to east

4.2.2 SIHP # 50-30-08-07013 Feature 2

FORMAL TYPE:	Unknown
FUNCTION:	Indeterminate
NUMBER OF FEATURES:	0
AGE:	Plantation
CONDITION:	Remnant

SIHP # 50-30-08-07013 Feature 2 is a concrete slab measuring 1.49 m in length by 0.42 m in width with a thickness of 0.36 m (Figure 23). The concrete slab was observed along a gently sloping area. Due to its present condition and lack of other information including figures, the formal type and function of this slab is unknown.

Figure 23. Concrete slab (SIHP # 50-30-08-07013 Feature 2) embedded in soil along a gently sloping area

4.2.3 SIHP # 50-30-08-07013 Feature 3

FORMAL TYPE:	Posts
FUNCTION:	Communication
NUMBER OF FEATURES:	2
AGE:	Plantation
CONDITION:	Intact

SIHP # 50-30-08-07013 Feature 3 consists of two concrete posts (SIHP # 50-30-08-07013 Feature 3A and SIHP # 50-30-08-07013 Feature 3B) measuring approximately 30 ft high (Figure 24 and Figure 25). SIHP # -7013 Feature 3A is square-shaped and measures 0.20 cm by 0.20 m. The base of the post is thicker at the bottom and tapers at the top. SIHP # -7013 Feature 3B is an octagon-shaped concrete post measuring 0.25 m in radius. At the base of the post on the west face, a date has been etched into the concrete: “1 22 1917.” The “1” is at the top, then below is “22,” and below is “1917,” which has been etched on its side (Figure 26).

Figure 24. SIHP # 50-30-08-07013 Feature 3, two concrete posts, SIHP # -07013 Feature 3A shown above, view to north

Figure 25. SIHP # 50-30-08-07013 Feature 3, two concrete posts, SIHP # -07013 Feature 3B shown above, view to east

Figure 26. Date etched into SIHP # 50-30-08-07013 Feature 3B, “1 22 1917,” view to west

4.2.4 SIHP # 50-30-08-07013 Feature 4

FORMAL TYPE:	Culverts
FUNCTION:	Water control
NUMBER OF FEATURES:	2
AGE:	Plantation
CONDITION:	Remnant

SIHP # 50-30-08-07013 Feature 4 consists of two remnant culverts (SIHP # 50-30-08-07013 Feature 4A and SIHP # 50-30-08-07013 Feature 4B, Figure 27 through Figure 29) constructed of basalt and mortar. SIHP # -07013 Feature 3A is located to the north and measures 3.5 m by 3.5 m with a depth of 0.83 m along the north face. SIHP # -07013 Feature 4A is in extremely poor condition. SIHP # -07013 4B measures 4.1 m in length (in an east/west direction) by 3.2 m in width (in a north/south direction) and walls measuring from 0.22 m to 0.37 m thick. SIHP # -07013 Feature 4B appears to have been at one time a four-way culvert. Sluice gate slots were observed as well as a single culvert opening on the west side (see Figure 28). The opening measures 0.43 m wide by 0.26 m high.

Figure 27. Photo of north culvert (SIHP # 50-30-08-07013 Feature 4A), view to south

Figure 28. Photo of the south culvert (SIHP # 50-30-08-07013 Feature 4B), view to west

Figure 29. Photo of the south culvert (SIHP # 50-30-08-07013 Feature 4B), view to north

4.2.5 SIHP # 50-30-08-07013 Feature 5

FORMAL TYPE:	Foundation
FUNCTION:	Indeterminate
NUMBER OF FEATURES:	0
AGE:	Plantation
CONDITION:	Intact

SIHP # 50-30-08-07013 Feature 5 consists of a large rectangular-shaped concrete slab measuring 10.0 m by 2.45 m with heights from 0.0 m at the northwest corner to 0.43 m at the central-east area (Figure 30). The thickness of the slab varies from 0.12 m to 0.20 m. On the southeast corner of SIHP # -07013 Feature 5, the name “GOMES” was observed (Figure 31). The function of the slab is indeterminate but is understood as related to plantation activities.

Figure 30. Large rectangular-shaped concrete slab (SIHP # 50-30-08-07013 Feature 5), view to southeast

Figure 31. Photo of name “GOMES” written in the southeast corner of SIHP # 50-30-08-07013 Feature 5, downward view

Section 5 Significance Assessment

Five features of a previously designated "New Kumukumu Camp" (Drennan and Dega 2007:51) historic property (SIHP # -50-30-08-07013) were identified within the current project area and were evaluated for significance according to the broad criteria established by HAR §13-284-6. The five criteria are as follows:

a. Be associated with events that have made an important contribution to the broad patterns of our history;
b. Be associated with the lives of persons important in our past;
c. Embody the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;
d. Have yielded, or is likely to yield information important for research on prehistory or history;
e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

SIHP # 50-30-08-07013, remnants of a former plantation camp, is assessed as significant under Criterion d (have yielded, or is likely to yield information important for research on prehistory or history). This reflects its value to our understanding of plantation era infrastructure. Water control was essential for sugarcane cultivation, as evidenced by the fact that water was transferred from as far away as Hanalei (Wilcox 1996:70). Communication within the plantation was also important. This is consistent with the significance assessment in Drennan and Dega (2007:110-111) that concluded that SIHP # -07013 were significant under Criterion D (only) of the Hawaii state Register of Historic Places..

Section 6 Summary and Recommendations

6.1 Summary

At the request of Mr. Scott Ezer of HHF Planners, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this LRFI for Keālia Mauka Homesites project, Keālia Ahupua‘a, Kawaihau District, Kaua‘i, TMK: [4] 4-7-004:001.

The fieldwork component of the archaeological literature review and field inspection was conducted on 1 May 2017 by CSH archaeologists Johnny Dudoit, B.A., and Missy Kamai, B.A. This fieldwork required approximately 2 person-days to complete. Archaeological investigations involved a field inspection to identify whether archaeological features are present within the current project area.

The CSH inspection of the current project area identified five historic features in the general area associated with the previously designated SIHP # 50-30-08-07013. SIHP #s -07013 was identified and documented during a 2007 AIS (Drennan and Dega 2007:51-52). The newly described features consist of basalt and mortar culverts, concrete posts, and concrete slabs. The historic properties identified during this inspection were all situated within the proposed Keālia Mauka Homesites project. Based on background research, the project area was part of the cultivation of sugarcane between the late nineteenth century and 2000. Due to its inclusion in, or close proximity to, previous archaeological studies (Drennan et al. 2006; Drennan 2007; Drennan and Dega 2007a; Drennan and Dega 2007b; and Drennan et al. 2007), the archaeological features identified during the current investigation most likely date to the early twentieth century and are considered part of the Kealia and Lihue Plantations' irrigation, communication, and transport system.

6.2 Recommendations

The proposed project may have an adverse effect on the plantation era infrastructure features of SIHP # 50-30-08-07013. This study supports the recommendation of Drennan and Dega 2007:111) for no additional archaeological work at this historic property. No additional archaeological work is recommended for this project area (in keeping with the recommendation of Drennan et al. 2006:60). Consultation with SHPD is recommended to gain clarity regarding state requirements prior to development based on the presently proposed plans.

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Appendix E

Draft Cultural Impact Assessment Report for the Proposed Keālia Subdivision
Cultural Surveys Hawai‘i

April 2018

Draft

Cultural Impact Assessment Report for the Proposed Keālia Subdivision Keālia Ahupuaʻa, Kawaihau District, Kauaʻi TMKs: [4] 4-7-004:001

Prepared for
Helber Hastert and Fee (HHF) Planners
on behalf of Keālia Properties, LLC

Prepared by
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawaiʻi, Inc.
Kailua, Hawaiʻi
(Job Code: KEALIA 3)

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Management Summary

Reference	Cultural Impact Assessment Report for the Proposed Keālia Subdivision Keālia Ahupuaʻa, Kawaihau District, Kauaʻi, TMKs: [4] 4-7-004:001 (Hammatt 2018)
Date	April 2018
Project Number(s)	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: KEALIA 3
Agencies	State of Hawaiʻi, Department of Health, Office of Environmental Quality Control (DOH/OEQC)
Land Jurisdiction	Private
Project Proponent	Keālia Properties, LLC
Project Location	The proposed Keālia Subdivision project area is bounded by Kūhiō Highway to the east, residential homes on both Kaʻao Road and Hōpoe Road as well as Keālia Road to the south, Kumukumu Ahupuaʻa (land division usually extending from the uplands to the sea) to the north, located in old cane lands. The project area is depicted on a portion of the 1996 Kapaa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.
Project Description	The proposed Keālia Subdivision project will consist of a 235-lot residential subdivision. Residential lots will range from 5,600 square feet (sq ft) to 7,300 sq ft. The project will be built to County subdivision standards and will include water and wastewater improvements, drainage improvements, and underground electric utilities. The proposed Keālia Subdivision project will be adjacent to an existing 36-lot subdivision, which was built in the 1950s. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval.
Project Acreage	The current project area includes approximately 53.361 acres (22 hectares)
Document Purpose	This CIA was prepared to comply with the State of Hawaiʻi's environmental review process under Hawaiʻi Revised Statutes (HRS) §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. The Constitution of the State of Hawaiʻi makes clear that the State and its agencies are bound by a fiduciary duty to, . . . protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands

	prior to 1778. [Hawaiʻi State Constitution, Article XII, Section 7] Protections for *ahupuaʻa* or native tenants, had been set forth far before the ratification of the State Constitution. Recognizing the challenges of a Western system of private landownership, in which the appurtenant rights of native tenants had not yet been codified into law, the Hawaiian Privy Council, on 19 October 1849, adopted resolutions to protect the rights of the *makaʻāinana* (people that attend the land). The Kuleana Act of 1850, comprised of seven articles, confirmed and protected the rights of native tenants. Article 7 established access to roads, water sources, and other natural resources: When the landlords have taken allodial titles to their lands, the people on each of their lands, shall not be deprived of the right to take firewood, house timber, aho cord, thatch, or ti leaf, from the land on which they live, for their own private use, should they need them, but they shall not have a right to take such articles to sell for profit. They shall also inform the landlord or his agent, and proceed with this consent. The people also shall have a right to drinking water, and running water, and the right of way. The springs of water, and running water, and roads shall be free to all, should they need them, on all lands granted in fee simple: Provided, that this shall not be applicable to wells and water courses which individuals have made for their own use. [5 August 1850; quoted from Territory of Hawaii 1925:2112] In 1992, the State of Hawaiʻi Supreme Court upheld these rights under HRS §7-1, amending it to include, "native Hawaiian rights. . . may extend beyond the *ahupuaʻa* in which a native Hawaiian resides where such rights have been customarily and traditionally excercised in this manner" (Pele Defense Fund v. Paty, 73 Haw. 578, 620, 837 P.2d 1247, 1272 (1992) cited in Dagher and Dega 2017:5). Act 50, enacted in 2000 with House Bill (HB) 2895, recognizes the importance of Native Hawaiian culture in defining the unique quality of life in Hawaiʻi. The act amended the definition of "significant effect" to include, . . . the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare,

	social welfare[.], or cultural practices of the community and State. [H.B. 2895, Act 50, 2000] Act 50 also requires that Enviromental Impact Statements and Environmental Assessments "include the disclosure of the effects of a proposed action on the cultural practices of the community and the State," thereby including cultural impact assessments (CIA) as part of the overall determination. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai‘i significance Criterion e, pursuant to Hawai‘i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity (HAR §13-275-6 and §13-284-6). The document will likely also support the project's historic preservation review under HRS §6E and HAR §13-275 and §13-284. The document is intended to support the project's environmental review.
Results of Background Research	Background research for this study yielded the following results: 1. Keālia Ahupua‘a belongs to the ancient district of Puna, one of five ancient districts on Kaua‘i (King 1935:228). For taxation, educational, and judicial reasons, new districts were created in the 1840s. In 1878, King Kalākaua, in an attempt to solidify the stature and influence of the Hui Kawaihau (a choral society established by Prince Leleiohoku), created the new district of Kawaihau. This new district encompassed the *ahupua‘a* ranging from Olohena on the south to Kīlauea on the north. Subsequent alterations to district boundaries in the 1920s left Kawaihau with Olohena as its southernmost boundary and Moloa‘a as its northernmost boundary (King 1935:222). 2. Keālia translates as "salt encrustation." According to John Clark, who translates Keālia as "the salt bed" or "the salt encrusted area," this is a direct reference to the natural salt ponds that formed along the low-lying coastal portions of Keālia Ahupua‘a. This salt or *pa‘akai* satisfied a variety of domestic, medicinal, and ceremonial needs (Clark 1990:11).

3. Generally, Keālia was described as "rather dry" (Handy and Handy 1972:423). This condition may be inferred by the relative lack of traditional rain names associated with Keālia Ahupuaʻa. The Nāulu rain is the only known associated rain name for Keālia. Due to the lack of rainwater, freshwater resources such as streams were modified to satisy the needs of *makaʻāinana* (commoners) living upon the lands.
4. Various members of the Kawelo family line are said to have spent time within Keālia and its environs. Two *moʻolelo* (stories) are associated with this legendary line of Kauaian kings. The first involves Kaweloleimakua and Kauahoa at the *wahi pana* (storied place) known as Waipaheʻe. In the legend, the two kinsfolk, as young boys, engage in a series of contests. In each of the contests, Kawelo is bested by Kauahoa. As grown men, they are finally pitted in bloody battle against each other. In order to thwart the conflict, Kawelo attempts to remind Kauahoa of their boyhood excursions, Kauahoa is not swayed and swears to fight to the death. The second legend concerns Kawelomahamahaia, the shark man of Kauaʻi. The shark man, a man-eater who hunted in the waters between Keālia and Wailua, was finally caught and stoned to death. This shark man was believed to be associated with Chief Kawelomahamahaia, a grandfather of Kawelo and descended from Manokalanipo (Beckwith 1970:141).
5. Several *heiau* (pre-Christian place of worship) stood in Keālia Ahupuaʻa including Pahua Heiau, Kumalae Heiau, Waiehumalama Heiau, Napuupaakai Heiau, Noemakalii Heiau, Puukoa Heiau, Piouka Heiau, Una Heiau, Mano Heiau, and Makanalimu Heiau (HEN 1885:214–216). Unfortunately, the exact locations of these *heiau* remain unknown. An additional significant temple was the *heiau* known as Kawelomamaia (Site 112) (Bennett 1976:129; Thrum 1907:41). Thrum identifies this *heiau* as being of the *poʻokanaka* ("skull") class. *Heiau* classified as *poʻokanaka* were used ceremoniously for human sacrifices (Stokes 1991:24). Kawelomamaia Heiau is also described as being associated with Kawelo, and dedicated to his shark god. Other important *wahi pana* include ʻĀhihi Point and Hōmaikawaʻa ("give me the canoe"); Kaea (the banana patch of Palila); Waipaheʻe ("slippery water"); Ōpae Kalaʻole (a waterfall); and a myriad of natural and manmade features including *ʻili* (land division smaller than an *ahupuaʻa*), streams, mountain peaks, and ridges.
6. Early foreign accounts describe the east coast of Kauaʻi, including Keālia Ahupuaʻa, as the "most fertile and pleasant district of the island" (Vancouver 1798:221–222). Captain

	George Vancouver places an extensive village, located in close proximity to a king's residence, somewhere along the northeast coast, an area spanning from Keālia to Moloaʻa Bay. 7. Keālia was granted to the *aliʻi* Miriam Keʻahikuni Kekauʻonohi (LCA 11216; Royal Patent 6071). Kekauʻonohi was a granddaughter of Kamehameha, one of Liholiho's wives, and served as Kauaʻi governor from 1842 to 1844. 8. Nearly five years later, beginning in 1850, the *makaʻāinana* began receiving their land titles. According to Māhele documentation, Land Commission Awards (LCAs) were awarded in an area immediately southeast of the current project area, in close proximity to the Kapaʻa Stream (also identified as the Keālia River). No LCAs were found within the project area. 9. With the increase in foreign interests on Kauaʻi Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. The first large-scale agricultural enterprise in the Keālia area was begun in 1877 by the Makee Sugar Plantation (led by Captain James Makee) and the Hui Kawaihau (Dole 1916:8). Although hoping to establish a successful sugar corporation on the east side of Kauaʻi, a series of unfortunate events led to the disbandment of the Hui, and the passing on of property and leasehold rights to Makee's son-in-law and the new Makee Plantation owner, Colonel Z.S. Spalding (Dole 1916:14). 10. As part of Colonel Spalding's takeover in 1885, the Makee Plantation mill was moved from Kapaʻa to Keālia. To transport their sugar product from the Keālia mill, a railroad was constructed in the late nineteenth century. This railroad line was part of a 20-mile network of plantation railroads with some portable track, and included a portion of Keālia Valley and the *mauka* regions of the plateau lands north of Keālia (Condé and Best 1973:180). 11. The Ahukini Terminal & Railway Company was formed in 1920 to establish a railroad to connect Anahola, Keālia, Kapaʻa to Ahukini Landing, and "provide relatively cheap freight rates for the carriage of plantation sugar to a terminal outlet" (Condé and Best 1973:185). 12. In 1934, the Lihue Plantation Company absorbed the Ahukini Terminal & Railway Company and Makee Sugar Company (Condé and Best 1973:167). Besides hauling sugarcane, the railroad was also used to haul plantation freight including "fertilizer. . . [and] canned pineapple from Hawaiian Canneries to Ahukini and Nawiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd." (Hawaiian Territorial Planning

	Board 1940:11). Longtime *kama‘āina* (native-born) families of Keālia recall a concrete pier (State Inventory of Historic Places [SIHP] # 50-30-08-789:H) just north of Kumukumu Stream, where pineapple waste was dumped into the ocean. According to *kama‘āina*, the current would carry the waste to Kapa‘a, which would attract fish and sharks (Bushnell, Shideler, and Hammatt 2003) 13. The explosive growth of the sugar industry within Keālia inevitably led to the development of a small town comprised mainly of sugar plantation workers, many of whom were immigrants from Portugal, Puerto Rico, the Philippines, Japan, and China (Kaua‘i Historical Society n.d.). However, the decline of sugar also marked the end of Keālia Town. The town slowly dispersed after the incorporation of the Makee Sugar Company into the Lihue Plantation in the 1930s. Many of the plantation workers bought property of their own and moved out of plantation camps. The plantation camps that bordered Kūhiō Highway were disbanded in the 1980s. In 1997, the entire *ahupua‘a* of Keālia was sold off as an effort to downsize Amfac’s landholdings and because Keālia is the most distant from the Lihue Plantation sugar mill, it was considered the least profitable (*Honolulu Advertiser*, 7 July 1997). 14. Previous archaeological studies locate two historic properties within the boundaries of the current project area; these sites are associated with sugar plantation operations (SIHP # -7013, “New Kumukumu Camp;” SIHP # -7016, railroad complex). Several historic properties are also located immediately north, west, and south of the current project area; these sites are associated with historic sugar plantation operations (SIHP # -3952, a concrete structure and historic petroglyph; SIHP # -1127, a historic terrace; SIHP # -1125, a plantation road and bridge; SIHP # -3957, culvert; SIHP # -7014, cement column pipe supports and concrete columns; SIHP # -3946, a well/cistern; SIHP # -3944, an alignment; SIHP # -3955, a bridge) (Drennan et al. 2006; Drennan and Dega 2007a; Drennan and Dega 2007b). Burial sites appear to be concentrated far south (SIHP #s -1851, -7040, -2161, -3960, -2162, -2074) and far northeast (SIHP # -1899) of the current project area.
Results of Community Consultation	CSH initiated its outreach effort in April 2017 through letters, email, telephone calls, and in-person contact. CSH completed its outreach effort in February 2018. CSH attempted to reach out to 34 individuals and agencies. The organizations consulted include the Office of Hawaiian Affairs (OHA), the Kaua‘i and Ni‘ihau Island Burial Council (KNIBC), the State Historic Preservation Division (SHPD) (Burial

	Sites Specialist and History and Culture Branch), Queen Deborah Kapule Hawaiian Civic Club and the Kauaʻi Council of Hawaiian Civic Clubs (via the Association of Hawaiian Civic Clubs), and community members of Kawaihau District. Below is a list of individuals who shared their *manaʻo* (thought, opinions) and *ʻike* (knowledge) about the project area and Keālia Ahupuaʻa: 1. Kenneth Ponce, *kamaʻāina* of Kapaʻa and descendant of former plantation workers, Pedring and Crescencia Ponce 2. Kupuna Valentine Ako, *kamaʻāina* of Kapaʻa 3. Uncle Richard Kaui, *kamaʻāina* of Keālia, *mahiʻai* (farmer) within Keahapana Valley 4. Timothy Reis, *mahiʻai* within Keahapana Valley, *kālai pōhaku*, *kālai kiʻi* (stone and image carver)
Non-Culturally Relevant Community Concerns and Recommendations	During consultation, the community may discuss non-culturally relevant concerns. As these relate to the environmental, economic, and social welfare of the community, they lay beyond the purview of the current CIA. However, these concerns should be evaluated within the final environmental impact assessment (FEIS). Based on information gathered from community consultation, participants voiced the following non-culturally relevant concerns: 1. A community concern expressed during consultation regarded the integrity of the Halaʻula Reservoir located *mauka* of the current project area. Comparisons were drawn to the Kaloko Dam catastrophe, and a request was made by Kupuna Beverly Muraoka that efforts be made to prevent a similar tragedy from occurring within Keālia. No additional recommendations were offered regarding this concern. 2. Kupuna Beverly Muraoka expressed a concern about the presence of chemical fertilizers and pesticides within the soil. As former cane lands, chemicals once utilized for this industry may be present within project area soils.
Culturally Relevant Community Concerns and Recommendations	During consultation, the community expressed concerns for cultural resources and cultural practices existing outside the current project area. Of those consulted, three community members articulated that currently there are no traditional cultural resources within the project area, nor are there any traditional cultural practices currently being exercised within the project area. However, comments provided by the community solely pertained to extant, surface cultural resources (or the lack thereof) within the project area. Although traditional Hawaiian cultural resources and cultural sites are not known to exist above surface within the current project area, the community expressed

	concerns that subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) may be impacted by the proposed project. Despite the impacts of historic-era sugar plantation activities, interviewees, in general, described Keālia Ahupuaʻa as a rich cultural landscape. Although, no surface sites were identified within the project area during community consultation, subsurface remains such as burials, pre-Contact rock alignments, and/or occupation scatters may exist in areas that were not extensively plowed or developed. Cultural material related to burials, pre-Contact features and/or religious structures remain significant to traditional Hawaiian religious belief and practice. Due to the cultural significance of such material, and several community comments postulating the potential for subsurface finds, CSH has made an effort to report these concerns. The following list is intended to present the *manaʻo* (concerns and mitigation recommendations) of the community, and should not be understood to represent CSH's own findings and analysis. The following list also presents community concerns for cultural resources and practices existing outside the current project area. Based on information gathered from community consultation, participants voiced the following specific, culturally relevant concerns, and provided mitigation recommendations when applicable: 1. It is necessary to note that certain types of historic properties and cultural sites are difficult to recognize by pedestrian survey alone. It is possible subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) may yet exist, and may be encountered during ground disturbing activities. During community consultation, both Dr. Kamanaʻopono Crabbe (OHA) and Kupuna Valentine Ako articulated that *iwi kūpuna* and other cultural finds may be present within the project area. Timothy Reis, a *kālai pōhaku* residing in Keahapana Valley, indicated culturally significant *pōhaku* may be buried within the project area. Culturally significant *pōhaku*, as noted by Mr. Reis, are understood to represent pre-Contact lithic material (i.e., lithic scatter, tool, debitage) or isolated remnants of pre-Contact rock alignments (i.e., walls, enclosures, upright stones). Mr. Reis recommended that GPR be utilized prior to ground disturbance. Mr. Reis also recommended that those working on the project must be educated on the types and varieties of traditional Hawaiian cultural material. To facilitate education, Mr. Reis recommended that a field guide be generated and utilized as a reference for on-site construction workers and archaeological monitors. This field guide should be generated in conjunction with stakeholders and/or descendants of Keālia Ahupuaʻa.

	2. During community consultation with Kupuna Valentine Ako, it was requested that all inadvertently discovered human remains be reinterred within the *ahupuaʻa* where they were originally encountered. Kupuna Ako additionally recommended that the selected reinterment site remain inconspicuous and landscaped in an appropriate way. 3. Current ongoing cultural practices within the *ahupuaʻa* of Keālia include the farming of plant resources. Farmed plant resources include *kalo*, *noni*, *maiʻa*, cacao, cinnamon, and heliconia. In addition to farming, pigs are also raised for consumption. The importance of *kalo* to the Keālia community has been underscored in both *moʻolelo* (stories) and *oli* (chant). As such, the *kamaʻāina* of Keālia have remained committed to growing this culturally signifcant staple. Mr. Reis and his *ʻohana* (family) still cultivate *loʻi* and *māla*, utilize spring water, gather flowers for burials, and raise pigs for meat. In particular, Mr. Reis expressed concern about potential impacts to a spring contained within his family's *kuleana* parcel (LCA 8061, approximately 1.64 km east of the current project area); this spring provides water to his *loʻi kalo*. Mr. Reis estimated that the proposed project will draw "2 million gallons a month (10,000 gallons x 200 homes) or 24 million gallons a year" from a well site near the project area. Mr. Reis requested "proof" that the proposed project will not have negative impacts on the aquifer and ground water resources throughout Keālia Ahupuaʻa. Mr. Reis believes that should his spring be impacted, it would be too late to rectify the situation, and thus did not provide mitigation recommendations.
Analysis	The following analysis is a summarization of Section 8.5. Please refer to Section 8.5 to view the analysis in its entirety. Based on information gathered from the cultural and historical background, and the community consultation, no culturally significant resources were identified within the current project area. At present, there are no traditional or customary Native Hawaiian rights being exercised within the current project area. Additionally, no traditional cultural practices are known to currently occur within the project area. While no cultural resources, practices, or beliefs were identified as currently existing within the project area, Keālia Ahupuaʻa maintains a rich cultural history. Evidence of pre-Contact settlement and land use, however, has most likely been obliterated by plowing and other historic-era sugar plantation activities. Large portions of the current project area have been subject to historic-era agricultural and, to a more limited extent,

	urban development. As consequence, this has resulted in the loss of cultural resources and possible archaeological remains. Despite this loss, a reconstruction of the traditional landscape can still be achieved through an examination of the historic record. Keālia Ahupuaʻa can be described as a stream valley, with a fairly large alluvial plain bisected by a major stream. Beginning in the twelfth century, a vast system of irrigated taro fields was constructed. Despite the fame of Keālia's "large, heavy taros," *loʻi kalo* were only one element of a complex of features that characterized Keālia during the pre-Contact (before 1778) period. Closer to the Keālia shoreline, house sites, salt beds, and fishponds once dotted the landscape. The post-Contact period brought numerous changes throughout the Hawaiian Islands. The socio-economic and socio-political changes of the nineteenth century were most visible within the landscape of Keālia. By the early twentieth century, the entire *makai* half of Keālia Ahupuaʻa was covered in sugarcane. Plantation infrastructure dominated the *makai* portion of the *ahupuaʻa*; traditional sites and resources were most likely altered or removed entirely to make way for this new industry. Coupled with these landscape changes, were changes to Keālia's racial and ethnic demographics. The growth of sugar within Keālia required the sponsorship of immigrant workers. Many of these workers were immigrants from Portugal, Puerto Rico, the Philippines, Japan, and China (Kauaʻi Historical Society n.d.). The influx of immigrants transformed Keālia, leading to the development of a small, diverse town. Although traditional Hawaiian cultural sites are not known to exist above surface within the project area, historic properties related to sugarcane plantation operations are known to exist within the project area. Previous archaeological studies have indicated the presence of two historic properties (SIHP # 50-30-08-7013, the "New Kumukumu Camp" and SIHP # -7016, a railroad complex associated with historic-era sugarcane plantation operations) within the current project area. Background research on sugarcane plantation operations indicates the project area was heavily plowed in the historic era. Typically, soils were plowed to a depth of 18 to 24 inches. Due to this disturbance, the likelihood of encountering subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) remains low. However, the community also indicated cultural material may exist below these plow zones, and thus may be impacted by the proposed project. Previous archaeological studies conducted in the vicinity of the project area have largely resulted in the identification of historic properties associated with sugarcane plantation operations. No burials or traditional cultural material have yet been encountered within the

	project area. In general, burials have been encountered along the *makai* portion of the *ahupuaʻa*. Only one burial, SIHP # -3959, was encountered in the *mauka* portion of Keālia Ahupuaʻa. This burial is located approximately 575 m southwest of the current project area. A concern was also expressed about potential impacts to cultural practices occurring within greater Keālia Ahupuaʻa. *Mahiʻai* (farmer) Timothy Reis shared concerns about potential impacts to ground water resources and the aquifer. He currently cultivates *kalo* within Keahapana Valley, utilizing a natural spring to water his crops. Although, the farming of *kalo* represents a traditional cultural practice, this practice occurs well outside the current project area. Mr. Reis requested that CSH provide evidence that the proposed action would not impact his cultural practices within Keahapana Valley. Per HHF Planners, > The Proposed Action has estimated water demand of 118,000 gallons per day (gpd), with maximum daily demand of 17,250 gpd. [The] existing water service agreement with Kealia Water Company allows for drawing up to 300,000 gpd. Two existing wells will be used. The existing and proposed pumpage is well within the pump capacity approved by the DLNR Commission on Water Resource Management.
Recommendations	Based on the above analysis, the following preliminary recommendations were made: 1. The proposed project may have an adverse effect on SIHP #s -07013 and -07016, historic properties related to sugarcane plantation operations. Consultation with the SHPD is recommended to determine if additional archaeological work is required. 2. Although the likelihood of finds remains low, project construction workers and all other personnel involved in the construction and related activities of the project must be informed of the possibility of inadvertent cultural finds, including human remains during a preconstruction meeting. As part of this preconstruction meeting, project construction workers and all other personnel involved in the construction and related activities of the project should be educated on the types of cultural material that may be encountered during the course of ground disturbance. 3. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the

	area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended. 4. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and/or preservation plan. Proposed reinterment sites must be located within Keālia Ahupuaʻa. 5. Although, the above analysis places water draw well within the pump capacity approved by the DLNR Commission on Water Resource Management, it is recommended that a hydrologeologist investigate this situation. The results of this investigation and mitigation measures, if necessary, must be included in the FEIS. Should stakeholders (i.e., *mahiʻai* and/or cultural descendants) observe changes or impacts to water resources, the landowner and/or developer should remain amenable to engaging in *hoʻoponopono* (conflict resolution).
Ka Paʻakai Analysis	In Ka Paʻakai v. Land Use Commission, 94 Hawaiʻi 31, 74, 7 P.3d 1068, 1084 (2000), the Court held the following analysis also be conducted: 1. The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area; 2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and 3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist. The CIA found there are no known traditional and customary Native Hawaiian rights exercised in the petition area. Under the Ka Paʻakai Case, the required analysis therefore ends after the determination that there are no known traditional and customary Native Hawaiian rights exercised in the 53.361-acre petition area.

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

1.1 Project Background

At the request of Helber Hastert and Fee (HHF) Planners and on behalf of Keālia Properties, LLC, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared a cultural impact assessment (CIA) for the proposed Keālia Subdivision, Keālia Ahupua‘a, Kawaihau District, Kaua‘i, TMKs: [4] 4-7-004:001. The approximately 53.361-acre (22-hectare) (including drainage detention basins) project area is bounded by Kūhiō Highway to the east, residential homes on both Ka‘ao Road and Hōpoe Road as well as Keālia Road to the south, and Kumukumu Ahupua‘a (land division usually extending from the uplands to the sea) to the north. The project area is understood to be privately owned and located in old cane lands. The project area is depicted on a portion of the 1996 Kapaa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), a tax map plat (Figure 2), a 2013 aerial photograph (Figure 3), and a client-provided layout of the proposed project (Figure 4).

The proposed Keālia Subdivision project will consist of a 235-lot residential subdivision. Residential lots will range from 5,600 square feet (sq ft) to 7,300 sq ft. The project will be built to County subdivision standards and will include water and wastewater improvements, drainage improvements, and underground electric utilities. The proposed Keālia Subdivision project will be adjacent to an existing 36-lot subdivision, which was built in the 1950s. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval.

1.2 Document Purpose

This CIA was prepared to comply with the State of Hawai‘i’s environmental review process under Hawai‘i Revised Statutes (HRS) §343, which requires consideration of the proposed project’s potential effect on cultural beliefs, practices, and resources.

The Constitution of the State of Hawai‘i makes clear that the State and its agencies are bound by a fiduciary duty 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. [Hawai‘i State Constitution. Article XII, Section 7]

Protections for *ahupua‘a* or native tenants, had been set forth far before the ratification of the State Constitution. Recognizing the challenges of a Western system of private landownership, in which the appurtenant rights of native tenants had not yet been codified into law, the Hawaiian Privy Council, on 19 October 1849, adopted resolutions to protect the rights of the *maka‘āinana* (people that attend the land). The Kuleana Act of 1850, comprised of seven articles, confirmed and protected the rights of native tenants. Article 7 established access to roads, water sources, and other natural resources:

> When the landlords have taken allodial titles to their lands, the people on each of their lands, shall not be deprived of the right to take firewood, house timber, aho

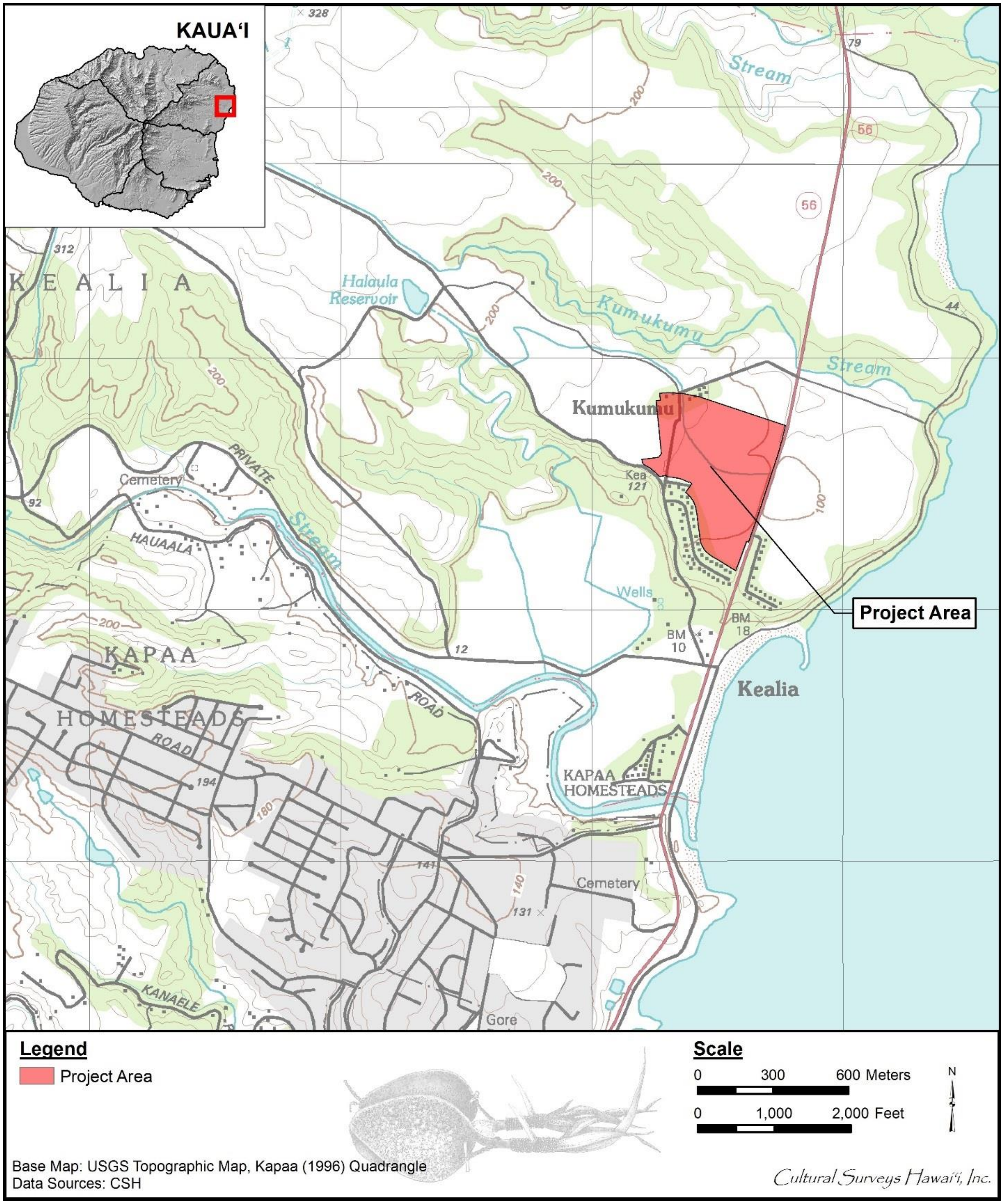


Figure 1. Portion of the 1996 Kapaa USGS 7.5-minute topographic quadrangle showing the location of the project area

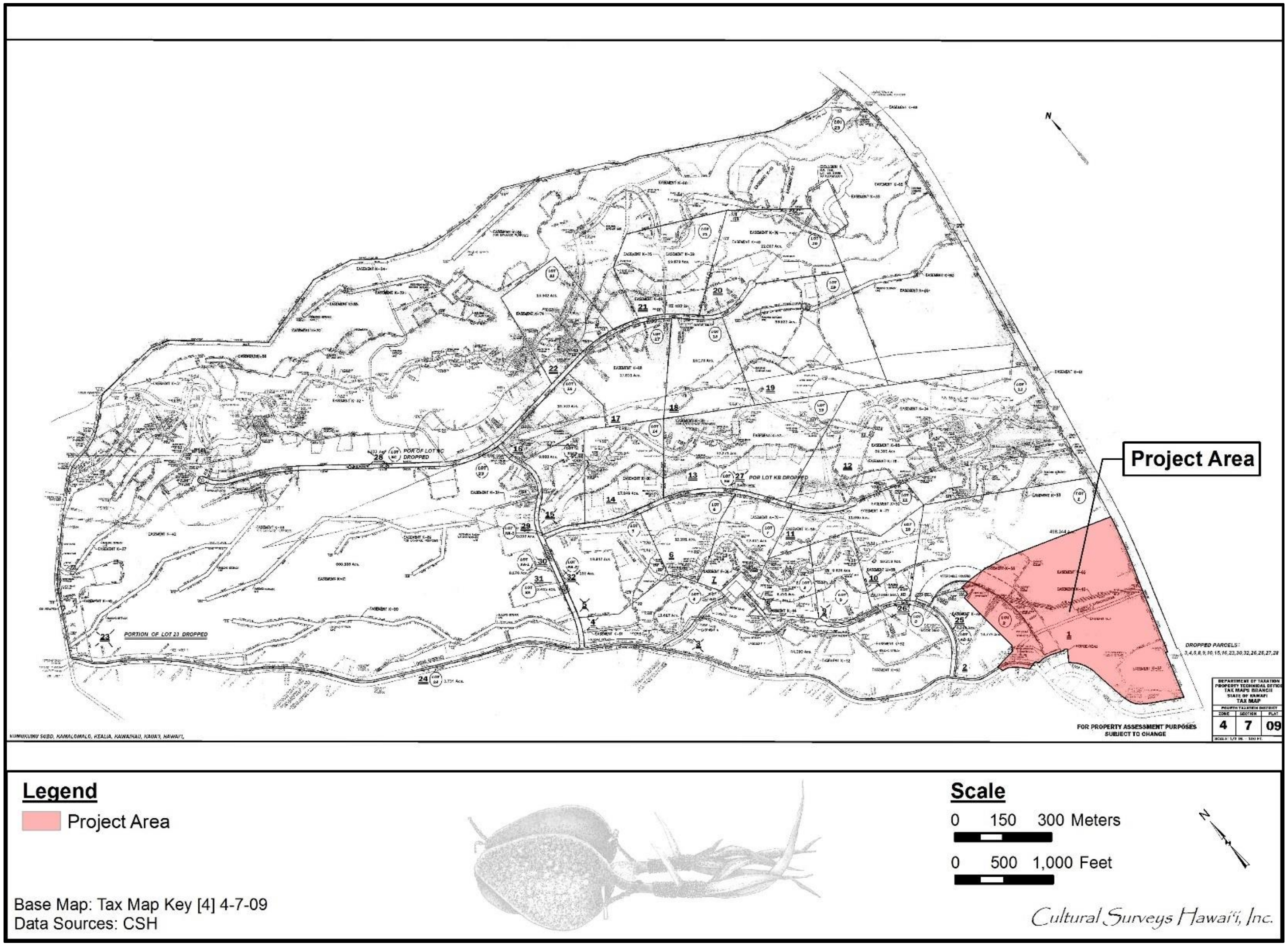


Figure 2. Tax Map Key (TMK) [4] 4-7-09 showing the project area (Hawaiʻi TMK Service 2014)

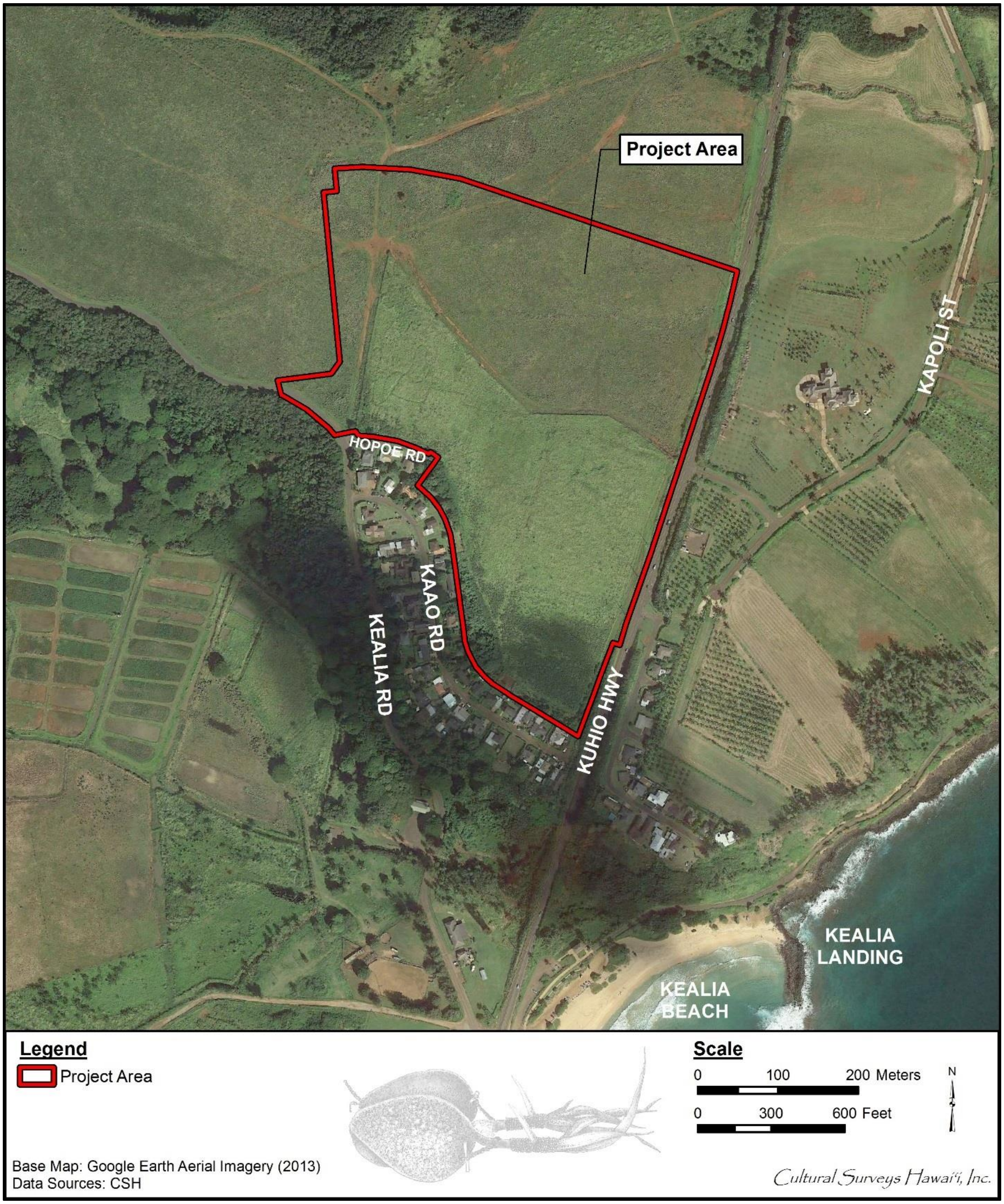


Figure 3. Aerial photograph showing the location of the project area (Google Earth 2013)

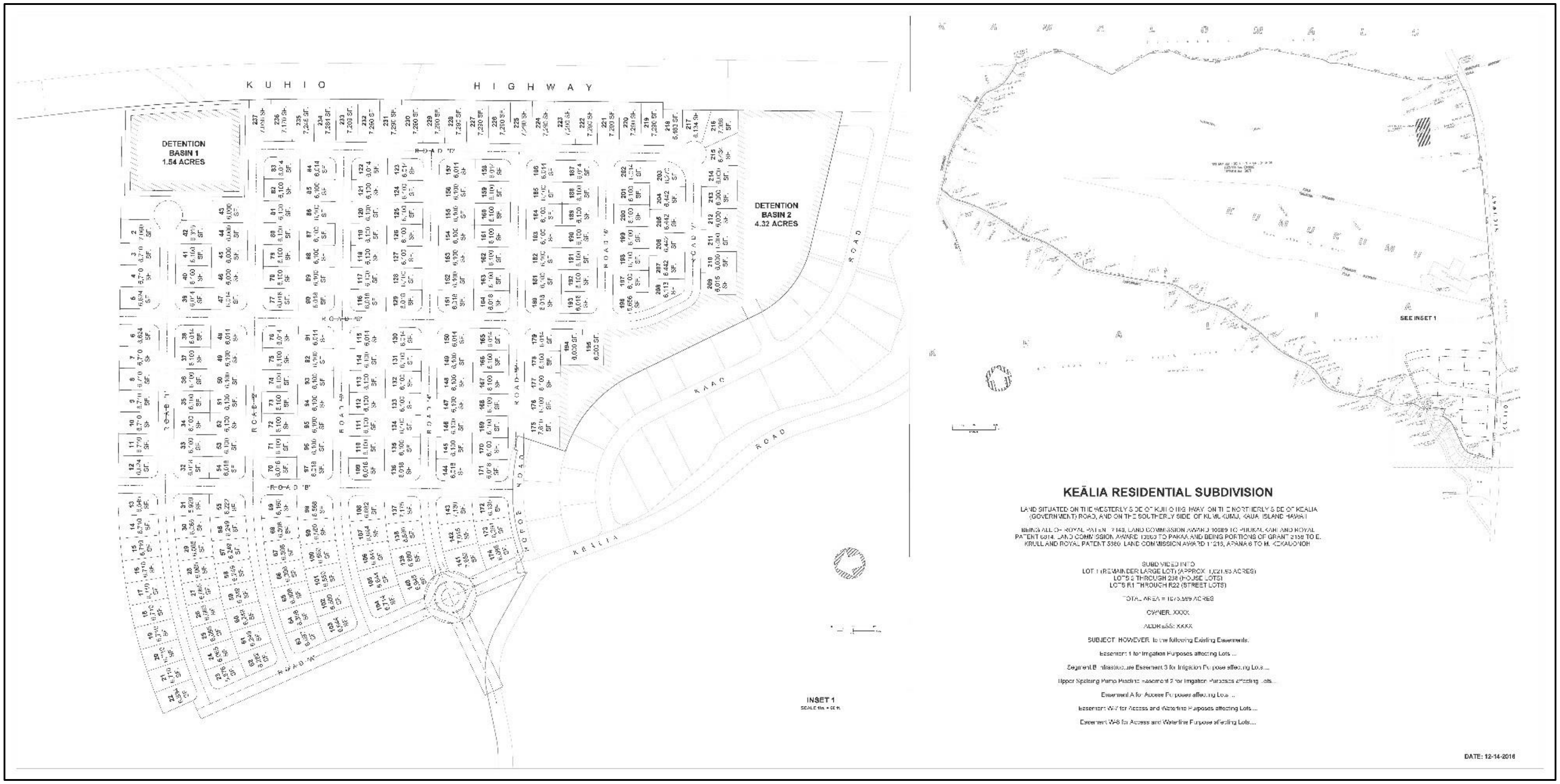


Figure 4. Layout of the proposed Keālia Subdivision (courtesy of client)

> cord, thatch, or ti leaf, from the land on which they live, for their own private use, should they need them, but they shall not have a right to take such articles to sell for profit. They shall also inform the landlord or his agent, and proceed with this consent. The people also shall have a right to drinking water, and running water, and the right of way. The springs of water, and running water, and roads shall be free to all, should they need them, on all lands granted in feesimple: Provided, that this shall not be applicable to wells and water courses which individuals have made for their own use. [August 5, 1850; quoted from Territory of Hawaii 1925:2112]

In 1992, the State of Hawaiʻi Supreme Court upheld these rights under HRS §7-1, amending it to include, "native Hawaiian rights. . . may extend beyond the *ahupuaʻa* in which a native Hawaiian resides where such rights have been customarily and traditionally excercised in this manner" (Pele Defense Fund v. Paty, 73 Haw.578. 620, 837 P.2d 1247, 1272 91992 cited in Dagher and Dega 2017:5).

Act 50, enacted in 2000 with House Bill (HB) 2895, recognizes the importance of Native Hawaiian culture in defining the unique quality of life in Hawaiʻi. The act amended the definition of "significant effect" to include,

> . . . the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare, social welfare[.], or cultural practices of the community and State. [H.B. 2895, Act 50, 2000]

Act 50 also requires that Enviromental Impact Statements and Environmental Assessments "include the disclosure of the effects of a proposed action on the cultural practices of the community and the State," thereby including Cultural Impact Assessments as part of the overall determination.

Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawaiʻi significance Criterion e, pursuant to Hawaiʻi Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that

> have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity. [HAR §13-275-6 and §13-284-6]

The document will likely also support the project's historic preservation review under HRS §6E and HAR §13-275 and §13-284. The document is intended to support the project's environmental review.

1.3 Scope of Work

The scope of work for this CIA includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports for the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work within and near the subject parcel that may be relevant to reconstructing traditional land use activities, and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices in or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.4 Environmental Setting

The project area is situated on the northeast side of the island of Kauaʻi, part of the ancient district or *moku* of Puna and the current district of Kawaihau. Kēālia can be characterized as flat, with irregularly shaped gulches and small valleys in the uplands, through which small tributary streams run from Kapaʻa including Kapahi, Makaleha, and Moalepe. Some of these streams combine with other tributaries in Kēālia to form Kapaʻa Stream (often referred to as Kēālia River) which empties into the ocean at the southern border of the *ahupuaʻa*. Kēālia Ahupuaʻa shows more characteristics of a typical stream valley with a good-sized alluvial plain dissected by a major stream, the Kapaʻa Stream in addition to a plateau land dissected by a few small drainages including Kumukumu and Hōmaikawaʻa streams.

1.4.1 *Ka Lepo* (Soils)

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), soils within the project area include Ioleau silty clay loam, 2 to 6% slope in the northern half of the project area (IoB); Ioleau silty clay loam, 6 to 12% slope (IoC) in the northeastern portion; a small portion of Ioleau silty clay loam, 12 to 20% slope at the northeast corner (IoD2), and the majority of the project containing Lihue silty clay, 0 to 8% slope (LhB) (Figure 5).

Soils of the Ioleau Series are described as follows:

> This series consists of well-drained soils on uplands on the island of Kauai. These soils developed in material weathered from basic igneous rock, probably mixed with volcanic ash. They are gently sloping to steep. Elevations range from 100 to 750 feet. The annual rainfall amounts to 40 to 70 inches. The mean annual soil temperature is 72° F. Ioleau soils are geographically associated with Lihue and Puhi soils.
>
> These soils are used for irrigated sugarcane, pasture, pineapple, irrigated orchards, irrigated truck crops, wildlife habitat, and woodland. The natural vegetation

> consists of lantana, koa haole, guava, and associated shrubs and grasses. [Foote et al. 1972:47]

Soils of the Lihue Series are described as follows:

> This series consists of well-drained soils on uplands on the island of Kauai. These soils developed in material weathered from basic igneous rock. They are gently sloping to steep. Elevations range from nearly sea level to 800 feet. The annual rainfall amount to 40 to 60 inches. The mean annual soil temperature is 73° F. Lihue soils are geographically associated with Ioleau and Puhi soils.
>
> These soils are used for irrigated sugarcane, pineapple, pasture, truck crops, orchards, wildlife habitat, woodland, and homesites. The natural vegetation consists of lantana, guava, koa haole, joee, kikuyugrass, molassesgrass, guineagrass, bermudagrass, and Java plum. [Foote et al. 1972:82]

1.4.2 *Ka Ua* (Rain)

The project area, located on the windward side of Kaua‘i, is exposed to prevailing tradewinds and their associated weather patterns. Rainfall on the coastal plains and plateaus of Keālia averages approximately 40 inches per year (Juvik and Juvik 1998:56).

Traditionally, the year was divided by two distinct annual seasons. The first, known as *kau* (period of time, especially summer), typically lasted from May to October and is marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season), continued through the end of the year from November to April and represented a much cooler period. Trade winds were less frequent, and widespread storms and rainfall were common (Giambelluca et al. 1986:17). Typically, the maximum rainfall occurs in January and the minimum in June (Giambelluca et al. 1986:17).

Each small geographic area on Kaua‘i had a Hawaiian name for its own rain, wind, and seas. The area of Keālia was no exception to this naming practice. According to Akana and Gonzalez (2015),

> Rain names are a precious legacy from our kūpuna who were keen observers of the world around them and who had a nuanced understanding of the forces of nature. They knew that one place could have several types of rain, each distinct from the other. They knew when a particular rain would fall, its color, its duration, its intensity, its path, its sound, its scent, and its effect on the land and their lives . . . Rain names are a treasure of cultural, historical, and environmental information. [Akana and Gonzalez 2015:n.p.]

Although rainfall on the eastern side of Kaua‘i Island is generally plentiful, only the Nāulu rain is known to be associated with Keālia Ahupua‘a. The Nāulu rain is mentioned in a chant originally composed for Lunalilo and inherited by Kalākaua (Akana and Gonzalez 2015:199). The *mele* (song), composed by Nāmāhana, speaks of the Nāulu rain and its spring-filling waters:

Hana ua wai Nāulu ‘o Kona	Kona produces the Nāulu rainwater
Hana ua wai Nāulu ‘o Mānā	Mānā produces the Nāulu rainwater

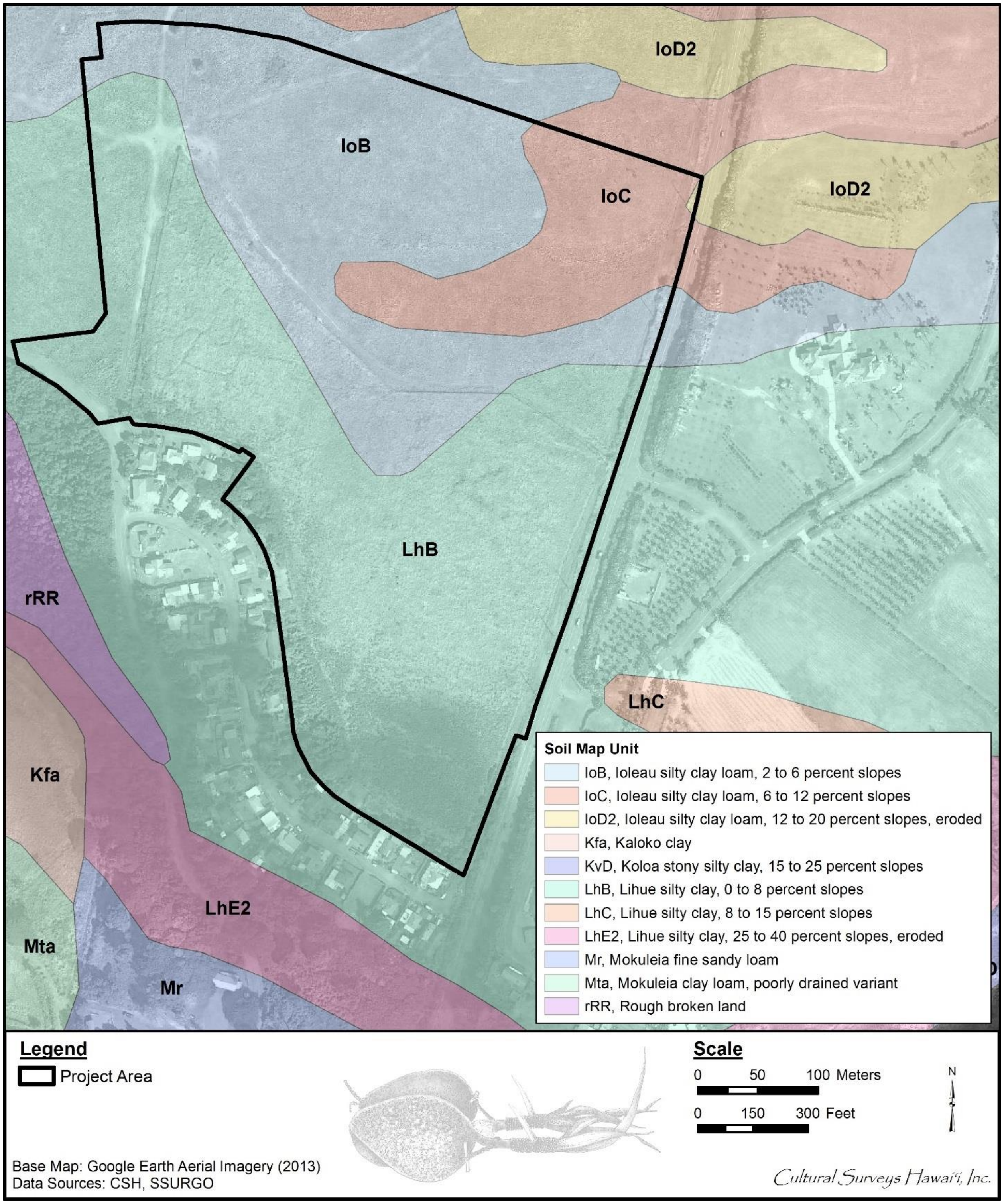


Figure 5. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972), indicating soil types within and surrounding the project area (U.S. Department of Agriculture Soils Survey Geographic Database [USDA SSURGO] 2001)

I hoʻonani ʻia e piha Keālia wai	That enhances and fills the spring of Keālia
Wai Kahelu, ua piha Kalanamaihiki	The waters of Kahelu, Kalanamaihiki is filled
Na ka wai ua Kaunalewa	By the rainwater of Kaunalewa
Maikaʻi iho i ka wai Lolomauna	Beautified by the water of Lolomauna

[Akana and Gonzalez 2015:199]

A relative lack of rain names may indicate historic environmental conditions within the *ahupuaʻa*; these conditions, in turn, most likely shaped agricultural practices in the area by forcing local inhabitants to modify nearby freshwater resources (see Section 1.4.4). Handy and Handy provide further evidence of Keālia's "dry conditions:"

> Two small *ahupuaʻa*, Kamalomaloʻo (Dry Kamalo) and Kealia are rather dry, with small streams and gulches and only a few *loʻi* areas. Where Kealia and Kapaʻa Streams join inland there are wide flats that were terraced. Seaward there were formerly many terraced areas. There are clumps of coconut and mango trees where formerly were *kuleana* with their *loʻi*. Inland there were a number of small streams which doubtless once had small *loʻi* developments. [Handy and Handy 1972:423]

1.4.3 *Ka Makani* (Wind)

Northeasterly trade winds prevail throughout the year, although their frequency varies from more than 90% during the summer months to 50% in January; the average annual wind velocity is approximately 10 miles per hour (O'Hare et al. 2009:8).

The name of the winds of Kauaʻi are listed in a chant concerning a powerful gourd called *The Wind Gourd of Laʻamaomao.* According to Handy and Handy (1972), the gourd is a *kino lau* (embodiment) of Lono, god of agriculture and fertility (Handy and Handy 1972:220). Handy and Handy elaborate, "Lono is the gourd; the cosmic gourd is the heavens whence come winds, clouds, and rain" (Handy and Handy 1972:220). When the gourd was opened, a specific wind could be called to fill the sails of a canoe and take the person in the desired direction. It is within this chant that the wind of Keālia, Mālamalamamaikai, is noted. Kūapākaʻa, the son of Pākaʻa and descendant of Laʻamaomao, calls out the winds of the ancient Puna District of Kauaʻi (Nakuina 1990:53):

> Hoʻolua is the wind of Makaīwa,
>
> Kēhau is of Kapaʻa,
>
> Malamalamamaikai is of Keālia,
>
> Hulilua is of Homaikawaʻa,
>
> Amu is of Anahola,
>
> [Nakuina 1990:53]

Mālamalamamaikai is identified by Pukui and Elbert as Mālamalamaiki (1986:232). Pukui and Elbert derive this spelling of the wind from Fornander's "Legend of Kuapakaa" (Fornander 1919:97). While the Mālamalamamaikai (Mālamalamaiki) wind of Keālia is prominently noted in both Nakuina's *Wind Gourd of Laʻamaomao* and Fornander's "Legend of Kuapakaa," an additional reference to this wind is located within *The Epic Tale of Hiʻiakaikapoliopele*.

During a break in the tale, the writer, Hoʻoulumāhiehie, makes a point to list the winds of "fair Kauaʻi, perfection in the calm" for "the benefit of future generations here in Hawaiʻi" (Hoʻoulumāhiehie 2008:15). The writer notes that these winds are listed in their entirety by the goddess Pele. Pele identifies the Mālamalama ("enlightenment, shining, radiant, clear") wind in her chant,

A pā a noua ka makani o Kauaʻi	The winds of Kauaʻi blow, urged on
Puhia ka makani a Laʻa	The winds of Laʻa [Laʻamaomao] are sent forth
Ke ahe Koʻolauwahine, ka makani o lalo	The Koʻolauwahine breeze, a wind from below
ʻO Kauaʻi kaʻu i ʻike . . .	Kauaʻi is what I see and know . . .
120. Ua paʻa i ke Kaiʻokia	120. Held fast by the Kaiʻokia law
He Kololio ka makani kepue	The wind like hard stone is a Kololio
E ala! E ala!	Arise! Arise!
Ua kani ʻo olokele nui maka onaona	The great olokele [*olokele* is the Kauaʻi name for the *ʻiʻiwi* or scarlet honeycreeper]
He Mālamalama ka makani o Kealia	The wind of Keālia is a Mālamalama

[Hoʻoulumāhiehie 2006:16–19]

1.4.4 *Nā Kahawai* (Streams)

Kauaʻi, geologically, is the oldest island within the main Hawaiian archipelago. In comparison, Kauaʻi is nearly five million years older than Hawaiʻi Island (Parham 2008). Differences in erosion between the two islands corresponds to differences in their ages (Parham 2008). These differences are observable via stream morphology:

> As flowing water cuts down through the lava substrate, streambeds generally become less steep, and the streams have fewer large waterfalls and a greater development of estuaries – sites where fresh waters and the ocean mix. [Parham 2008]

Keālia Ahupuaʻa contains the general features of a stream valley; notable amongst these features is a fairly large alluvial plain bisected by a major stream. Kapaʻa ("the solid or the closing") Stream (also identified as Keālia River), is the major stream within the area. Mimino ("to wither, as blighted fruit") was the next sizeable stream emptying into Keālia ("salt encrustation"), followed by the Halaʻula ("red pandanus") (Handy 1940:68–69). Kapaʻa Stream is formed by the joining of the Kapahi ("the knife"), the Makaleha ("eyes looking about as in wonder and admiration") and the Moalepe ("chicken with comb") streams (all occurring within the Kapaʻa watershed) (Handy 1940:68). Also intersecting with Kapaʻa Stream is Keālia Stream. The headwaters of Keālia include Waipahi, Maiakiʻi, and Waiʻawaʻawa ("bitter water"). *Kula* (upper area) lands within Keālia were also cut by small streams, including the Kumukumu ("stubs") (occurring within the Kumukumu watershed) and Hōmaikawaʻa ("give me the canoe").

Although the twentieth century resulted in waters being taken for sugarcane irrigation projects, modification to freshwater resources had been ongoing for centuries. "After about 1100 A.D., Hawaiians developed more complex agricultural irrigation systems. Streams were diverted into well-engineered lateral ditches" (State of Hawaiʻi Commission on Water Resource Management 1993:9). Diverted water was then utilized to irrigate *loʻi kalo* (taro pondfields), as well as various agriculture and aquaculture features. Especially prone to modification were the upper and lower portions of streams. Lower stream valleys were generally converted to *loʻi kalo*, *loko iʻa* (fishpond), or *loko iʻa kalo* (combined fishpond and taro patch), while stream flats within upper valleys were converted to agricultural terraces (State of Hawaiʻi Commission on Water Resource Management 1993:9). Within Keālia, terraces were believed to have once existed in the shallow gulches of Hōmaikawaʻa and Kumukumu (Handy 1940:68). Handy elaborates on other possible terrace locations within Keālia:

> In its upper part Kealia Stream runs through a course too narrow for terraces. Below Kaohe, however, as far as its junction with Kapaa Stream, there is a mile of sizable flats along the meandering watercourse which must have been utilized as terraces. This ground is now all under sugar cane. There are old mango trees here and there indicating *kuleana* [a small area of land, such as were awarded in fee by the Hawaiian monarch about the year 1850, to all Hawaiians who made application thereafter]. Below the junction of Kapaa and Kealia Streams the flatland on either side of the river was formerly all in terraces. A small section below the junction is now in sugar cane. Between this and the broad flats above Kealia Bay old terrace land is now under pasture or planted with bananas, corn, and other crops. The broad flatland above bay and town is now in sugar cane; formerly it must have been m terraces throughout. There were a number of *kuleana* grants here, the location of some of which are still indicated by clumps of old coconut and mango trees. Halaula is a small stream emptying into these flats from the northwest. In upper Kealia the topography indicates that there were probably small terraces in Waipahi, Maiakii, and Waiawaawa, which are at the headwaters of the Kealia River. [Handy 1940:68–69]

Evidence of a traditional irrigation system within Keālia Ahupuaʻa was documented by Wendall Clark Bennett in 1931. Bennett, citing Antonio Perry, notes that most *loʻi kalo* were watered directly from ditches, with the major exception being those watered by "overflow or percolation from adjoining patches" (Perry 1913 in Bennett 1971:n.p.). South of Keālia Valley, Bennett identified Site 111, an irrigation ditch:

> A large, simple dirt ditch about 6 feet in width and of varying depths, which is traditionally referred to -as a Hawaiian ditch. The interesting part is a deep cut about 100 feet long made through a low ridge alongside of which the ditch ran. The lands to be irrigated were on the other side of this ridge and so the cut was made to a depth of 10 or 15 feet through loose rock and subsoil. [Bennett 1971:n.p.]

Handy (1940) commented further on Bennett's observations, noting that the "inland part of the valley are old terraces and that on the level land at the seaward end of the valley. . . wet taro is still planted" (Handy 1940:69).

The aforementioned agricultural system proved especially vital in the cultivation of the traditional Hawaiian staple crop, *kalo* (taro; *Colocasia esculenta*). For spiritual and dietary reasons, *kalo* was a sacred staple in the Hawaiian diet. According to Hawaiian mythology, man was born from the taro plant.

The *Kumulipo* ("origin, genesis") details this kinship. Hāloa, "he of the long breath," is the second son of Wākea and Papa. Wākea and Papa's first born, Hāloa-naka was born premature and died shortly after his birth (Kanahele 1995:17). After burying Hāloa-naka, a *kalo* plant sprouted at his grave. Shortly after, a second son (Hāloa) was born. A human child, Hāloa symbolizes *kalo* and man. *Kalo* is a metaphor for life, Kanahele explains as follows:

> In the mythologies of many cultures, plants have been used to symbolize human spiritual growth. Hawaiians made taro a metaphor for life because, like the taro plant, it needs to be rooted in good soil and to be constantly nourished with the waters of Kāne. As the stalk grows taller with its leaves reaching toward the light of the sun, symbolized by Wākea, so Hawaiians grow aspiring to be closer to their heavenly spirit. Just as every young shoot can become a full-grown plant, so can they become gods as descendants of Hāloa. As every plant must die, however, they too must die. And from the remains a new plant lives again. In this continuity of life, both plant and man repeat the mystery of the unending cycle. [Kanahele 1995:18]

Currently, the Halaʻula Reservoir, located *mauka* (inland, toward the mountains) of the current project area, is an additional source of water supply. Smaller reservoirs or wells have been observed to the northwest of the current project area (Figure 6).

1.4.5 *Lihikai ame ka Moana* (Seashore and Ocean)

The literal translation of Keālia, "the salt bed" or "the salt-encrusted area" is a direct reference to the salt ponds and *kai hoʻolulu* (natural salt basins) that once dotted the shoreline. Low-lying, coastal portions of Keālia were often inundated by high surf and high tides, especially during the winter and spring months. Following these flooding events, shallow ponds would form. According to waterman and historian John Clark,

> After several days of exposure to the sun, the water that had inundated the flats would evaporate, leaving behind a thin layer or occasionally a pocket of salt. Salt from the deeper pockets was gathered to satisfy a variety of domestic, medicinal, and ceremonial needs. [Clark 1990:11]

In addition to the production of *paʻakai* (salt), the *makai* (seaward) region provided a variety of fish and ocean invertebrates for consumption. Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional Hawaiian society; Kanahele asserts that "early Hawaiians regarded fishing as the oldest, and hence the most prestigious of professions (Kanahele 1995:17).

Figure 6. Overview of small reservoir immediately northwest of the current project area. A group of *nēnē* (Hawaiian goose; *Branta sandvicensis*) are visible in the middle ground, view to northwest

According to Charles Howard Edmondson, the east coast of Kaua‘i was once replete with “varied fauna of molluscs, crustaceans, and echinoderms” (Edmondson 1946:7). Animals of these phyla would have included species such as *‘opihi* (*Cellana exarata*), *pipipi* (snails; *Neritidae*), *he‘e* (octopus; *Octopus cyanea*), *ula* (Hawaiian spiny lobster; *Panulirus marginatus*), *wana* (sea urchin; *Echinothrix* spp.), or *loli* (black sea cucumber; *Holothuria atra*).

The bounty of the sea is further described in one man’s chant for the ancient Puna District of Kaua‘i. The man is asked by his companion why he has love for Puna; filled with *aloha* (love) for both land and sea, he responds with poetic descriptions of the fishing grounds at Kalualihilihi, the sea urchins of Kapuka, and the breakers at Niau:

I ke ao hookanunu i luna o Pohakupili	For the clouds that gather on Pohakupili,
I na puawa ona o Maiakii. . .	For the potent awa of Maiakii. . .
I na Uhi moe lehu Makialo	For the yams that lie in the ashes at Makialo,
I na Kawalo pahee o Waipahee. . .	For the shrimps of the mossy waters of Waipahee. . .
I na Manienie hawanawana o ka loko o Kupalii	For the rustling *manienie* grass of the pond of Kupalii,
I na Ko ia o Kalualihilihi	For the fishing grounds at Kalualihilihi,
I na Ohia wai maka nui o Puuhokeo	For the large juicy mountain apple of Puuhokeo,
I na ai kahea i ka lau o Koki	For the food plants that call to those multitudes of Koki,
I na kalo palakai o Lapanui	For the stunted taro of Lapanui,
I na ia hoai nahanaha o Haumea	For the wide-backed edible fish of Haumea,
I na kalo pahi laho o Keahapana	For the taro that pelts the scrotum at Keahapana,
I na Ia ina mai o Kapuka	For the sea urchin of Kapuka,
I na nalu hai muku o Niau	For the short breaking surf of Niau,
I ka uliuli o ke kai o ka hee	For the dark fluid (*kai*) in the squid dish,
I ka uliuli o ke kai o ka ina	For the dark fluid in the sea urchin,

I ka uliuli o ke kai o ka Limu kala	For the dark fluid in the *kala* seaweed,
O ka mai o ka‘u wahine,	For the dark color of my wife's private,
A, aloha ai no au ia Puna nei [HEN 1885:I:215]	That is why I love Puna.

The seashore and ocean also maintained spiritual significance for residents of the *ahupua‘a*:

> The Ocean *(ka moana nui a Kane)* surrounded the earth. It was made salt by Kane so that its waters should not stink, and to keep it thus in a healthy and uninfested state is the special occupation of Kane. In imitation of Kane, the priests prepare waters of purification, prayer and sanctification (holy water) '*wai hui kala*,' '*wai lupalupa*,' and '*Ke Kai olena*,' wherewith to drive away demons and diseases; it was called '*Ka wai kapu a Kane*.' Women purified themselves after child-birth by bathing naked in the sea and sprinkling their *pa‘u*, or skirt, with sea water. If they were too far from the sea, they took a calabash of salted water, and at high noon offered a prayer of blessing and poured it over their bodies. Doses of medicine (taken by fives) were followed by a sea bath. In the Pele legend, Lohiau, after being brought back to life from the dead, is bathed five times in the sea for purification. [Fornander in Green and Beckwith 1926:176]

In more recent times, the seashore at Keālia has been utilized for surfing and bodyboarding. There exist two "surfing spots" within Keālia Ahupua‘a. The first is located at the shorebreak beach of Keālia. This beach, contained between two rocky points, is approximately 150 ft wide and half a mile long (Figure 7). Ocean conditions within the area are succinctly described by Clark:

> The nearshore bottom is a long sand bar whose depth constantly changes. Surf breaks on the sand bar throughout year, attracting a constant flow of bodyboarders and surfers. Most of these wave riders tend to congregate at the north end of the beach, where the best waves are usually found. High surf during the winter and spring on Kaua‘i's north shore wraps around the island and breaks at Kealia. It often undermines the sand bar, exposing the bedrock below. During these periods of high surf, nearshore rip currents are very powerful and dangerous. Over the years many drownings and near-drownings have occurred here. At the north end of the beach, a small jetty offers swimmers some protection from the surf. The jetty is all that remains of the former Kealia Landing. [Clark 1990:11]

Keālia Landing (Figure 8) is located at Niau; Niau is the traditional name of the northern side of Keālia Bay (see chant above). This *wahi pana* (storied place) of the ancient Puna district was famed for its breaking surf (HEN 1885:I:215). Currently, vegetation along this stretch of Keālia Beach consists of *naupaka kahakai* (*Scaevola taccada*), *kauna‘oa* (dodder; *Cuscuta sandwichiana*), *pōhuehue* (beach morning glory; *Ipomea pes-caprae*), *koa haole* (lead tree; *Leucaena leucocephala*, and *niu* (coconut; *Cocos nucifera*) (Figure 9 and Figure 10).

The second of these two "surf spots," is an area traditionally known as Kuna (a variety of freshwater eel), located approximately one and a half miles northeast of Keālia Beach. Today, this coastal area is also known as Palikū ("vertical cliff") or Donkey Beach. Palikū is the name of a

Figure 7. General view of Keālia Beach, view to southwest

Figure 8. General view of Keālia Landing (visible in middle ground), view to southeast

Figure 9. Close-up of *pōhuehue* and *kauna‘oa*, view to southwest

Figure 10. Close-up of vegetation within *makai* portion of Keālia Ahupuaʻa; *niu*, *pōhuehue*, and *kaunaʻoa* are pictured, view to southwest

seaside cliff on the southern end of Kuna Bay, which is noted for fishing (Bushnell et al. 2002:37). The nickname “Donkey Beach,” was given in the plantation era, inspired by a large herd of mules and donkeys from the Lihue Plantation Company that grazed in the shoreline pastures. As of his 1990 publication of *Beaches of Kaua‘i and Ni‘ihau*, John Clark noted that only a few mules remained in the pastures immediately behind the Palikū beach area (Clark 1990:13).

1.4.6 Built Environment

Utilizing aerial photographs of the project area from 1982 (Figure 11) and 2013 (see Figure 3), changes to the built environment were analyzed and summarized below. The project area’s built environment includes a large portion of former cane lands and the “New Kumukumu Camp.” Within the last 30 years, visual evidence of this camp has been removed from the landscape (see Figure 3). At present, the current project area is leased for cattle raising. A very small portion of Route 56 (Kūhiō Highway) and Hōpoe Road are also located within the project area. Residential housing along Ka‘ao Road abuts the southern portion of the project area.

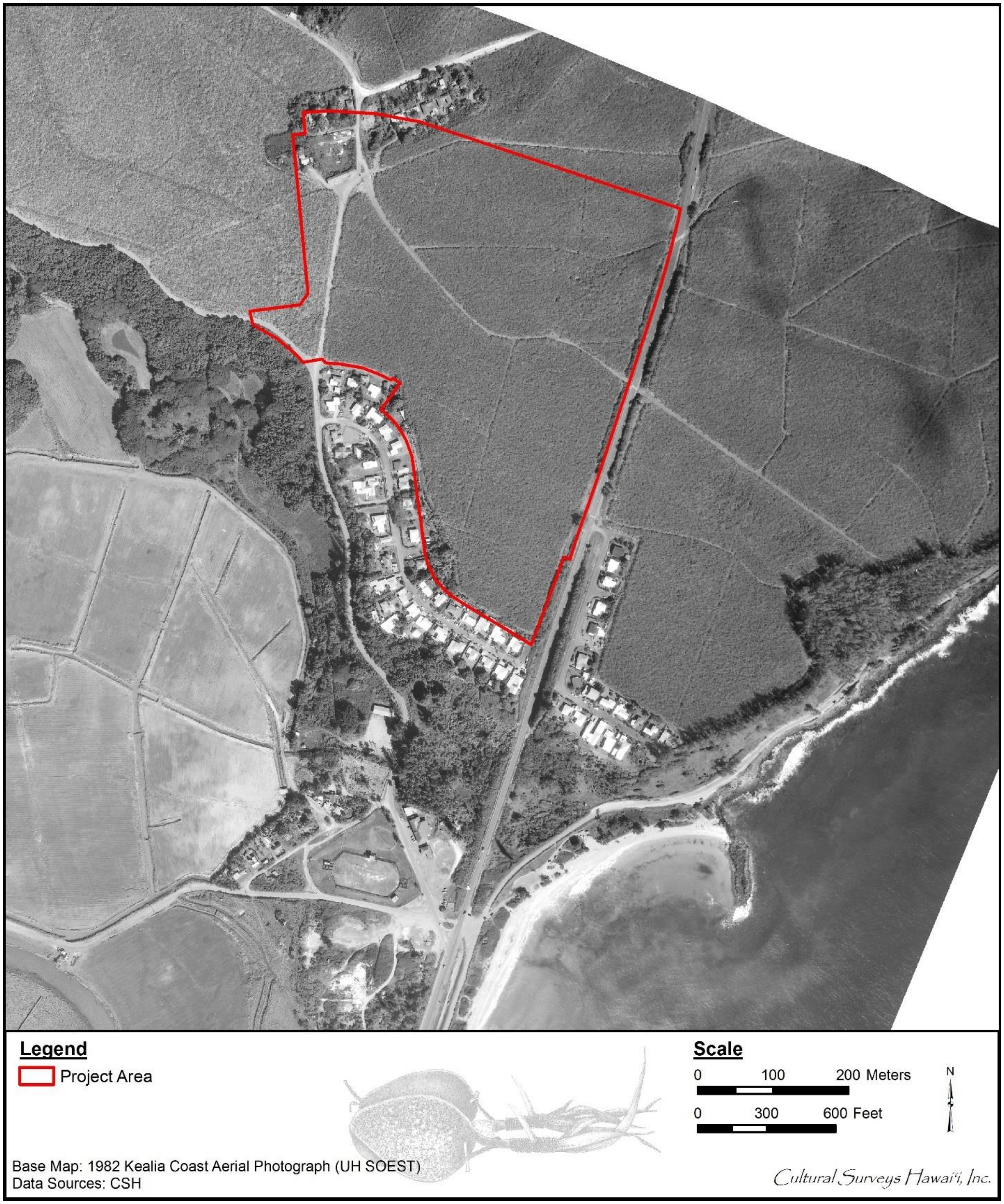


Figure 11. 1982 area photo (UH SOEST) showing cane lands in majority of the project area, “New Kumukumu Camp” in the north corner, residential housing along Ka‘ao and Hōpoe roads to the south, and Kūhiō Highway to the east

Section 2 Methods

Through archival research and community consultation, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural resources, practices, and beliefs (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*; OEQC 2012).

2.1 Archival Research

Research centers on Hawaiian activities including *kaʻao* (legends), *wahi pana* (storied places), *ʻōlelo noʻeau* (proverbs), *oli* (chants), *mele*, traditional *moʻolelo* (stories), traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawaiʻi State Archives, the Bishop Museum Archives, the University of Hawaiʻi at Mānoa's Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau.org 2014), the State Historic Preservation Division (SHPD) Library, the State of Hawaiʻi Land Survey Division, the Hawaiian Historical Society, the Kauaʻi Historical Society, the Kauaʻi Museum, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ʻAina Corporation's Māhele database (Waihona ʻAina 2000), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ʻĀina website (Ava Konohiki 2015).

2.2 Community Consultation

2.2.1 Scoping for Participants

The cultural department commences our consultation efforts by utilizing our previous community contact list to facilitate the interview process. We then review an in-house database of *kūpuna* (elders), *kamaʻāina* (native born), cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior's NHO list), and community groups. CSH also contacts agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response to the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 "Talk Story" Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *ʻike* (knowledge) and *manaʻo* (thought, opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign (see Appendix G).

“Talk Story” sessions range from the formal (e.g., sit down and *kūkā* [consultation, discussion] in the participant’s place of choice over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, CSH also conducts group interviews, which range in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewees’ answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) adding missing details to *mo‘olelo*.

CSH seeks *kōkua* (assistance) and guidance in identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupua‘a*; past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana* [storied places], archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*ka‘ao* and *mo‘olelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

2.2.3 Interview Completion

After an interview, CSH cultural researchers create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the interview summary to the interviewee for review and ask that they make any necessary edits. Once the interviewee has made those edits, CSH incorporates their *‘ike* and *mana‘o* into the report. When the draft report is submitted to the client, cultural researchers then prepare a finalized packet of the participant’s interview summary, and any photos taken during the interview. We also include a thank you card and honoraria.

It is important that CSH cultural researchers cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *‘ohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *‘ohana* and community.

“*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk,” is an *‘ōlelo no‘eau* (#1261) shared by Mary Kawena Pukui with the simple explanation: “Without our ancestors we would not be here” (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we do not lose their wisdom and words. We routinely check obituaries and gather information from other community contacts if we have lost our *kūpuna*. CSH makes it a point to reach out to the *‘ohana* of our *kūpuna* who have passed on and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference. All field activities are performed in a manner so as to minimize impact to the natural and cultural environment in the project area. Where appropriate, Hawaiian protocol may be used before going on to the study area and may include the *ho‘okupu* (offering) of *pule* (blessing), and *oli*. All participants on field visits are asked to respect the integrity of natural and cultural features of the landscape and not remove any cultural artifacts or other resources from the area.

Section 3 *Kaʻao* and *Moʻolelo* (Legends and Stories) of Keālia

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained teachings while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX). According to Pukui and Green (1995), storytelling is better heard rather than read for much is lost in the transfer from the spoken to the written word and *kaʻao* (legends) are often full of *kaona* or double meanings.

Kaʻao are defined by Pukui and Elbert as a "legend, tale […], romance, [and/or], fiction" (1986:108). *Kaʻao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been "consciously composed to tickle the fancy rather than to inform the mind as to supposed events" (Beckwith 1970:1). Conversely, Pukui and Elbert define *moʻolelo* as a "story, tale, myth, history, [and/or] tradition" (1986:254). The *moʻolelo* are generally traditional stories about the gods, historic figures or stories which cover historic events and locate the events with known places. *Moʻolelo* are often intimately connected to a tangible place or space (*wahi pana)* (see Section 3.2 *Wahi Pana* (Legendary or Storied Places).

In differentiating *kaʻao* and *moʻolelo* it may be useful to think of *kaʻao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. *Moʻolelo* on the other hand, reference a host of characters from *aliʻi* (royalty), to *akua* (gods) and *kupua* (supernatural beings), to finally *makaʻāinana* (commoners), and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, "In reality, the distinction between *kaʻao* as fiction and *moʻolelo* as fact cannot be pressed too closely. It is rather in the intention than in the fact" (Beckwith 1970:1). Thus a so-called *moʻolelo*, which may be enlivened by fantastic adventures of *kupua*, "nevertheless corresponds with the Hawaiian view of the relation between nature and man" (Beckwith 1970:1).

Both *kaʻao* and *moʻolelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remains a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kamaʻāina* as well as others who also value that place.

The following section presents traditional accounts of ancient Hawaiians living in the vicinity of the project area. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *aliʻi* (chief) and *makaʻāinana*. The *kaʻao* in and around the project area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

3.1 *Kaʻao* and *Moʻolelo*

3.1.1 Hiʻiaka and Wahineʻōmaʻo in Keālia

In the *kaʻao* of Hiʻiakaikapoliopele, Hiʻiaka, the younger sister of Pele, engages in a quest to retrieve her sister's lover, Lohiʻauipo, from Kauaʻi and bring him back to Halemaʻumaʻu Crater. Hiʻiaka does not attempt the quest alone, and is joined by her *aikāne* (friend), Wahineʻōmaʻo. Their journey was to be a perilous one, requiring them to travel across the island chain.

On their way to Haʻena, Hiʻiaka, Wahineʻomaʻo, and their traveling companion Pāʻūopalaʻā stopped near Keālia to rest. While debating where to spend the night, their companion, Pāʻūopalaʻā pointed out a small house within a grove of *hala* trees near Keālia Beach. According to Wichman (2001), as the party neared the home, they saw an old man sitting outside, attempting to light his cooking fires. From within the home, Hiʻiaka overheard a *kahuna lapaʻau* (healer) attempt a chant. The traveling party immediately recognized that both the man and the *kahuna lapaʻau* were failing to accomplish their tasks. Hiʻiaka soon captured the man's attention, inquiring into the situation at hand. The man, identifying himself as Kalalea, informed the party that he was attempting to cook *lūʻau* (young taro tops, especially as baked with coconut cream and chicken or octopus) for his sick wife Koʻanawai:

> 'My wife is Koʻana-wai. She is sick. The kahuna lapaʻau says she has angered one of the gods but I do not see how. She has always followed their way. Perhaps, he says, she has angered someone and that person has called upon a kahuna ʻanaʻana who is praying her to death. But I do not think so. She has been ill too long. Black magic is swift, is it not?'
>
> 'Yes, it is,' Pāʻū-o-palaʻe answered.
>
> 'Perhaps your kahuna isn't very knowledgeable,' Wahine-ʻōmaʻo said.
>
> 'Be careful.' The words came from the doorway to the house. An old man with long white hair stuck his head out the door. 'I am no amateur. I tell you this woman is very sick. Only by offering the proper sacrifices can she recover.'
>
> 'What must I offer as sacrifice?' Kalalea asked.
>
> The kahuna stroked his chin, considering. 'I shall need some lipoa seaweed from the reef of Molo-aʻa,' he said, holding out his hand and pulling one finger flat against his palm. 'Then some awa root from Wai-paheʻe.' Another finger went down. 'Some leaves from the hau trees at Ho-mai-ka-waʻa, a gourd of water from Uluoma, and last, forty kukui [candlenut; *Aleurites moluccana*] blossoms from Kahiki-kolo.'
>
> The palm of his hand was gone. Only a fist remained which the old man shook in Kalalea's face. 'Get them and we shall see what we can do for your wife.'
>
> 'It will take time,' Kalalea said. 'Already it is night. I must wait until dawn.'
>
> 'Will she last the night?' Wahine-ʻomaʻo demanded.
>
> 'Perhaps,' the kahuna replied.
>
> 'Perhaps?' Wahine-ʻomaʻo's voice rose questioningly. She brushed past the kahuna and went into the house. In a few minutes she returned and said to Hiʻiaka, 'She will not last the night. She needs something nourishing to eat, like those lūʻau leaves Kalalea is trying to cook. It is only a fever that this stupid kahuna has only made worse. This is something you can easily make right.'
>
> 'You must go,' the kahuna shouted. 'You are only making trouble.' His words and his tone of voice angered Hiʻiaka. She gestured and the kahuna fell silent, although his lips continued to form words there was no sound. He clutched his throat.

> ʻLeave us,ʼ Hiʻiaka ordered. ʻFrom now on, only when you speak the truth will your voice be heard. The lies shall remain silent. Go!ʼ [Wichman 2001:94]

The three then set forth to help cook *lūʻau*, and heal the sick woman. Hiʻiaka offered a chant prior to giving Koʻanawai food and water:

> Come, gods, enter, possess and inspire me,
>
> First you, Kāne-kapolei, god of wildwood,
>
> Hiʻiaka calls you,
>
> For she calls for the power to heal.
>
> Pray enter, and heal, and let live
>
> Koʻana-wai, the ailing woman of Ke-ālia.
>
> Give her life! [Wichman 2001:95]

In the Rice version of the story, Hiʻiaka and Wahineʻōmaʻo help a man cook his *lūʻau* to eat with his *poi* (Hawaiian staff of life made from cooked taro corms). Noticing an ailing woman in the man's house, Hiʻiaka said a prayer which brought the woman back to health. All the *kahuna* in the region had been unable to help the woman previously (Rice 1977:10).

In the Hoʻoulumāhiehie version of the Hiʻiakaikapoliopele tale, Hiʻiaka and Wahineʻōmaʻo's connection to Keālia is discussed rather obliquely. Their connection to the area is not explicitly established, however, Keālia is referenced by the author when imagining the beautiful physiques of Wahineʻōmaʻo, Papanuioleka, Hiʻiaka, and Pāʻūopalaʻā as they swam uncovered across the Wailoa River (on Hawaiʻi Island). Hoʻoulumāhiehie, "imagining their fine physiques uncovered" (2008:70) recalled the following lines,

> I wish to sip of the waters below
>
> Enhanced by the Koʻapuaiʻa showers
>
> Mānā shudders and clamors in haste
>
> Rushing to the sheltered strands of Nohomalu, yes, there
>
> There was I, where Kaunalewa sways side to side
>
> While Kawailiʻulā, the land of mirages, relaxes peacefully
>
> Perhaps rejoicing over Limaloa
>
> Who crafted fantasies at Keālia, yes, there. [Hoʻoulumāhiehie 2008:70]

Limaloa, the *kupua* (demi-god) mentioned in line seven of the above stanza, was said to have been able to "make grand mirages of whole villages along the western coast of Kauaʻi, which would then disappear" (Hoʻoulumāhiehie 2008:70).

3.1.2 *Kaʻao no Kaipalaoa, ke Keiki Hoopapa* (Legend of Kaipalaoa, the Hoopapa Youngster)

There exist several versions of the Kaipalaoa story, however, they all remain centered upon the art of *hoʻopaʻapaʻa* (to argue, riddle). The Fornander version of the tale is set in the days of Pueo-nui-o-Kona, ruling chief of Kauaʻi (Beckwith 1970:460). It is during these ancient days that the father of Kaipalaoa, Hale-pa-ki, is killed in a riddling contest with the Kauaʻi chief Ka-lani-aliʻi-loa (Beckwith 1970:460). The stakes were high for those who dared to challenge Kalanialiʻiloa in a riddling game, a loss resulted in death. The chief had the bones of losing challengers used to build a fence around his home. Kaipalaoa, a skilled riddler himself, intended to avenge his father's death. Beckwith, in summarizing the Fornander version of the legend, describes the character of Kaipalaoa:

> Kaipalaoa lives at Waiakea in Hilo with his mother Wailea who is skilled in the art of riddling, but who sends him to her sister Kalena-i-haleauau, wife of Kukui-pahu the ruling chief of Kohala, to complete his education. He then journeys to Wailua, Kauai, and challenges the chief to a riddling contest, invoking his own god Kane-pa-iki against the god Kane-ulu-po (god who presides over the cock crow) invoked by the Kauai chief's instructors. [Beckwith 1970:460]

Fornander provides details about Kaipalaoa's journey to Kauaʻi, and it is within these details that the *ahupuaʻa* of Keālia is briefly mentioned:

> *Haalele iho la keia ia Hanalei, hele aku la ma Koolau a hiki i Waiakalua, hoomaha; hele aku la a Anahola a Kealia, hiki i Wailua; ilaila o Kalanialiiloa kahi i noho ai. Ilaila ka pa iwiw a Kalanialiiloa, e ku ana, ua kokoke e puni i ka iwi kanaka. Nana aku la keia e ku ana na iwi Halepaki, ka makuakane, e koko ana no, aole I maloo; uwe iho la keia me ke kulu o na waimaka. Hele aku la keia a ka pahu lepa, kulai iho la keia I ka lepa, kukulu ae la I ka oililepa; lalau aku la keia I ka pahu kapu kulai, kukulu ae la keia I ke kikakapu. Ma keia mau hana a ke keiki, he hoopapa kea no. Ike mai la o Kalanialiiloa a me na kumu hoopapa I nei mau hana a ke keiki, maopopo ia lakou he keiki hoopapa keia, hoouna mai la I elele e olelo I ke keiki.* [Fornander 1917:577]

> Soon after this the boy left Hanalei and proceeded on his way, going by way of Koolau until he arrived at Waiakalua where he rested. From this place he continued on to Anahola; thence on to Kealia and then on to Wailua where Kalanialiiloa resided, where was his bone fence, almost completed, built from human bones. When he arrived at the place he looked and saw the bones of Halepaki his father; they were still fresh, the bones not yet being bleached. At sight of this the boy bowed in sorrow and wept. After his weeping he approached the flagstaff and pushed it down and put up the oililepa, one of the fish brought along by him. He then next took the kapu stick and pushed it down and put up in its place the other fish, the kikakapu. By this action of the boy, it was meant as a challenge to the people that he was come to meet them in a wrangling contest. When Kalanialiiloa and his instructors saw the action of the boy, they knew at once that he was challenging them to a contest of wits, so a messenger was dispatched to meet the boy showing the challenge was accepted. [Fornander 1917:577]

Although ridiculed because of his age, Kaipalaoa successfully outwits the chief and his *kumu*. As death was the wager, Kaipalaoa had the losers cooked in an oven and the flesh stripped from their bones (Beckwith 1970:460).

3.1.3 Kaweloleimakua and Kauahoa in Waipaheʻe

In the *mauka* areas of Keālia is a place called Waipaheʻe, a slippery slide used for recreation up until recent times. This *wahi pana* is associated with Kaweloleimakua and Kauahoa, who one day traveled to this place with their companion ʻAikanaka (Wichman 1998:86). Here the two boys engaged in a contest of who could make the best *lei* (garland) for their chief. Kauahoa won this contest by making his *lei* of *liko lehua* (the young leaves of *ʻōhiʻa lehua*) while Kaweloleimakua made his of fern. The boys then held a *naʻinaʻi mimi* (urination contest), to see who could urinate the longest, but because Kauahoa was much bigger than Kawelo, he also won this contest. Later, when the two were men engaged in war, Kawelo reminded Kauahoa of this boyhood excursion in an attempt to avoid bloodshed between them, however, he was unsuccessful.

3.1.4 Kawelomahamahaia, the Shark Man of Kauaʻi

Although sharing similarities in name, the Kawelo of this legend is not the fierce fighter of Kauaʻi and opponent of Kauahoa; he is in fact Kawelomahamahaia, the shark man of Kauaʻi. Kawelomahamahaia (Kawelo) carried the mark of a shark's mouth on his back and had a tail on the lower part of his body. According to Beckwith,

> Many local legends are told of shark-men, always to be known by the mark of a shark's mouth upon the back, who can change form from man to shark and who for a long time go undetected until it is noticed that an apparently disinterested warning to swimmers is always followed by a fatal attack by a man-eating shark. [Beckwith 1970:140]

As *kupua*, Kawelo was able to evade capture for quite some time. Gifted with supernatural powers, he could not only take the form of a shark, but could also transform into a worm, a moth, a caterpillar, and a butterfly (Beckwith 1970:141). Able to move between worlds, he maintained homes on land as well as underwater. He was said to have a home within the Wailua River and another home below the cave of Mamaaku-a-Lono; Beckwith notes these represent his two houses as a shark and as a man (1970:141). Kawelo hunted along the coast between Keālia and Wailua.

> [He] would eat up the children who ventured to swim out between those two places. Finally he was discovered and a long line of men formed who stoned him to death. He is identified with the famous chief Kawelomahamahaia (Kawelo with fins like a fish), a grandfather of Kawelo and descended from Mano-ka-lani-po, who was believed to become a shark god (akua mano) at death. [Beckwith 1970:141]

The shark was one of the many animal forms (*kinolau*) that *ʻaumākua*, or ancestor gods, could take. However, on the Island of Kauaʻi, this was not the case; according to Pukui and Elbert (1986):

> Family or personal gods, deified ancestors who might assume the shape of sharks (all islands except Kauaʻi), owls (as at Mānoa, Oʻahu and Kaʻū and Puna, Hawaiʻi), hawks (Hawaiʻi), *ʻelepaio*, *ʻiwi*, mudhens, octopuses, eels, mice, rats, dogs, caterpillars, rocks, cowries, clouds, or plants. A symbiotic relationship existed; mortals did not harm or eat *ʻaumākua* (they fed sharks), and *ʻaumākua* warned and reprimanded mortals in dreams, visions, and calls. [Beckwith 1970:124-43, 559; Pukui et al. 1972:37-38; cited in Pukui and Elbert 1986:32]

3.1.5 ʻAʻaka at ʻAhihi Point

In Kamalomaloʻo, what some consider to be the northernmost *ahupuaʻa* of the ancient Puna District (now Kawaihau), is the *wahi pana* of ʻAhihi. ʻAhihi is a headland that juts out into the ocean in between what is now known as Keālia and Anahola. Wichman (1998:87) retells a *moʻolelo* about ʻAʻaka, a *menehune* (legendary race of small people). This *moʻolelo* is also understood to be associated with Hōmaikawa‘a, the valley adjacent to ‘A‘aka, and ‘Ahihi, a plant with long runners.

One of ‘A‘aka’s favorite pastimes was to throw a stone into the ocean from‘Ahihi Point and then jump in after it. On one occasion, upon plunging into the sea, ‘A‘aka encountered a *niuhi* (a man-eater; great white shark); the *niuhi* almost swallowed him whole, ‘A‘aka, devised a plan to fabricate a net made from *‘ahihi* to catch the shark. After ordering the canoe, “Hōmaikawa‘a,” he and his companions were able to catch the shark and tow it to the reef at ‘Aliomanu (“where the water is made still by the oil from the shark”), near Anahola.

In the Rice version of the tale, it is noted that the *menehune* never again dare to jump into the sea at Hōmaikawa‘a, however, they construct a large *heiau* (temple) nearby. Kawelo worships his shark god at this *heiau* (Rice 1977:44). It is also noted that they erected a pile of stones, known as Kahuaaliko, at ‘Aliomanu “in memory of their delivery from the shark” (Rice 1977:44).

3.2 *Wahi Pana* (Legendary or Storied Places)

Wahi pana are legendary or storied places of an area. These legendary or storied places may include a variety of natural or human-made structures. Oftentimes dating to the pre-Contact period, most *wahi pana* are in some way connected to a particular *mo‘olelo*, however, a *wahi pana* may exist without a connection to any particular story. Davianna McGregor outlines the types of natural and human-made structures that may constitute *wahi pana*:

> Natural places have mana, and are sacred because of the presence of the gods, the akua, and the ancestral guardian spirits, the ‘aumakua. Human-made structures for the Hawaiian religion and family religious practices are also sacred. These structures and places include temples, and shrines, or heiau, for war, peace, agriculture, fishing, healing, and the like; pu‘uhonua, places of refuge and sanctuaries for healing and rebirth; agricultural sites and sites of food production such as the lo‘i pond fields and terraces slopes, ‘auwai irrigation ditches, and the fishponds; and special function sites such as trails, salt pans, holua slides, quarries, petroglyphs, gaming sites, and canoe landings. [McGregor 1996:22]

As McGregor makes clear, *wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, offshore islands and reefs, or they can refer to Hawaiian land divisions such as *ahupua‘a* or *‘ili* (land division smaller than an *ahupua‘a*), and man-made structures such as fishponds. In this way, the *wahi pana* of Keālia tangibly link the *kama‘āina* of Keālia to their past. It is common for places and landscape features to have multiple names, some of which may only be known to certain *‘ohana* or even certain individuals within an *‘ohana*, and many have been lost, forgotten or kept secret through time. Place names also convey *kaona* (hidden meanings) and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the Hawaiian Islands, cultural information was exclusively preserved and perpetuated orally. Hawaiians gave names to literally everything in their environment, including individual garden plots and *‘auwai* (water courses), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku* (rock, stone), *pūnāwai* (freshwater springs), and many others. According to Landgraf (1994), Hawaiian *wahi pana* “physically and poetically describes an area while revealing its historical or legendary significance” (Landgraf 1994:v).

Keālia Ahupuaʻa belongs to the ancient district of Puna, one of five ancient districts on Kauaʻi (King 1935:228). Puna was the second largest district on Kauaʻi, behind Kona, and extended from Kīpū, south of Līhuʻe to Kamalomaloʻo, just north of Keālia. For taxation, educational, and judicial reasons, new districts were created in the 1840s. The Puna District, with the same boundaries, became the Līhue District, named for an important town in that district. In 1878, King Kalākaua in securing a future and name for the new Hui Kawaihau, created the new district of Kawaihau. This new district encompassed the *ahupuaʻa* ranging from Olohena on the south to Kīlauea on the north. Subsequent alterations to district boundaries in the 1920s left Kawaihau with Olohena as its southernmost boundary and Moloaʻa as its northernmost boundary (King 1935:222). Although the legendary accounts and celebrated places (*wahi pana*) of Keālia are not as numerous as nearby Wailua, there are still several accounts that refer to the area.

The land division of Keālia lies between the *ahupuaʻa* of Kapaʻa ("the solid or the closing"), Kalihiwai ("Kalihi with a stream"), Anahola, and Kamalomaloʻo ("the dry loincloth"). The *mauka* border extends from the Makaleha Mountains in the south to the Anahola Mountains in the north, and includes the prominent peaks of Makaleha, Puʻu ʻEu ("rascal hill"), and Anahola. The western border of Keālia abuts the eastern boundary of Kalihiwai Ahupuaʻa and the southeastern boundary of Anahola Ahupuaʻa. Both Keiwa Ridge and Kapaʻa Stream form portions of Keālia's southern boundary, while the northern boundary generally follows the path of Kamalomaloʻo Stream. The ocean constituted the *makai* border, as it does today.

Natural features often served as boundaries within the *moku* and *ahupuaʻa*. The *ahupuaʻa* themselves were often entire valleys (Kamehameha Schools 1994:VI). Man-made features could also mark the boundaries of an *ahupuaʻa*. However, these established boundaries were not always observed. Only during the time of ʻUmi, son of the great chief Līloa, were the Hawaiian Islands divided into taxable districts: "The four *mokupuni* (larger islands) of Kauaʻi, Oʻahu, Maui, and Hawaiʻi were divided into *moku* (districts). . . For ease in collecting annual tribute the *moku* were subdivided into *ahupuaʻa*. . ." (Kamehameha Schools 1994:VI).

Ahupuaʻa were often further sub-divided into *ʻili*. *ʻIli* could consist of a single tract, be divided, or be divided and cross over *ahupuaʻa* boundaries (Kamehameha Schools 1994:VI). Contained within the natural limits of Keālia Ahupuaʻa were several *ʻili*. The *ʻili* of Keālia, as identified within Land Commission Awards (LCA) claims, were Akiana (LCA 10907), Awikiwili (LCA 10907), Haleki (LCA 7966), Haulei (LCA 8060, 1980), Hawaipahea (LCA 8060, 1980), Kaʻeleʻele (LCA 10473, 1980), Kahue (LCA 8834), Kapuna (LCA 8061), Kapunakai (LCA 3413), Kauaha (also Kanaha or Kaha) (LCA 8842), Kaukuolono (LCA 10906), Kaunakakai (LCA 10628), Kealohipaa (LCA 10149, 8060), Kuaiula (LCA 10628), Kuakahi (also Kuahaki or Makuahaki) (LCA 10473), Kulehaole (also Kulehale or Kulihaele) (LCA 8833), Mahuaku (Mahuali) (LCA 7966), Makapono (Makahono) (LCA 8842), Pauahi (LCA 10473), Puhokea (LCA 10473), and Waipunaula (LCA 08833). Waipunaaula was also identified as a fishpond within Keālia. Not explicitly designated within Keālia, but identified within nearby localities were Kapuahola (Kapuaahole) possibly an *ʻili* in Hōmaikawaʻa (LCA 10689) and Naapakukui an *ʻili* in Kumukumu (LCA 10660).

Several *wahi pana* are identified within the *kaʻao* and *moʻolelo* of Keālia. Within the *moʻolelo* of ʻAʻaka the *menehune*, ʻĀhihi Point and Hōmaikawaʻa figure prominently. It is at ʻĀhihi Point that the daring *menehune*, ʻAʻaka, has a nearly fatal encounter with a man-eating shark (Wichman 1998; see Section 3.1.5 for the Wichman version of the tale). In the Rice (1977) version of the story, ‘A‘aka goes swimming with other *menehune* at Hōmaikawa‘a. While bathing, they are nearly caught by the shark. The *menehune* swim ashore, and continue fleeing inland toward the plain known as ‘A‘aka. Led by the *menehune* ‘A‘aka, the group devises a plan to catch the shark. Utilizing the *‘āhihi* plant, ‘A‘aka and his companions weave a basket and fill it with bait. With the trap set, they capture the shark, dragging it to the reef at ‘Aliomanu, near Anahola. According to Rice, “The odor of the shark soon brought so many land and sea birds to feast upon the flesh that the reef was called A-li-o-ma-nu, Where-the-Water-is-made-still-by-the-Oil-from-the Shark, and is still known by this name. . .” (Rice 1977:44).

The *wahi pana* of Kaea is also enlivened through its association with a mythic character. This *wahi pana* is the banana grove of Palila, and was believed to be located in the *mauka* region of the Kawaihau District. Kaea is also identified in a boast by Makakuikalani, a chief of Maui,

O ka lila maia ia o Kaea,	He is the shriveled banana of Kaea,
Aole e pala i ke anahulu.	Which will not ripen in ten days.

[Fornander 1917:334–335]

The *wahi pana* of Waipahe‘e, located in the *mauka* portion of Keālia, is associated with Kaweloleimākua and Kauahoa (Wichman 1998:86). Kaweloleimākua is the fierce fighter of Kaua‘i and the opponent of Kauahoa, the handsome youthful hero of Hanalei (*Hoku o Hawaii* 1908). Kaweloleimākua’s connection to the ancient Puna District is expressed in an article published in the Hilo newspaper, *Hoku o Hawaii* on 31 December 1908,

E Kawelo-lei-makua, e pae,	O Kaweloleimakua, land,
E Kamahana a ka lapa o Puna,	O Kamahana of the ridges of Puna
Na maka o Halona iluna,	The eyes of Halona above,
Kuu haku, kuu lawaia alii o Kauai.	My lord, my fishing chief of Kauai.

[*Hoku o Hawaii* 31 December 1908]

Often contained within *oli* and *mele* are valuable descriptions of *wahi pana*. The *wahi pana* of Keālia Ahupua‘a and Kawaihau Moku are identified within a famous *oli* for the ancient Puna District. This *oli* (see Section 1.4.5) was originally recorded by Lahainaluna students conducting ethnological research in the late nineteenth century. The descriptions of Kalualihilihi, Kapalua, Kapuka, Niau, and Keahapana are particularly salient (see Section 1.4.5).

Keahapana (identified by interviewee Richard Kaui as “Keapana”), was famed for its “heavy taro” (HEN: *Kuokoa*, May 1913). In an interview conducted by CSH in 2002 (Bushnell et al. 2002), Keahapana was identified as an area located up the Keālia River, where Hawaiians continue to live, and where taro was grown until the late 1990s.

Natural geological features were also considered *wahi pana*. These natural features served as markers on the landscape but also functioned as psychic anchors, providing a “lifeline to a continuous sense of identity” (Andrade 2014:8; Relph 1976:231). In many ways, these *wahi pana* are signs of identity and signs of memory, they are “markers and makers of cultural identity” (Cipolla 2008:196). There exist notable natural features within both the *mauka* and *makai* portions of Keālia Ahupua‘a.

Among the notable natural features of Keālia Uka are the various hills and peaks that dot the uppermost reaches of the *ahupua‘a.* Included among the hills and hillocks are Pohakuomanu, Pukahulu, Moalepi (Moalepe), and Pu‘u Kinui. Pohakuomanu is the name of a low hillock in Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862). Pukahulu and Moalepi (Moalepe) are the names of *pu‘u* (hills) in the *mauka* region of Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

The cloudy peaks of Pualani, Pohakupili, and ‘Ōhi‘a belong to the *wao akua* (a distant mountain region, believed inhabited only by spirits). Sam ‘Ohukani‘ohi‘a Gon III elaborates further on the significance of high elevation places within an *ahupua‘a*,

> And when you think about high elevation places in the Hawaiian Islands, of course you have to talk about that basic dichotomy between the lower elevation places where people live.
>
> And in old times, that would have been called the Wao Kanaka. Wao being a word that means ‘zone’ and ‘Kanaka’ being a person. So the Wao Kanaka is a zone in which people belong.
>
> When you rise above that zone, you enter into a realm in which all of the living things there are not there because of human activity. They flourish as the result of the activity of the gods, or the Akua. And so that zone is called the Wao Akua. And the transition from Wao Kanaka to Wao Akua is not taken lightly. [Sam ‘Ohukani‘ohi‘a Gon III in *Na Maka o ka Aina* 2017]

Pualani, Pohakupili, and ‘Ōhi‘a are the names of mountain peaks in Keālia (Hawai‘i State Archives, Interior Department, Land, 23 June 1862). The place name Pohakupili, however, is also the name of a mountain in the larger Puna (Kawaihau) District. This peak is famed in chant as a place where clouds gather (HEN I:211–216). Pohakupili is also utilized as a landmark, “when it appears to be on the hill of Nounou,” by those fishing at the fishing ground of Limawela (HEN 1885:I:211).

Found within these mountainous regions were the *kumuwai* (headwaters of streams). As *kahawai,* they cut their path *makai*, “carving gulches, gullies, and narrow canyons, tumbling over rocky cliffs in misty waterfalls, and plucking boulders and trees from their banks during storms” (State of Hawai‘i Commission on Water Resource Management 1993:7). The Keālia Stream, in following the topography of the land, feeds ‘Ōpae Kala‘ole, a *wailele* (waterfall) located within Keālia.

The streams (including tributaries) feeding the *ahupua‘a* of Keālia included the Kapa‘a (also identified as Keālia River), the Mimino, the Hala‘ula, the Kapahi, the Makaleha, the Moalepe (also Moalepi), the Keālia, the Waipahi, the Maiaki‘i, the Wai‘awa‘awa, the Kumukumu, and the Hōmaikawa‘a (see Section 1.4.4). An additional tributary within Keālia Uka was the Opeka (Hawai‘i State Archives, Interior Department, Land, 23 June 1862).

Fresh water was an important component of ancient Hawaiian culture and lifestyle. Besides the role it played in irrigating taro terraces (and thus feeding the people), streams were understood to be the physical representation of Kāne on earth. Additionally, streams were often associated with historic sites, people, events, and/or family lineages (State of Hawai‘i Commission on Water

Resource Management 1993:5). Thus, streams and their associated features also constituted *wahi pana*.

The connection between land and sea was well understood by those living within the *ahupuaʻa*. The boundaries of the *ahupuaʻa* also included inshore fisheries, shore-side salt sources (see Section 1.4.5), and potable springs (Hommon 2013:13). Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Keālia. According to Malo, the ocean was divided into smaller divisions, stretching from *ae kai* (strip of the beach over which waves ran after they had broken) to *moana* (pelagic zone) (Malo 1951:25–26).

Resources were extracted by the people of Keālia within these various zones. Within Keālia Kai, salt was gathered (see Section 1.4.5). Moving out into the *poina kai* (area where waves break), were the localities known as Kuna ("a variety of freshwater eel") and Niau ("moving smoothly, swiftly, silently, peacefully"). Kuna is the Hawaiian name to a place referred to as "Donkey Beach" (Bushnell et al. 2002:36). Niau is the name of the northern side of Keālia Bay and location of Keālia Landing; it is also the name of a place in Puna district famed in chant for its short, breaking surf (see Section 1.4.5). On the southern end of Kuna Bay is a *pali* (seaside cliff) known as Palikū, which is noted for fishing (Bushnell et al. 2002:37). The name Palikū is also utilized to identify "Donkey Beach." While natural geographic locations such as streams, peaks, ridges, and seas were inherently sacred, particular man-made structures were also imbued with *mana* (supernatural or divine power).

Human-made structures utilized for religious purposes were also considered sacred sites or *wahi kapu*. During their expeditions around Hawaiʻi in the 1880s collecting stories from *ka poʻe kahiko* (elders), Lahainaluna students stopped in Keālia and gathered information regarding *heiau* of the region (HEN 1885). Ten *heiau* were named, suggesting Keālia as well as Kapaʻa Ahupuaʻa were probably more politically significant in ancient times. These *heiau* (spelt *haiau* by the Lahainaluna students) were identified as Pahua, Kumalae, Waiehumalama, Napuupaakai, Noemakalii, Puukoa, Piouka, Una, Mano, and Makanalimu:

3. *O Kahua ka haiau, o Kiha no ke alii, o Lukahakona no ke Kahuna.*
4. *O Kumalae ka haiau, o Kiha no ke alii, o Lukahakona ke Kahuna.*
5. *O Waiehuomalama ka haiau, o Kiha no ke alii, o Lukahakona no ke Kahuna.*
6. *O Napuupaakai ka haiau, o Kiha no ke alii, o Lukahakona no ke Kahuna.*
7. *O Naemakalii ka haiau, o keia kekahi kumu alii o Kauai nei, alike me Holoholoku.*
8. *O Puukoa kekahi haiau [He mau unu liilii]*
9. *O Piouka kekahi haiau [He mau unu liilii]*

I ka wa kahiko, oiai keia mau heiau e ku ana, hoopaapa na alii nona keia mau haiau no ka wai e kahe ana i loko o keia mau haiau, aka hoi, i ka wa i hiki mai ai ka papaa la o ka aina, pio ka wai o Piouka, nolaila, nele ia i ka wai.

10. *O Una Kekahi haiau, o Kiha no ke alii, o Lukahakona no ke Kahuna.*
11. *O Mano kekahi haiau, o Kiha no ke alii, o Lukahakona no ke Kahuna.*

Translation (by Mary Kawena Pukui):

3. Pahua was the heiau, Kiha was the chief, Lukahakona, the priest.
4. Kumalae was the heiau, Kiha was the chief, Lukahakona, the priest.
5. Waiehuomalama was the heiau, Kiha was the chief, Lukahakona, the priest.
6. Napuupaakai was the heiau, Kiha was the chief, Lukahakona, the priest.
7. Noeamakalii was the heiau, This pne was one of the heiaus for the birth of the chiefs of Kauai, like Holoholoku.
8. Puukoa was a heiau and, 9, Piouka was a heiau; they were of the small unu type. In the olden days, when these heiaus were standing the chiefs who owned heiaus quarreled over the stream that flowed through them. When drought came the water at Piouka dried up and so it had none.
10. Una was a heiau; Kiha was the chief and Lukahakona the priest.
11. Mano was a heiau, kiha was the chief, Lukahakona the priest.

[HEN 1885:214–216]

Table 1 lists the names of the *heiau*, their location if known, their type, associated chief and priest, any comments, and the reference. The exact locations of these *heiau* remain unknown.

Table 1. List of *heiau* in Keālia (source: Bushnell, Shideler, and Hammatt 2003)

Name	**Location**	**Type**	**Associated Chief/Priest**
Pahua	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Kumalae	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Waiehumalama	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Napuupaakai	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Noemakalii	Kapa‘a/Keālia	“Heiau for birth of Kauai Chiefs, like Holoholokū”	Unknown
Puukoa	Kapa‘a/Keālia	“Unu” (*heiau* for fishermen or an agricultural *heiau*)	Unknown
Piouka	Kapa‘a/Keālia	“Unu-type heiau”	Unknown
Una	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Mano	Kapa‘a/Keālia	Unknown	Kiha/ Lukahakona
Makanalimu	Upland of Kawaihau	Unknown	Kaumuali‘i

Besides the *heiau* identified by Lahainaluna students in the late nineteenth century, an additional religious site is known to exist within Keālia. Kawelomamaia Heiau, identified by Bennett as Site 112, was believed to have been located where the Kawelomamaia Stream runs into the sea north of Keālia (Bennett 1976:129). Thrum placed Kawelomamaia within Hōmaikawa‘a, and described the site as, “Kawalo’s [*sic*] heiau dedicated to his shark god; of pookanaka class. Foundations traceable” (Thrum 1907:41; see Section 3.1.5).

Heiau of *po‘okanaka* (sacrificial) classification were used ceremoniously for human sacrifices (Stokes 1991:24). Kawelo, the champion associated with this *heiau*, was also known as the “water-tailed child of Wailua,” and said to descend from a “shark family” (Green and Pukui 1936:11).

The *ali‘i* (royal) lineage of Kaua‘i is said to come from the Kawelo *‘ohana*. While there exist many versions of the Kawelo story, the Green and Pukui version of the *mo‘olelo* (as dictated to them in Hawaiian by Kaululaau) recounts this royal lineage in part,

> Mano-ka-lani-po, ruling chief of Kauai, has by his wife Ka-wai-kini a tiny son of extraordinary rank and beauty Maihuna-li‘i-iki-o-ka-poko (The little chief Maihuna) who is brought up a a foster child of the high chief Holoholoku. When the boy reaches the age to marry, a wife is sought for him over all Kauai, but since none is found of sufficient beauty, the foster father, directed by a dream, launches his wife’s magic canoe transformed out of a hibiscus blossom and is carried by favorable breezes invoked from the wind gourd of his ancestor Nahiukaka to Oahu, where he obtains the hand of Malei-a-ka-lani, a high chiefess descended from Paao, daughter of Ihiihi-lau-akea and his wife Manana and brought up by her grandmother Olomana in the Koolau mountains, and is borne back with the bride that same day, to find that his wife has already, with the help of the little Mu and Menehune people, prepared a sumptuous feast for the marriage celebration.
>
> Three sons are born to the two at Wailua, each birth preceded by a pregnancy craving satisfied only by the little Menehune people, who bring ice from the mountains of Hawaii, awa planted by the birds at Panaewa, honey from the mingled blossoms of lehua and pandanus to be found only on Hawaii. Kawelo is the eldest born, Kamalama the second, Ka-lau-maki the third. The boys are brought up under tapu and not allowed to play with other boys. . . [Green and Pukui in Beckwith 1970:405]

Several older, traditional place names were repurposed in the historic period; among these were Hala‘ula, Kalualihilihi, and Kumukumu. Hala‘ula (“the red pandanus”) is a place name often associated with the Hanalei and Kawaihau Districts (Soehren 2002:12; Pukui et al. 1974:36). This traditional name was given to a historic plantation camp associated with Makee Sugar Company at Keālia. Hala‘ula (see Figure 1) is also the name of the reservoir located north of the current project area.

Kalualihilihi, originally understood as the name of a fishing ground in Puna district (HEN 1885:215), was later used to identify the area where Krull Dairy was once located. The Krull Dairy, established in Keālia Uka in the mid-1800s, “extended westward from the area where the Spalding Monument would later be built to nearly the vicinity of the Waipahee Slippery Slide” (Kapa‘a Elementary School 1983; Soboleski 2014).

Kumukumu is currently associated with the Kawaihau district, but may have possibly been an old *ahupuaʻa* name in the ancient Puna District. According to a ten-page reminiscence of Keālia, Kumukumu means "to cut short roots or a stump" (Kauaʻi Historical Society n.d.). The name "Kumukumu" was also given to a historic plantation camp associated with Makee Sugar Company at Keālia, located in the northwest corner of the project area (see Figure 1 and Figure 11). As seen in Figure 1, Kumukumu is also the name of a stream north of the project area.

3.3 *ʻŌlelo Noʻeau* (Proverbs)

Hawaiian knowledge was shared by way of oral histories. Indeed, one's *leo* (voice) is oftentimes presented as *hoʻokupu* ("to cause growth," a gift given to convey appreciation, to strengthen bonds); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional Hawaiian "aesthetic, historic, and educational values" (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawaiʻi and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawaiʻi, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *ʻōlelo noʻeau* may be understood as proverbs. The Webster dictionary notes it as "a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation." It is a pithy or short form of folk wisdom. Pukui equates proverbs as a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *ʻāina* (land), chiefs, plants, and places. The following proverbs concerning Keālia come from Mary Kawena Pukui's *ʻŌlelo Noʻeau* (Pukui 1983).

3.3.1 *ʻŌlelo Noʻeau* #645

> *He ʻiwa hoʻohaehae nāulu.*
>
> An *ʻiwa* that teases the rain clouds.
>
> A beautiful maiden or handsome youth who rouses jealous envy in others. [Pukui 1983:73]

The Nāulu rain, as referenced in the above *ʻōlelo noʻeau*, is a known rain of Keālia, Kauaʻi.

3.3.2 *ʻŌlelo Noʻeau* #744

> *Hele ka hoʻi a hiki i Kealia, ua napoʻo ka lā.*

When one reaches Kealia at last, the sun is set.

Said of one who procrastinates. A play on *alia* (to wait). [Pukui 1983:82]

3.3.3 *ʻŌlelo Noʻeau* #1121

Huʻe a kaua, moe i ke awakea.

A battle attack, then sleep at midday.

The sleep of death. When Kawelo fought Kauahoa, the latter uttered this meaning that he would fight back until his opponent was dead. [Pukui 1983:120]

As Kawelo fought Kauahoa, he implored him to recall fond memories shared together at the *wahi pana* of Waipaheʻe in Keālia. Kawelo's attempts to recall their boyhood excursions together were futile, however, as Kauahoa swore to fight to the death.

3.3.4 *ʻŌlelo Noʻeau* #1347

Ka iʻa kaʻa poepoe o Kalapana, ʻīnaʻi ʻuala o Kaimū.

The round, rolling fish of Kalapana, to be eaten with sweet potato of Kaimū.

The *kukui* nut, cooked and eaten as a relish. This is from a *hoʻopāpā* riddling chant in the story of Kaipalaoa, a boy of Puna, Hawaiʻi, who went to Kauaʻi to riddle with the experts there and won. [Pukui 1983:147]

This *ʻōlelo noʻeau* recalls the *kaʻao* of *Kaipalaoa, ke Keiki Hoopapa*. On his way to battle wits with the *hoʻopāpā* experts of Kauaʻi, Kaipalaoa passes through the *ahupuaʻa* of Keālia.

3.3.5 *ʻŌlelo Noʻeau* #1450

Ka lulu o Moikeha i ka laulā o Kapaʻa.

The calm of Moikeha in the breadth of Kapaʻa.

The chief Moikeha enjoyed the peace of Kapaʻa, Kauaʻi, the place he chose as his permanent home. [Pukui 1983:157]

Kapaʻa was the home of the *aliʻi*, Moʻikeha. Although born on Hawaiʻi Island, Moʻikeha sailed back to Kahiki (Tahiti), the home of his grandfather Maweke. After a period, Moʻikeha sailed back to Hawaiʻi, establishing his permanent home at Kapaʻa. Some time later, Kila, the son of Moʻikeha travels back to Kahiki, seeking out his grandfather Maweke. When Maweke inquires as to how Moʻikeha is enjoying his new home, Kila offers a chant. Kila's *oli* describes the lands of Keālia, including the heavy taros of Keahapana and the crooked surf of Makaiwa (see Section 3.4.1).

3.3.6 *ʻŌlelo Noʻeau* #1488

Ka moku kāʻili lā o Manokalanipo.

The sun-snatching island of Manokalanipo.

Kauaʻi, the northwesternmost island of the group, beyond which the sun vanishes at dusk. Manokalanipo was an ancient ruler of Kauaʻi. [Pukui 1983:161]

Begotten from the union of Manokalanipo and Kawaikini, was chief Maihuna. When the young chief was of age to marry, the hand of Maleiakalani, descendant of Paʻao, was sought. From the union of Maihuna and Maleiakalani, Kawelo was born. Various *moʻolelo* illuminate Kawelo's connection to Keālia, Kauaʻi.

3.3.7 *ʻŌlelo Noʻeau* #1523

> *Kāpae ke kaua e ka hoahānau.*
>
> Let kinsman cease fighting each other.
>
> Said by Kawelo to his opponent and kinsman, Kauahoa. [Pukui 1983:164]

This *ʻōlelo noʻeau* once again recalls the *moʻolelo* of Kawelo and Kauahoa at Waipaheʻe Falls. Kawelo's attempts to cease battle with his kinsman, Kauahoa (see Section 3.1.3) is evidenced within the proverb above.

3.4 *Oli* (Chant)

Oli, according to Mary Kawena Pukui (Pukui 1995:xvi–xvii), are often grouped according to content. Chants often were imbued with *mana* (spiritual power); such *mana* was made manifest through the use of themes and *kaona*. According to Pukui, chants for the gods (prayers) came first, and chants for the *aliʻi*, "the descendants of the gods," came second in significance. Chants "concerning the activities of the earth peopled by common humans," were last in this hierarchy (Pukui 1995:xvi–xvii). Emerson conversely states,

> In its most familiar form the Hawaiians—many of whom [were lyrical masters]—used the oli not only for the songful expression of joy and affection, but as the vehicle of humorous or sarcastic narrative in the entertainment of their comrades. The dividing line, then, between the oli and those other weightier forms of the mele, the inoa, the kanikau (threnody), the pule, and that unnamed variety of mele in which the poet dealt with historic or mythologic subjects, is to be found almost wholly in the mood of the singer. [Emerson 1965:254]

While *oli* may vary thematically, subject to the perspective of the *hoʻopaʻa* (chanter), it was undoubtedly a valued art form used to preserve oral histories, genealogies, and traditions, to recall special places and events, and to offer prayers to *akua* (gods) and *ʻaumākua* (family gods) alike. Although *oli* often underpins religious practice, it also ". . . created a mystic beauty . . . confirming the special feeling for the environment among Hawaiians: their *one hānau* (birthplace), their *kula iwi* (land of their ancestors) (Alameida 1993:26)"

3.4.1 Chant of Puna

Adjacent to Keālia was the *ahupuaʻa* of Kapaʻa. Both Kapaʻa and Keālia belonged to the ancient Puna District. Kapaʻa was also the home of the legendary *aliʻi*, Moʻikeha. Moʻikeha's love for Kapaʻa Ahupuaʻa and the greater Puna Moku is recalled in *ʻōlelo noʻeau* #1450, "*Ka lulu o Moikeha i ka laulā o Kapaʻa* (The calm of Moikeha in the breadth of Kapaʻa)."

Born at Waipiʻo on the island of Hawaiʻi, Moʻikeha sailed to Kahiki (Tahiti), the home of his grandfather Māweke, after a disastrous flood. On his return to Hawaiʻi, he settled at Kapaʻa, Kauaʻi. Moʻikeha's subsequent union with the Kauaʻi chiefess Hoʻoipoikamalani, begot three sons. Of these three boys, Kila was his favorite. Inevitably, Kila was sent back to Kahiki by his father Moʻikeha. His mission was to slay his father's old enemies and retrieve a foster son, the high chief Laʻamaikahiki (Handy and Handy 1972:424; Beckwith 1970:352–358; Kalakaua 1888:130–135; Fornander 1916:4(1):160).

Akina (1913) elaborates further on this favorite son, telling the story of how Kila stocked the islands with *akule* (big-eye scad; *Selar crumenophthalmus*), *kawakawa* (mackerel tuna; *Euthynnus affinis*) and *ʻopelu* (mackerel scad; *Decapterus macarellus*) fish. When Kila finally reached Kahiki, he sought out Māweke. He reveals to Māweke that he is in fact the child of Moʻikeha, and thus the great-grandchild of Māweke. When Māweke asks Kila if Moʻikeha is enjoying himself, Kila answers with the following chant of Puna:

> My father enjoys the billowing clouds over Pohaku-pili,
>
> The sticky and delicious poi,
>
> With the fish brought from Puna,
>
> The broad-backed shrimp of Kapalua,
>
> The dark-backed shrimp of Pohakuhapai,
>
> The potent awa root of Maiakii,
>
> The breadfruit laid in the embers at Makialo,
>
> The large heavy taros of Keahapana
>
> The crooked surf of Makaiwa too
>
> The bending hither and thither of the reed and rush blossoms,
>
> The swaying of the kalukalu grasses of Puna
>
> The large, plump, private parts of my mothers,
>
> Of Hooipoikamalani and Hinau-u,
>
> The sun that rises and sets,
>
> He enjoys himself on Kauai,
>
> All of Kauai is Moikeha's.
>
> [Akina 1913:6]

Māweke is delighted, and when the boy is questioned as to his purpose, Kila tells his great-grandfather he is seeking fish for his family. Māweke tells Kila to lead the fish back to his homeland. This is how Kila led the *akule, kawakawa,* and *ʻopelu* to Hawaiʻi.

This chant shares many similarities to the *oli* recounted to Lahainaluna students in the late 1800s (see Section 1.4.5). The Lahainaluna students, however, do not attribute this chant to Prince Kila, nor do they relate any *moʻolelo* connected to Māweke, Moʻikeha, and/or Kila.

3.5 *Mele* (Song)

There exist a few *mele* that concern or mention Keālia and/or Kawaihau (Puna) Moku. These particular *mele* may also be classified as *mele wahi pana* (songs for legendary or historic places). *Mele wahi pana* such as those presented here may or may not be accompanied by *hula* (dance) or *hula wahi pana* (dance for legendary or historic places). As the Hula Preservation Society notes,

> Hula Wahi Pana comprise a large class of dances that honor places of such emotional, spiritual, historical, or cultural significance that chants were composed for them. Only the composers of the chants could know the deepest meanings, as they would be reflections of their feelings and experiences . . . Since the subjects of Wahi Pana compositions are extremely varied, their implementation through hula are as well. Coupled with the differences from one hula style and tradition to the next, Hula Wahi Pana can be exceptionally diverse. They can be done sitting or standing, with limited body movement or wide free movement; with or without the use of implements or instruments; with the dancers themselves chanting and/or playing an implement or being accompanied by the *hoʻopaʻa* [drummer and *hula* chanter (memorizer)]. Beyond the particular hula tradition, what ultimately determines the manner in which a Hula Wahi Pana is performed are the specific place involved, why it is significant, the story being shared about it, and its importance in the composer's view. [Hula Preservation Society 2014]

3.5.1 Waipaheʻe (Slippery Water)

This *mele* was composed by James Von Ekekela. Inspired by a bass voice within a (unnamed) quartet, the *haku mele* (composer), Von Ekekela wrote this song specifically for the group (Huapala n.d.). The *mele* speaks of the lovely freshness of Keālia, its slippery slide, as well as the freshwater shrimps or *ʻōpae* known to populate its *mauka* streams.

Hoʻoihihi kani manaʻo	One's mind is fascinated
I ka uʻi nohea o Kealia	By the lovely freshness of Kealia
Ia uʻi e walea ana	Loveliness to enjoy
I ka nani aʻo Waipaheʻe	In the beauty of Waipaheʻe
Hui:	Chorus:
E he he he he he	A ha ha ha ha ha
E pakika, e paheʻe	Slip, slide
Kahi wai kili ʻopu	That waterfall for diving feet first
Kahi wai kili ʻopu	That waterfall for diving feet first
Aʻo Waipaheʻe	Waipaheʻe
Na ʻopae kua hāuli	The black freshwater shrimp
ʻOʻo pohaku no Hapai	Stone digging tools from Hapai
Me na uhi mālelehu	With the twilight mist
ʻIhiʻihi aʻo Makiala	Reverenced is Makiala

[Huapala n.d.]

3.5.2 Lanakila Kawaihau

This *mele*, composed in 1903 by Mekia Kealaka‘i, celebrated the political victory of Colonel Samuel Parker and Prince Jonah Kūhiō Kalaniana‘ole. The district of Kawaihau is mentioned metaphorically throughout the song. There have been different interpretations of the song over the years. Mary Kawena Pukui details the origination of "Kawaihau," explaining that during the reign of King David Kalākaua, a *haole* (foreign) woman would often visit the court. During her visits, she was offered refreshment, usually an alcoholic beverage. Refusing the "strong beverage," she would then request ice water (Huapala n.d.). As a result, she was given the nickname Ka Wahine Kawaihau (Huapala n.d.):

> The ice water, "Kawaihau," became an inside joke and was used as the name of the club of young men who supported the King. There were 15 members of this choral club of which Prince Leleiohoku, the King's younger brother, was also a member. The hui refers to the singing landshells whose song is most beautiful just before dawn. [Huapala n.d.]

The *hui* (group), with the help of Captain James Makee, would later attempt to establish a large scale sugar corporation on the east side of Kaua‘i. Makee's son-in-law, Colonel Zephaniah Swift Spalding would later take on operations and establish a sugar mill at Keālia.

Ke lei nei ko lei nani	Your beautiful lei adorns you
A ke onaona e hea mai nei	Whose sweetness beckons
Walea ana i ka inu wai	Delighting in a sip of water
A he ‘ai ha‘aheo no Kawaihau	And it's a proud win for Kawaihau
Hui:	Chorus:
Inu i ka wai māpuna	Drink of the spring water
Ha‘aheo i ko lei lehua	Proud in your lehua lei
A he leo no pūpū kani oe	Land shells trill the refrain
Ua lanakila ‘o Kawaihau	Kawaihau is victorious
Nohenohea ia mau pua	Those blossoms are so handsome
A he kumu o ke ‘ala	And a source of sweet perfume
A na‘u na ke onaona	And it was I, the charming one
I ho‘okani ke kaula kia	Who made the reins sing

[Wilcox et al. 2003:145]

Other explanations of the *mele* have focused heavily upon the political victory of Prince Jonah Kūhiō. Prince Kūhiō's victory is compared to the sweetness of Kawaihau, Kaua‘i. Just as Kawaihau is the source for the sweet fragrance, Jonah Kūhiō ("the charming one") is the reason for the accolades, he is the source, the individual responsible for the great political victory (Huapala n.d.).

3.5.3 Hula o Makee

According to Wilcox et al. (2003), the following *mele* tells "the true story of the foundering of the ship *Makee* (pronounced "Makī")" in the waters off of Keālia. The wreck was soon discovered by another ship, the *Malulani*. Alerted by a whistle from the *Malulani*, *kamaʻāina* within this portion of coastal Kawaihau reacted quickly, launching a full-scale rescue mission. The wreck of the *Makee* was steered off the reef by Hailama, a well-known steersman and fisherman from Haʻena (Wilcox et al. 2003:79). However, damages to the ship were so severe that it sank soon after its removal from the reef.

This *mele* is also believed to be rich with *kaona* (hidden meanings), more specifically, there may be suggestions of love, illicit love, and love lost within the lyrics (Wilcox et al. 2003:79).

According to Wilcox et al. (2003),

> An event like this would inspire composers, and indeed several versions and attributions exist, providing a good example of oral tradition and its influence on Hawaiian song as a collaborative process. Two versions were published in 1903, one attributed to James Kaʻopuiki and the other, longer version, unattributed. A slightly different version in Nā Mele o Hawaiʻi Nei, in which the Makee founders off Kapaʻa, is not attributed, but the Huapala website credits that version to William S. Ellis. Linda Sproat was told by her grandmother, Julia Akana, that Amy Hobbs Mahikoa from Kalihiwai wrote this song. [Wilcox et al. 2003:79]

Historical accounts, however, place the sinking of the *Makee* in the waters off Kapaʻa. According to an article published in the *Ka Makaʻāinana* on 4 January 1897, the *Malulani* accompanied the *Makee* (damaged but still sailable) into Kapaʻa:

> Po Poakolu iho la, i ka mokumahu Kimo Maki ma Kapaa, Kauai, i ka wa a ka makani oolea e pa ana i o kakou nei a me Laila pu, ua puhiia aku oia no kula oiai pae oia e hoao ana o hoopuka iwaho. No elua ona hora i paa ai a iloko o ia manawa, ua pau kona ukaua i ka hue ia a ua hiki aku ka Malulani e kokua iaia. I ka nanaia ana o lalo ae, ua ikeia ua lilo aku kahi wahi o ke kila, elua kuli a me kekahi kua o mua i owa, a ua puka ae o lalo ona he ekolu paha kapuai malalo aku o ka ilikai i ke kumu o ka heleuma. Ua ukali mai ka Malulani iaia a hoea mai la lanei i kakahiaka Poalima iho nei. E hookauia aku ana oia iluna o ke ala hukimoku. [*Ka Makaʻāinana*, 4 January 1897:8]

> Tuesday Night past, when the steamship James Makee was in Kapaʻa, Kauaʻi, while the strong winds were blowing upon us and there as well, it was blown towards land while it attempted to head out to sea. It was stuck for two hours, and during this time, its cargo was unloaded, and the Malulani arrived to give assistance. Looking from the underside, it was seen that part of its keel [kila] was lost, two knees [kuli] and one beam [kua] at the stem were split, and there was a hole underneath, perhaps three feet below sea level at the base of the anchor. The Malulani accompanied it until arriving here in the morning of this past Friday. It will be placed atop the marine railway. [Translation by Huapala n.d.]

The *Ka Makaʻāinana* article may have also influenced the *mele*, Hula o Makee. The *mele* below, however, places the foundering of the Makee in the waters off of Keālia.

‘Auhea iho nei lā ‘o Makee?	Where has the Makee gone?
A ka Malulani lā e huli hele nei	The Malulani looks everywhere
Eia ‘o Makee kaha i ka pa‘a	Here’s the Makee, sweeping in to become stuck
Ka waiho kapakahi i ka ‘āpapa	Left keeled over on the reef
‘O ke kani honehone a ke oeoe	Softly sounds the alarm
A e ha‘i mai ana lā i ka lono	Telling the news to be heard
‘O ka hola ‘umi ia o ke aumoe	It’s ten o’clock at night
Kā‘alo Malulani ma waho pono	The Malulani passes by, just outside
Kū mai Hailama pa‘a i ka hoe	Hailama stands and grasps the paddle
I mua a i hope ke kūlana nei	The ship rocks forward and back
A he e‘e kakeke mai nei au	And I’m a slip-sliding passenger
No nēia ‘oneki nui ākea	On this great, wide deck
Ākea ka moana nou e Makee	The ocean is too broad for you, Makee
Ma ke kai holuholu o ka ‘Ie‘ie	And the rolling seas of ‘Ie‘ie channel
Ha‘ina ‘ia mai ana ka puana	Tell the refrain
‘Auhea iho nei lā ‘o Makee	Where has the Makee gone?

[Wilcox et al. 2003:79]

3.5.4 Kealia

Composed by Patrick Cockett, this *mele ‘auana* recalls Keālia’s plantation days. A brief description of the song is contained within the liner notes for Keola Beamer’s *Wooden Boat* album (1994). Beamer identifies Keālia as a “small valley on the outskirts of Kapa‘a” (Beamer 1994). The notes explain that a visitor to Keālia might see only a peaceful, rural community and quickly assume the locality has been such for generations. However, Beamer points out that “a hundred years ago, the valley was exploding with the industrial revolution and sugar cane” (Beamer 1994). The *mele* serves as a reflection on the passage of time and the many changes that Keālia Ahupua‘a has witnessed over the years. As a reflection of the past, Beamer’s arrangement of the composition is sweet and tender; he further notes the “dream quality pervades like ‘leaves blowing softly in the wind’” (Beamer 1994).

Kealia. . . all the years are passing by and now you’re sleeping

you lay dreaming.

Kealia. . . all the people that you knew, almost forgotten

In your lullaby of hill and winding stream

Memories like leaves will drift away

and I will feel your soft caress. . . all of my days

Far away, it seems so far away
far away. . .

Can you hear the voices calling your name
from the time the century turned to sugar cane.

Kealia. . . all the years are passing by and now you're sleeping you lay dreaming
Kealia. . . all the people that you knew, almost forgotten
in your lullaby of hill and winding stream
Memories like leaves will drift away
and I will feel your soft caress. . . all of my days
Far away, it seems so far away
Far away, it seems so far away
far away. . .
(repeat)
[Beamer 1994]

3.5.5 Waipahe‘e Falls

The following jubilant ditty, recorded by Israel Kamakawiwo‘ole and The Makaha Sons of Ni‘ihau, was included within their *Unforgettable* album (2008). This *mele* fondly recalls a day spent at the *wahi pana* known as Waipahe‘e Falls. The falls, also known as Kaua‘i's slippery slide, are located within Keālia Uka.

Hike a trail along the mountainside,
There you'll find Kauai's slippery slide,
Waipahe‘e, Waipahe‘e Falls,
Can you hear rushing waters?
Near the valley down below,
Does the sky see the clouds?
In Waipahe‘e Falls

Chorus:
There she stood with the sun shining up on her,
Children laughing all day as they slide all the way,
Hear the laughter in the air,
Birds sing everywhere,
Waipahe‘e, Waipahe‘e Falls

Feel the breeze of the wind,
And your heart it starts to sing,
Touch the leaves wet with dew,
Rain falling through,
As I leave behind this precious land,
I'll remember how she stood so grand,
Waipahe‘e, Waipahe‘e Falls

(Repeat Chorus)
Waipahe‘e, Waipahe‘e Falls.
[Kamakawiwo‘ole and The Makaha Sons of Ni‘ihau 2008]

Section 4 Traditional and Historical Accounts of Keālia

4.1 Pre-Contact to Early 1800s

Captain George Vancouver, sailing off the east coast of Kauaʻi during his third voyage to the Hawaiian Islands in 1793, proclaimed it the "most fertile and pleasant district of the island." Vancouver only confirmed the qualities that must have much earlier attracted the Hawaiians living within the *ahupuaʻa* of that coast. Wailua Ahupuaʻa, where its river enters the sea, was home to the island's high chiefs. Kapaʻa Ahupuaʻa, north of Wailua, "in legendary history . . . is famous as the home of the great *aliʻi* Moikeha who lived there in his later years" (Handy and Handy 1972:424). Hanalei Ahupuaʻa, further northwest, was celebrated in numerous legends. The *ahupuaʻa* of Keālia, though located amidst these residences of the *aliʻi* and legendary places, did not attain a similar repute.

While traditional sources record little about Keālia Ahupuaʻa during the years preceding Western Contact in the late eighteenth century, the presence of *loʻi* and terraces on wide flats suggest it could have supported a stable population.

The earliest written documentation of life in the *ahupuaʻa* appears in the 1830s when missionary censuses recorded a total population of 283, comprising 265 adults and 18 children within Keālia (Schmitt 1973:25). Other Protestant missionary records focused more specifically on areas where mission stations were established. An 1847 census of 23 land divisions in the Hanalei and Kawaihau districts gives population figures for Keālia (Schmitt 1969). Most notable is the decline in population in Keālia, from 283 in the 1830s to 143, a reduction of almost half (Schmitt 1969:229). Accounting for the high death toll caused by the introduction of foreign disease, this still seems like an extremely high death rate. A population distribution map by Coulter (1931) (Figure 12) indicates the population of Kauaʻi ca. 1853 "was concentrated chiefly on the lower flood plains and delta plains of rivers where wet land taro was raised on the rich alluvial soil" (Coulter 1971:14).

Although most of the historic documents for Kauaʻi in this period revolve around missionary activities and the missions themselves, there was indication the Kapaʻa area was being considered for new sugarcane experiments, similar to those occurring in Kōloa. In a historic move, Ladd and Company received a 50-year lease on land in Kōloa from Kamehameha III and Kauaʻi Governor Kaikioʻewa of Kauaʻi. The terms of the lease gave the new sugar company "the right of someone other than a chief to control land" and had profound effects on "traditional notions of land tenure dominated by the chiefly hierarchy" (Donohugh 2001:88). In 1837, a very similar lease with similar terms was granted to Wilama Ferani, a merchant and U.S. citizen based in Honolulu (Hawaiʻi State Archives, Interior Department, Letters, August 1837). The lease was granted by Kauikeaouli (Kamehameha III) for the lands of Kapaʻa, Keālia, and Waipouli for 20 years for the following purpose:

> [F]or the cultivation of sugar cane and anything else that may grow on said land, with all of the right for some place to graze animals, and the forest land above to the top of the mountains and the people who are living on said lands, it is to them whether they stay or not, and if they stay, it shall be as follows: They may cultivate the land according to the instructions of Wilama Ferani and his heirs and those he

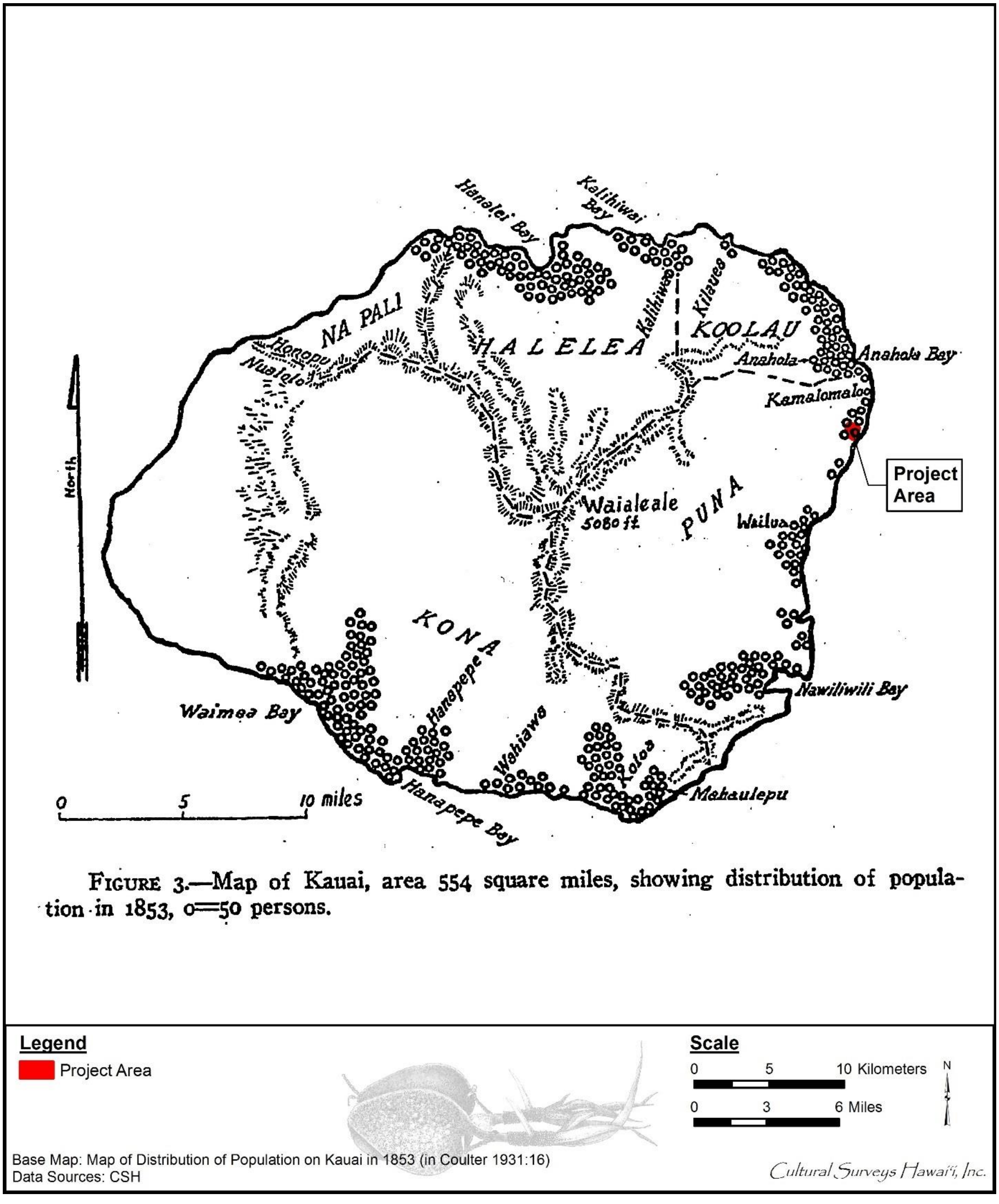


Figure 12. Map showing population estimate for Kaua'i in 1853 (Coulter 1931:16) and the location of the project area

> may designate under him. [Hawaiʻi State Archives, Interior Department, Letters, August 1837]

Unlike Ladd & Company, which eventually became the Koloa Sugar Company, there is no further reference to Wilama Ferani and his lease for lands in Kapaʻa, Keālia, and Waipouli. In a brief search for information on Honolulu merchant Wilama Ferani, nothing was found. It is thought that perhaps Wilama Ferani may be another name for William French, a well-known Honolulu merchant who is documented as having experimented with grinding sugarcane in Waimea, Kauaʻi at about the same time the 1837 lease for lands in Kapaʻa, Keālia, and Waipouli was signed (Joesting 1984:152).

In 1849, William P. Alexander, son of a Waiʻoli missionary, recorded a trip he took around Kauaʻi. Although he focuses on the larger mission settlements like Kōloa and Hanalei, he does mention Keālia.

> A few miles from Wailua, near Kapaa we passed the wreck of a schooner on the beach, which once belonged to Capt. Bernard. It was driven in a gale over the reef, and up on the beach, where it now lies. A few miles further we arrived at Keālia. We had some difficulty crossing the river at this place, owing to the restiveness of our horses. The country here near the shore was rather uninviting, except the valley which always contained streams of water. [Alexander 1991:123]

One of the first people to succeed in business in the Keālia area was a German by the name of Ernest Krull.

In 1854, a government survey was prepared for Kumukumu, Kauaʻi. In handwritten notes of the map, it is indicated that Mr. Krull desired to buy government interest to the land for $200.00. Apparently, Mr. Krull was successful in obtaining Kumukumu because by the early 1860s, he was running a thriving business supplying whaling ships with beef and dairy products (Joesting 1984:171). Mr. Krull's ranch and dairy were located in the Waipaheʻe area of Kumukumu in a place called Kalualihilihi (Kapaʻa Elementary School 1983:4). By 1870, Krull apparently had purchased the entire *ahupuaʻa* of Keālia. In a 22 July 1870 petition to the Commissioner of Boundaries for the Fourth Judicial District, Island of Kauaʻi, Krull states "he is the owner and in possession of the ahupuaas of lands called Kealia Halaaula & Komaikawaa" (Boundary Commission, Kauai:1:ll). *The ahupuaʻa* boundaries were decided by the Commissioner on 5 December 1870. The only man-made features noted in the decision were along the Keālia/Kamalomaloʻo boundary—the "Kealia auwai" and the "old mountain road into the forest." His residence also served as a rest stop for travelers during the 1860s (Lydgate 1991:142). Mr. Krull continued to lease a portion of the tablelands above Keālia until 1876 when he sold his ranch to Colonel Z.S. Spalding and Captain James Makee (Hawaiʻi State Archives, Interior Department, Letters, 1879; Kapaʻa Elementary School 1983:4).

Krull was one of a growing number of Germans settling on Kauaʻi in the nineteenth century. ("Of the approximately 1,200 German immigrants to come to the Islands by 1897, all but about 290 went to Kauai" [Joesting 1984:226]). In the 1850s, Hoffschlaeger and Company, a Honolulu firm established by German entrepreneurs, began ranching operations at Wailua (see Figure 14). The company also installed a cotton mill at Hanamāʻulu and, in 1864, sent August Conradt to Keālia to set up a cotton plantation and mill there. The venture was short-lived:

> . . . the absence of marked seasonal changes in the climate and the prodigal hand of Nature in this mid-ocean paradise produced a wealth of blossoms simultaneously mingled with ripe cotton bolls themselves. Picking the mature crop involved destruction to these young blossoms, and harvesting became, therefore, an exceedingly expensive process. The southern states, moreover, were not long in recovering their position as cotton producers after the Civil War, and the market price dropped too low to make it profitable at this geographical distance. [Damon 1931:376]

4.2 Mid-to Late 1800s and the Māhele

The depopulation of Keālia, however, was not total and the *ahupuaʻa* continued to sustain Hawaiians living traditionally into the mid-nineteenth century. Many of these families continued to carry out traditional agricultural and aquacultural practices. Land Commission Award records associated with the Māhele show that awardees continued to maintain fishponds and irrigated and dryland agricultural plots, though on a greatly reduced scale than had been possible previously with adequate manpower.

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *aliʻi* received their land titles. The *makaʻāinana* began to receive their *kuleana* awards (individual land parcels) in 1850. Although many Hawaiians did not submit or follow through or were not granted the claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns of residence and agriculture probably had existed for centuries past. By examining the patterns of *kuleana* (commoner) LCA parcels in the vicinity of the survey area, insight can be gained to the likely intensity and nature of Hawaiian activity in the area (Chinen 1958:8–12).

Keālia was granted to the *aliʻi* Miriam Keʻahikuni Kekauʻonohi (LCA 11216; Royal Patent 6071). Kekauʻonohi was a granddaughter of Kamehameha, one of Liholiho's wives, and served as Kauaʻi governor from 1842 to 1844.

Eighteen *kuleana* land claims were made (Table 2 and Figure 13). One claimant, Lono (LCA 09973) relinquished his Keālia land to the *konohiki* (land supervisor) and went to live in Waiʻoli. Of the 17 claims registered, 15 were awarded. The great majority of claims were made on lands adjacent to Kapaʻa Stream (also called Keālia River), a good-sized stream capable of supporting large-scale irrigation projects. Other *kuleana* lands were situated adjacent to smaller streams or *ʻauwai* (ditch) north of Kapaʻa Stream. Sixty-seven cultivated *loʻi* (taro terrace) are claimed in the *kuleana*, with reference to numerous uncultivated *loʻi* and boundaries of other cultivated *loʻi* that were not claimed. In the Māhele documents, individual *loʻi* are referred to with their personal names in ten instances. Two ditches or *ʻauwai* are recorded, Kaauwaelalo (LCA 01980) and Kahaukua (LCA 10148). Keālia River and Keahapuna (Keahapana; also Keapana) River were also named as boundaries, although they may refer to the same river. This information suggests taro farming continued to be central to Keālia. In addition, four *kōʻele* (land cultivated by the tenant for a local chief) are named in the Keālia documents. This suggests the *konohiki* of Keālia maintained a fair amount of power and played an active role in land and water distribution even as population was declining and foreign powers were beginning to trickle in.

Table 2. Keālia Ahupuaʻa Land Commission Awards

LCA	Claimant	*ʻIli*	Claims	Award
01980	Puali	Haulei, Kaeleele	House lot, four *loʻi*, *kula*	One parcel
02381	Kekoowai		Five *loʻi*, two ponds, two orange trees, one *kahe ʻoʻopu* (fish trap), *kula* (pasture)	Not awarded
03413	Kaaki	Kapunakai	House lot, *kula*, 11 *loʻi*, two orange trees	One parcel
07966	Keaonui and Paekaia	Mahuaku, Haleki	Five *loʻi*, *kula*, house lot	One parcel
08060	Hulialo	Haulei, Kalohipa	House lot, two *loʻi*, *kula*	One parcel
08833	Kiaipa	Waipunaula, Kiohale	Five *loʻi*, *kula*, house lot	Two parcels
08834	Kalawaia	Lapanui, Kahue	House lot, two *loʻi*, *kula*	Two parcels
08842	Kaawapupuole	Kauaha, Makapono	House lot, four *loʻi*, *kula*	Two parcels
08061	Hainau	Kapuna	House lot, four *loʻi*, *kula*	One parcel
09973	Lono		*Loʻi* and *kula*	Relinquished land to *konohiki*
10148	Mamaki	Lapanui	House lot, two *loʻi*, *kula*	Two parcels
10149	Makuahine	Kealohipaa	Three *loʻi*, *kula*	One parcel
10451	Naawa		Ten *kihapai* (garden), goat enclosure	not awarded
10473	Nahi	Pauahi, Kuakahi, Kaeleele	House lot, 15 *loʻi*, *kula*, orange trees	Three parcels
10628	Puhi	Kaunakakai, Kuaiula	House lot, one *loʻi*	Two parcels
10906	Umiumi	Kaukuolono	*House lot, two loʻi, kula*	Two parcels
10907	Umiumi	Akiana, Hawaipahea, Awikiwili	Two *loʻi*, one *kula,* house lot	Two parcels
11216 K	Kekauonohi	Keālia Ahupuaʻa		6,500 acres

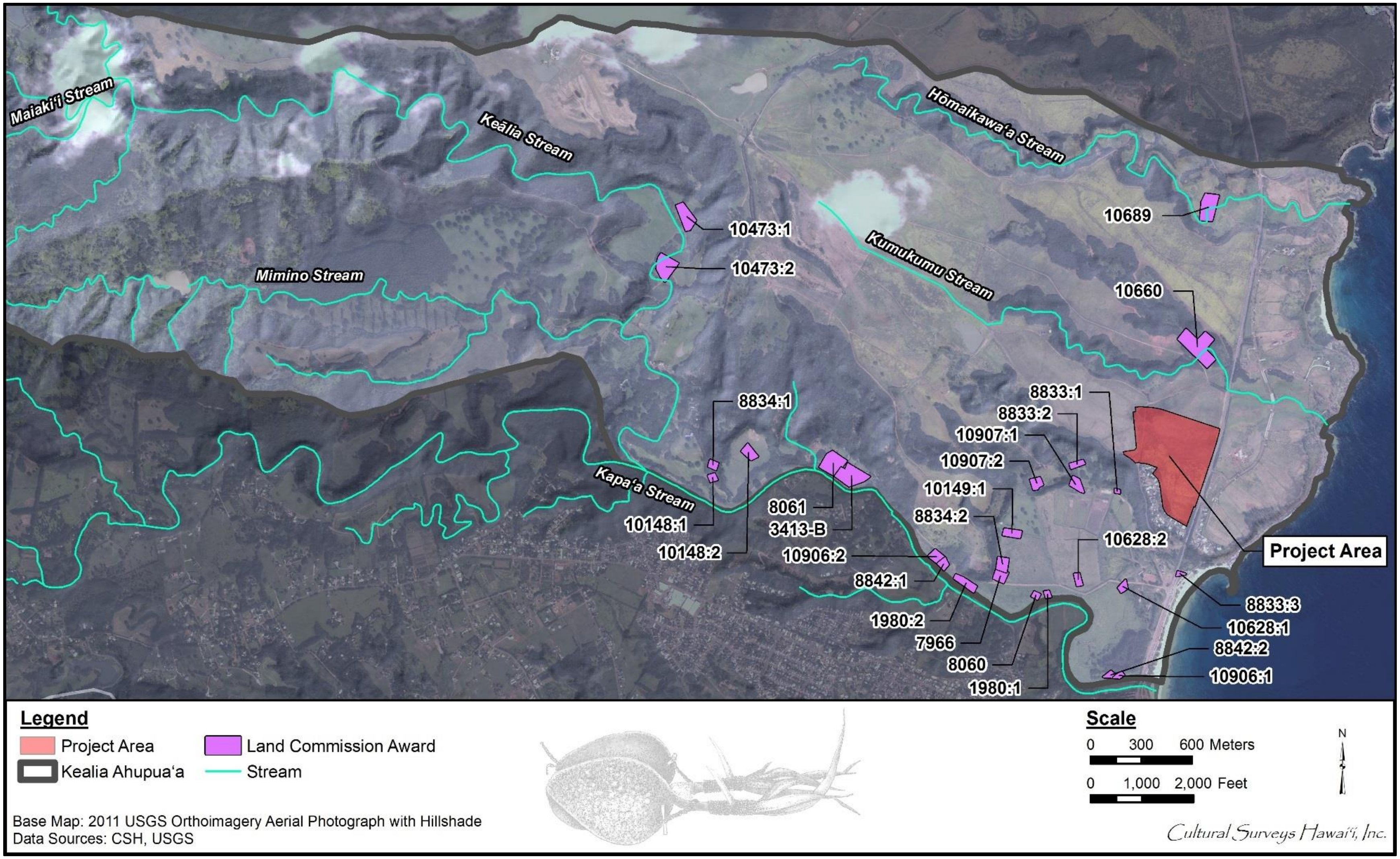


Figure 13. 2011 aerial photo (USGS Orthoimagery) showing LCA parcels in the *ahupua'a* of Keālia

Another noteworthy resource in Keālia were ponds or *loko*. Four ponds were mentioned, though no reference to location is given for two. Akiana Pond (LCA 8060) is thought to be in the *‘ili* of Akiana and Loko Waipunaula (LCA 8833) is thought to be in Waipunaula ‘Ili. In addition to the fishponds providing fresh fish, the Keālia records indicate freshwater fish were also caught in the rivers and streams. One individual claims a *kahe ‘o‘opu* or *‘o‘opu* fish trap (LCA 2381). Māhele documents for Keālia indicate people were raising turkeys, goats, and pigs. One individual (LCA 8061) claimed a *mauka* parcel of land with *noni*, a useful medicinal plant and *wauke*, a plant used in making *kapa* and cordage. *Noni* traditionally was used for the treatment of abrasions, lacerations, broken bones, and concussions. *Wauke* was also used as a medicinal plant, useful in treating respiratory illnesses and general ailments. There were several disputes over orange trees (LCAs 3413B, 2381, 10473). In one case, the *konohiki* affirmed he himself had taken away two orange trees belonging to a claimant.

4.2.1 Sugar Cultivation

As the numbers of *malihini* (foreign-born) increased on Kaua‘i Island, an array of diversified agricultural enterprises were begun in earnest. The first large-scale agricultural enterprise in the Keālia area was begun in 1877 in Kapa‘a by the Makee Sugar Plantation and the Hui Kawaihau (Dole 1916:8). The Hui Kawaihau was originally a choral society begun in Honolulu whose membership consisted of many prominent names, both Hawaiian and *haole*. It was Kalākaua’s thought that the Hui members could join forces with Makee, who had previous sugar plantation experience on Maui, to establish a successful sugar corporation on the east side of Kaua‘i. Captain Makee was given land in Kapa‘a to build a mill and he agreed to grind cane grown by Hui members. Kalākaua declared the land between Wailua and Moloa‘a a fifth district called Kawaihau and for four years the Hui attempted to grow sugarcane at Kapahi, on the plateau lands above Kapa‘a. After a fire destroyed almost one half of the Hui’s second crop of cane and the untimely death of Captain James Makee, one of their principal advocates, the Hui began to disperse and property and leasehold rights passed on to Makee’s son-in-law and the new Makee Plantation owner, Colonel Z.S. Spalding (Dole 1916:14).

As part of the infrastructure of the new plantation, a sugar mill was erected and the Makee Landing was built in Kapa‘a. Following Captain Makee’s death, Colonel Spalding took control of the plantation and in 1885 moved the mill to Keālia (Cook 1999:51) (Figure 14 through Figure 18). Soil prepping was required for all sugar operations around the islands, including Keālia. Soil was tilled by plowing to a depth of 18 to 24 inches, this would then be followed by discing (CTAHR 2001). In some instances, “subsoiling” (tilling soil at depths below the levels worked by a regular plow) was required to break up “hardpans that [had] form[ed] at the bottom of the plow layer” (CTAHR 2001). Kealia’s sugar fields were watered by an elaborate water catchment system (Drennan and Dega 2007:10). The Hōmaikawa‘a Valley figured largely in this system; Drennan and Dega identify Hōmaikawa‘a Valley as part of “a larger, historic plantation ditch system that led from the mountain watershed and emptied into Hōmaikawa‘a Stream” (2007:4). Colonel Spaulding’s endeavors proved quite successful, producing nearly 5,000 tons of sugar during the year of 1889 (Drennan and Dega 2007:10). Over a thousand workers were employed by the plantation, and they soon established a vibrant community. This plantation community was concentrated along the coast and around plantation facilities:

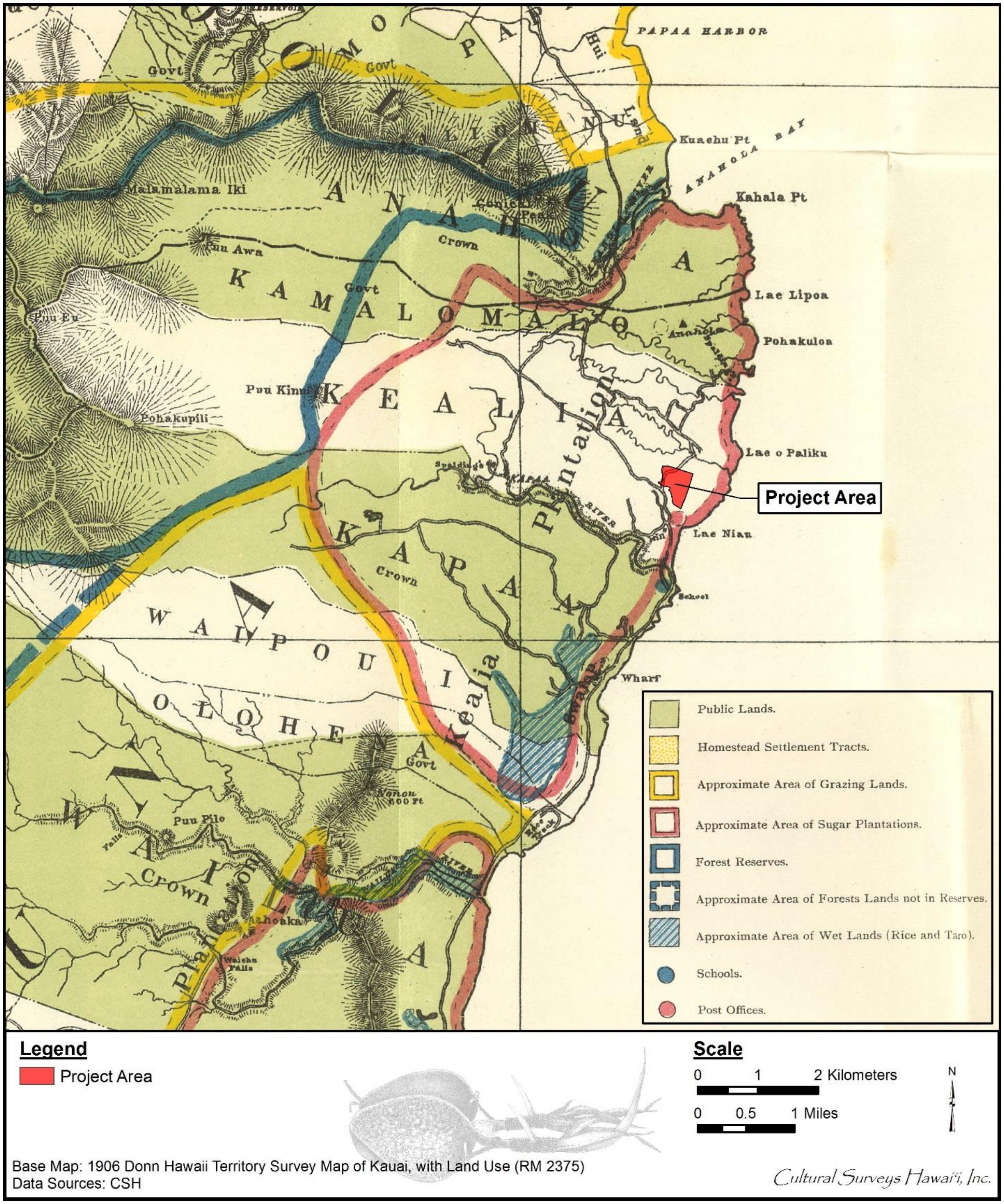


Figure 14. 1906 Donn map showing project area and land use from Wailua at the south to Anahola to the north

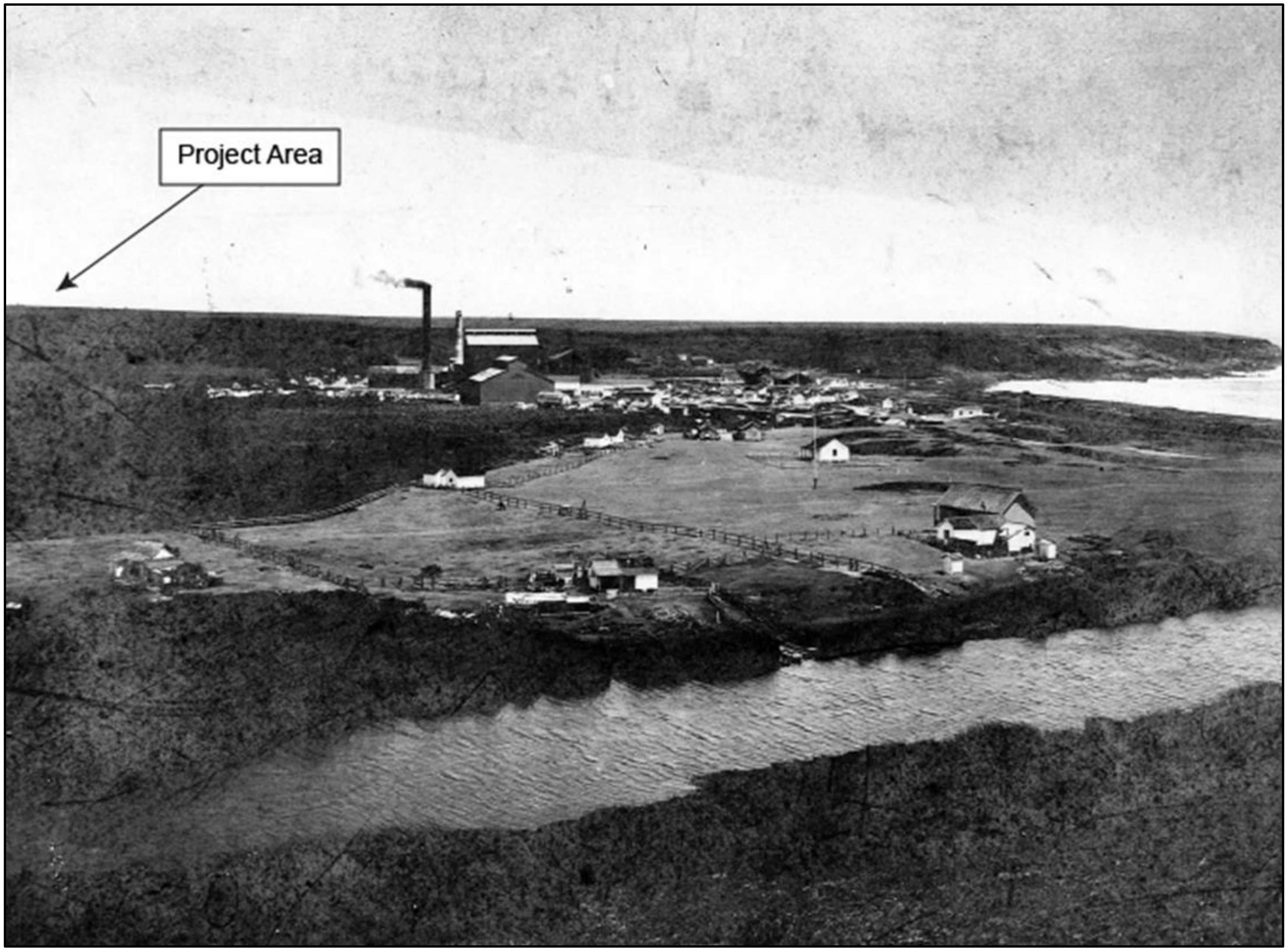


Figure 15. Makee Sugar Company Mill and Camp at Keālia, ca. 1894 (taken from Hammatt and Chiogi 1998:14) showing project area location

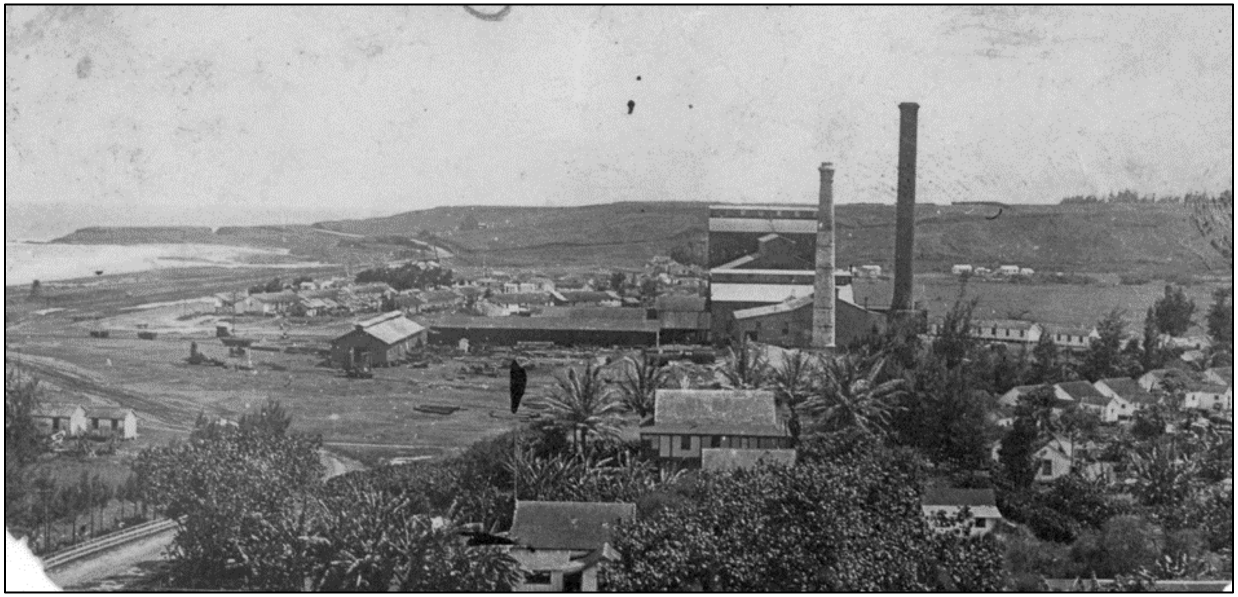


Figure 16. Photograph (date unknown) of Keālia Sugar Mill area (from the collections of Kauaʻi Historical Society)

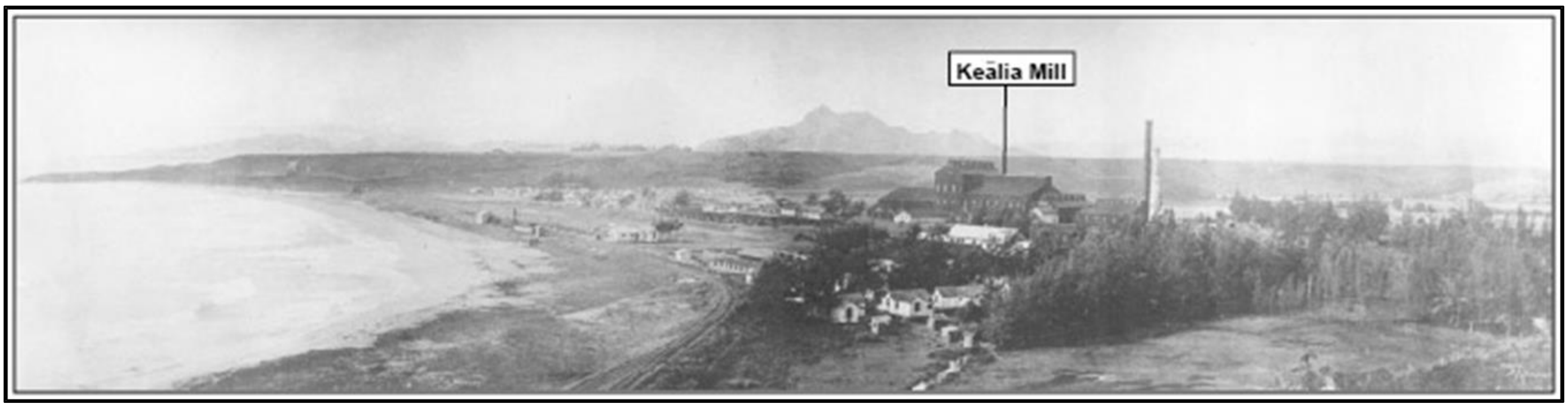


Figure 17. L.E. Edgeworth photo (October 1919) of Makee Sugar Company Mill in Keālia (taken from O'Hare et al. 2003:13)

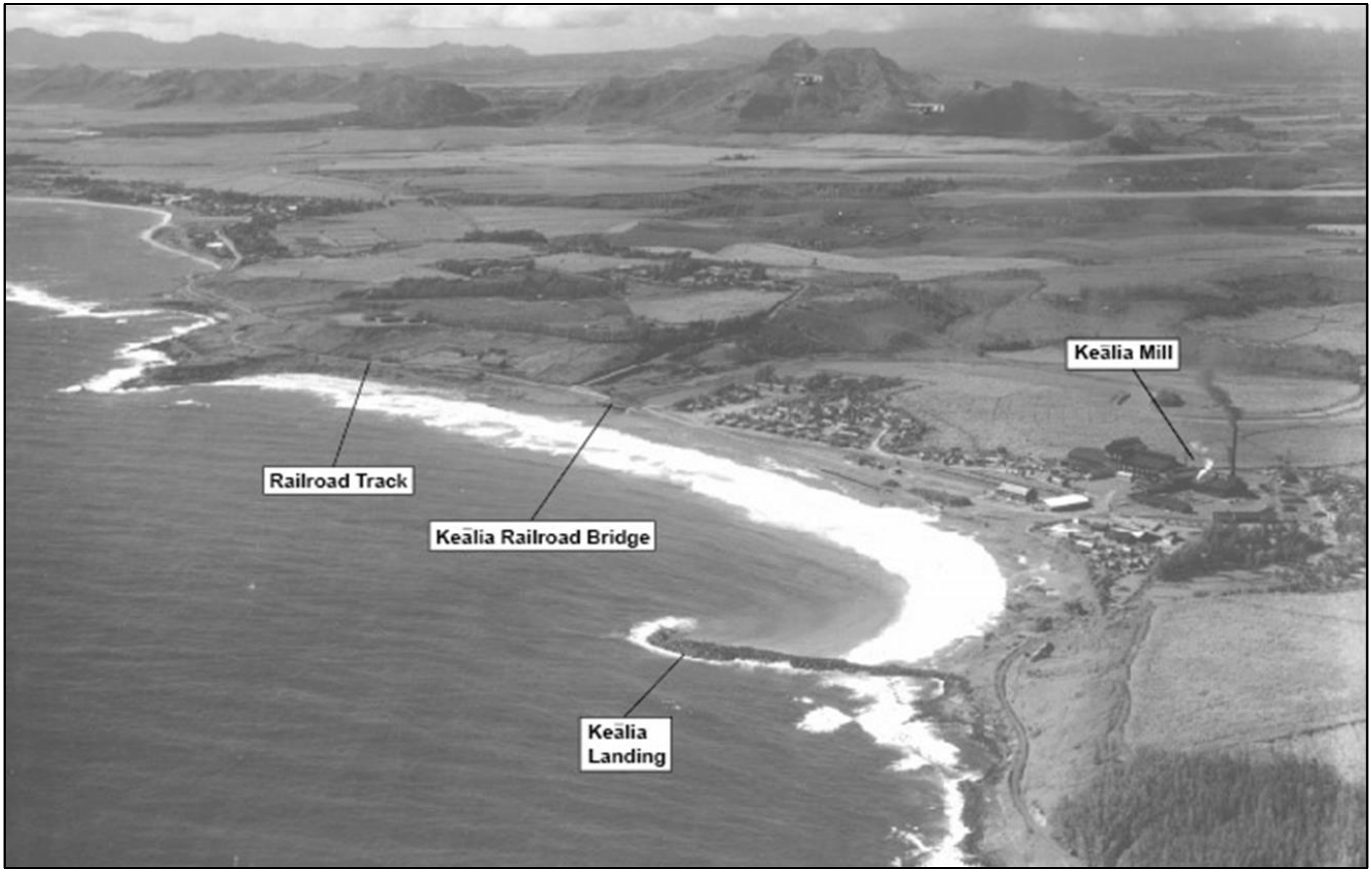


Figure 18. 1933 aerial view of Keālia (taken from O’Hare et al. 2003:14)

> . . . it included a post office, church, school, and theater. The Plantation constructed a new reservoir and transportation infrastructure to include a roadway system, a commercial boat landing, and railway connections to nearby Anahola and to Līhuʻe, and several plantation camps.
>
> The majority of the plantation camps were established in the Kumukumu *ʻili*. The camps were given meaningful names that distinguished immigrant groups or site locations: Yaki Camp was for Japanese immigrants, Chong for the Chinese; Mimino Camp for the Russians; New Stable Camp, Old Stable Camp, Amberry Camp, and Halaula Camp were other camps that were on the Makee Plantation. [Drennan and Dega 2007:10]

The deteriorating stone smokestack and landing were still there well into the 1900s (Damon 1931:359).

Condé and Best (1973:180) suggest railroad construction for the Makee Plantation started just prior to the mid-1890s. There is one reference to a railroad line leading from the Kapaʻa landing to Keālia in 1891. During Queen Liliʻuokalani's visit to Kauaʻi in the summer of 1891, the royal party was treated to music by a band, probably shipped in from Oʻahu. "The band came by ship to Kapaʻa and then by train to Keālia" (Joesting 1984:252). This line is depicted on a 1910 USGS map that shows it heading south from Keālia Mill (Figure 19). This railroad line was part of a 20-mile network of plantation railroads with some portable track and included a portion of Keālia Valley and the *mauka* regions of the plateau lands north of Keālia (Condé and Best 1973:180).

Narrow wagon roads gave way to macadamized roads in the early part of the twentieth century. This new road was called the Kauaʻi Belt Road and parts of it are thought to have followed the "Old Government Road" (Cook 1999). In Kapaʻa, the present day Kūhiō Highway probably follows the same route as the original Government Road and subsequent Kauaʻi Belt Road.

In Keālia, however, there is evidence of numerous traditional trails leading to Anahola with possibly two principal routes, a *makai* (seaward) route and a *mauka* route. In 1881, Z.S. Spalding, proprietor of the Makee Sugar Plantation, appealed to the Department of the Interior with a formal petition to have the *makai* road (in Keālia) officially closed stating that the natives were breaking through his fences to take short cuts between Keālia and Anahola (Hawaiʻi State Archives, Letter: Z.S. Spalding, 16 May 1881). The exact location of the *makai* road is unknown although it is thought to have been on the plateau lands, somewhat removed from the coastline, in areas fit for sugarcane production. The route of the Old Government Road, also known as the "Mauka road" is described as such, "crossing the Kealia River above the Rice Plantation and passing over the hill near Mr. Spalding's residence" (Hawaiʻi State Archives, Letter: Z.S. Spalding, 21 April 1882). When the Kauaʻi Belt Road was constructed in the first two decades of the twentieth century, a portion of the old Government Road route was abandoned. The new route crossed the river at the *makai* end of Keālia Stream, paralleled the ocean and the railroad track, and then turned *mauka* passing through Keālia town and went up the hill to meet up with the "Old Government Road" (see Figure 19). The Keālia Bridge built for the Kauaʻi Belt Road is thought to date to ca. 1912. A traveler writing about their travels in 1913, mentions the bridge: "In the twinkling of an eye we passed on the steel bridge of Kealia. This new bridge is beautiful" (Akina 1913).

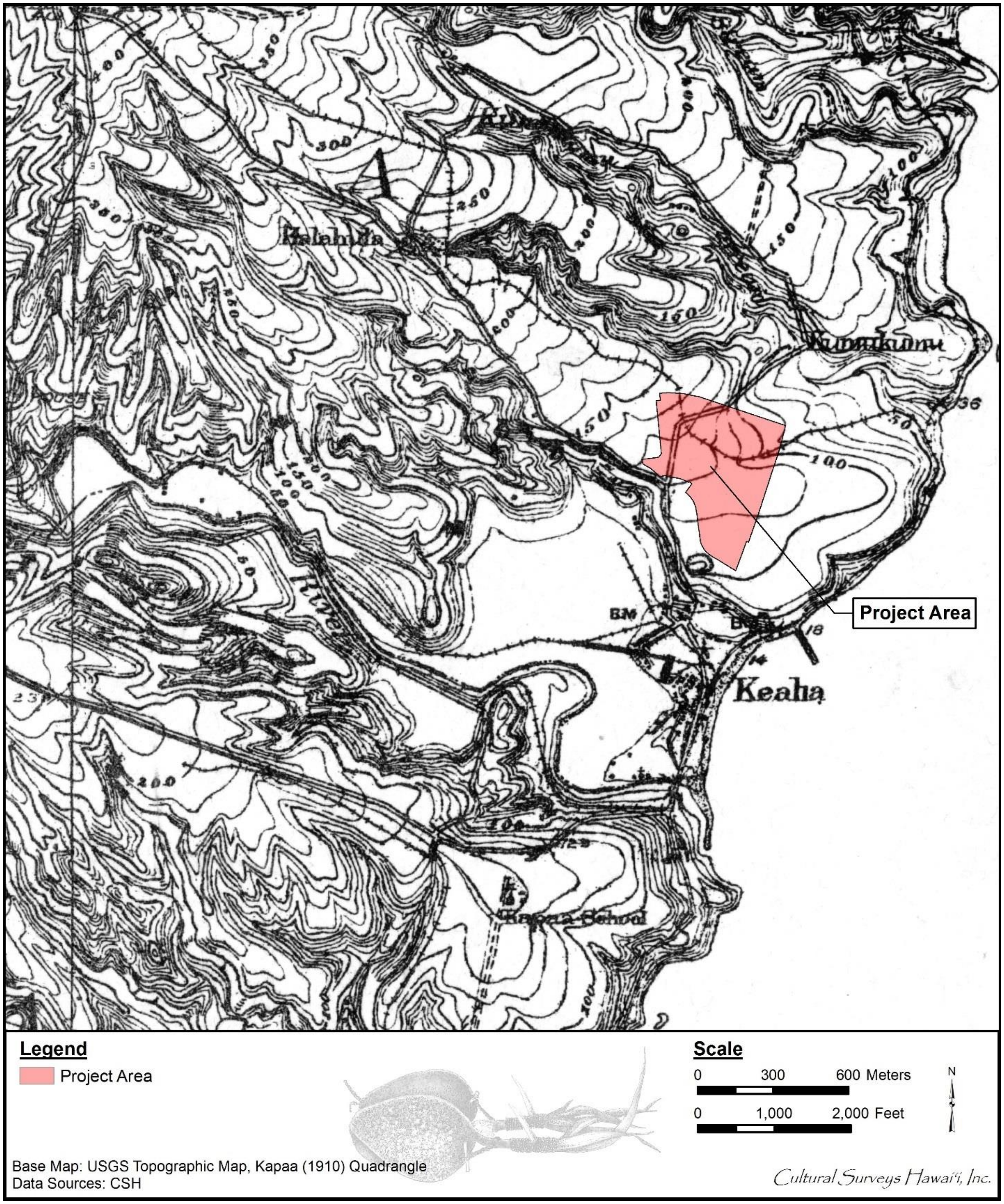


Figure 19. Portion of the 1910 Kapaa USGS topographic map depicting historic road and railroad alignment in the current project area

4.3 1900s

The Ahukini Terminal & Railway Company was formed in 1920 to establish a railroad to connect Anahola, Keālia, and Kapa‘a to Ahukini Landing and "provide relatively cheap freight rates for the carriage of plantation sugar to a terminal outlet" (Condé and Best 1973:185). This company was responsible for extending the railroad line from the Makee Landing, which was no longer in use, to Ahukini Landing, and constructing the original Waika‘ea Railroad Bridge and the Moikeha Makai Railroad Bridge. In an annual report written in December 1921, the line between Ahukini and Keālia was opened by 7 May 1921 stating, "can run trains from Ahukini to Kealia on twenty-four hours notice" (Condé and Best 1973:185) (see Figure 19 and Figure 20). The report also specifically mentions a bridge near the Hawaiian Canneries Company which cost $12,000.00 to build and was washed away in a "freshet" in January 1921 and needed to be rebuilt. The Keālia River Railroad Bridge was described as "an old wooden bridge" and was recommended to be replaced with concrete as soon as "finances permitted" (Condé and Best 1973:186).

As the twentieth century progressed, calls were also made to remedy the conditions of plantation workers. Beginning in the early 1900's, a series of strikes occurred across the Hawaiian Islands. Many of these strikes occurred as a result of inadequate wages, abusive managers, and unsanitary living conditions. Drawing upon testimony from former plantation workers, Takaki (1983) outlines how the plantation resembled a pyramid:

> At the top of the slope was the big house, the home of the manager; below were the "nicer looking" homes of the Portuguese, Spanish, and Japanese lunas; then the "identical wooden frame houses of Japanese Camp;" and finally the "more run-down Filipino Camp." Moreover, the organization of the housing hierarchy was "planned and built around its sewage system." The concrete ditches that serviced the toilets and outhouses ran from the manager's house on the highest slope down to the Filipino Camp on the lowest perimeter of the plantation. [Takaki 1983:92]

The reinforcement of such social hierarchies did little to support the happiness and well being of workers, rather, they reinforced the plantation manager's power over the physical and political bodies of their laborers. However, managers of the Makee Sugar Plantation realized the necessity of maintaining stable and healthy living conditions for their workers. To ensure the success of the company, the Makee Sugar Plantation began a series of infrastructure improvements:

> . . . in 1929 Makee made plans to build custom plantation homes. The "new" Kumukumu Camp was built, along with new wells, and a brand new sewer system. Work began May 1, 1929 on the building of the new camp houses equipped with outhouses and connected to a main conveyance sewer. In a letter dated August 28, 1929, noting the progress on the well drilling at Kumukumu, the Kumukumu well was the eighth on record for Makee, having obtained a depth of 300 feet; Well numbers 5, 6 and 7 were drilled over the period of February 21 to May 14, 1928 (Plantation Archives, UH, Manoa). [Drennan and Dega 2007:15]

In 1934, the Lihue Plantation Company absorbed the Ahukini Terminal & Railway Company and Makee Sugar Company (Condé and Best 1973:167) (Figure 21). The railway and rolling stock formerly owned by Makee Sugar Company became the Makee Division of the Lihue Plantation. At this time, besides hauling sugarcane, the railroad was also used to haul plantation freight

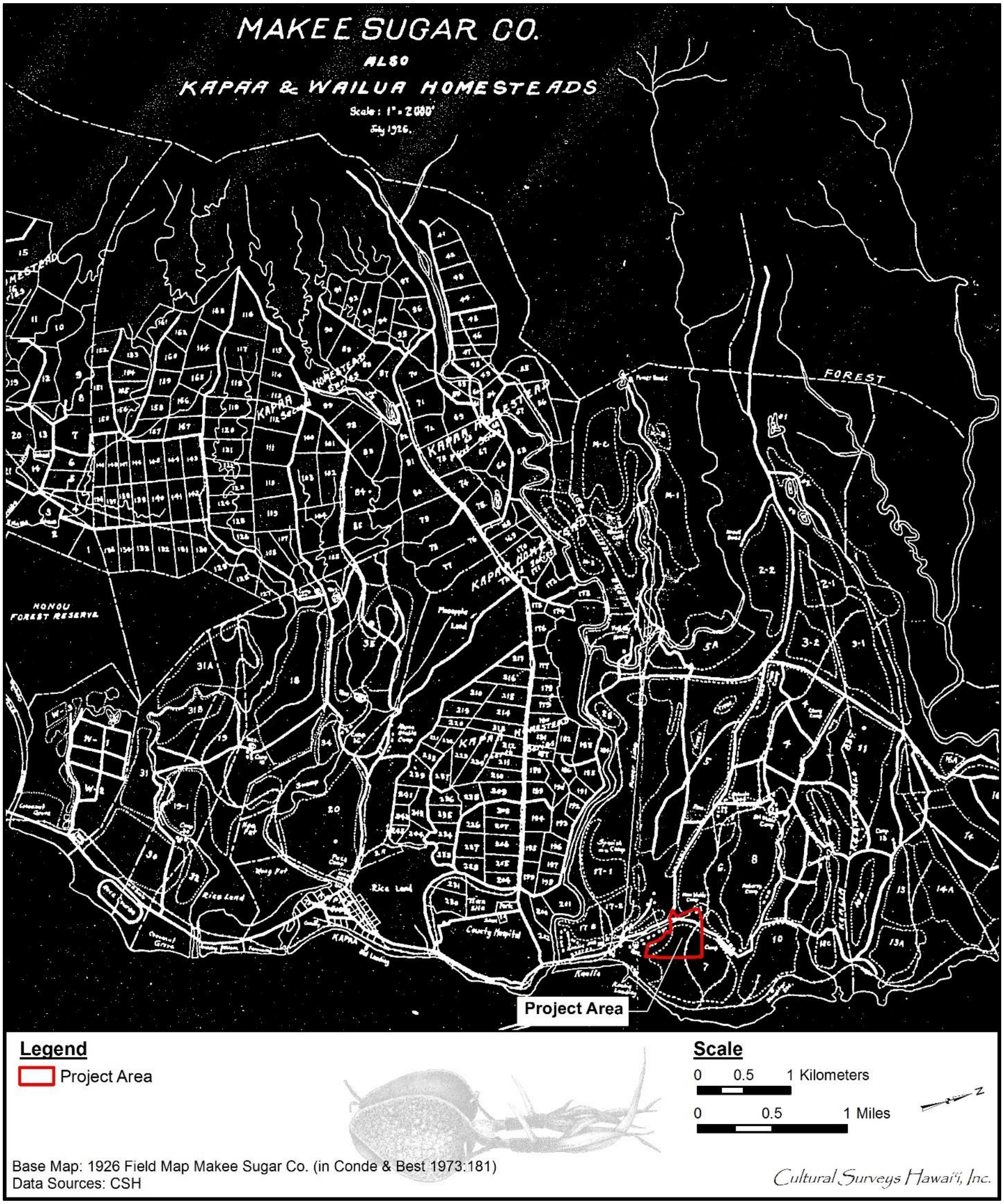


Figure 20. A 1926 field map for Makee Sugar Company (in Condé and Best 1973:181) showing the railroad system running through the western portion of the project area to Anahola

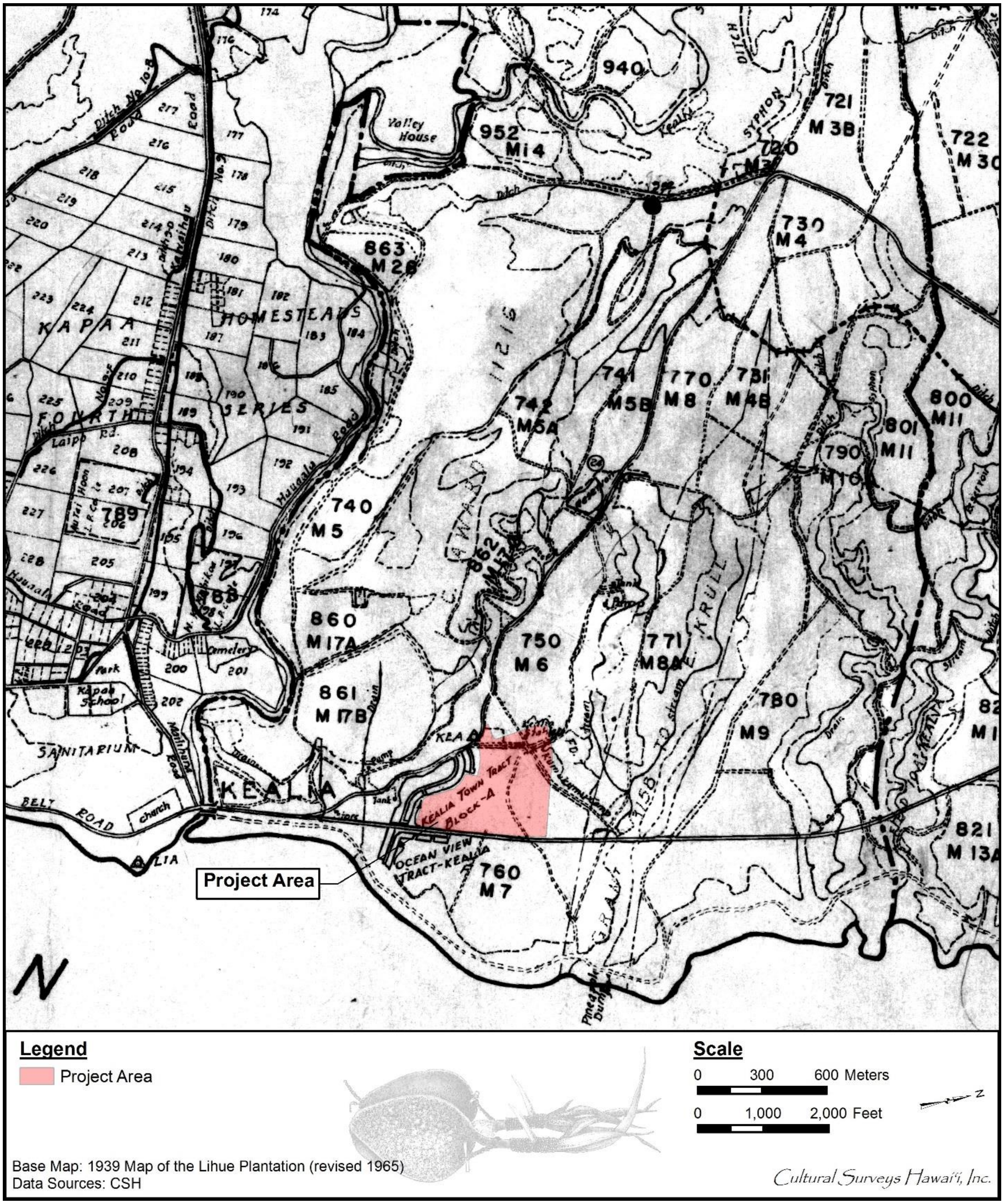


Figure 21. A portion of a 1935 Lihue Plantation field map (revised in 1965) showing "Kumukumu Camp" in the northwest corner of the project area

including "fertilizer, etc. . . . canned pineapple from Hawaiian Canneries to Ahukini and Nawiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd." (Hawaiian Territorial Planning Board 1940:11). Former plantation workers and *kamaʻāina* growing up in Kapaʻa remember when the cannery would send their waste to the pineapple dump, a concrete pier just north of Kumukumu Stream (State Inventory of Historic Places [SIHP] # 50-30-08-789:H) by railroad. The structure is built over the water where the rail cars would dump the pineapple waste. The current would carry the waste to Kapaʻa, which would attract fish and sharks (Bushnell, Shideler, and Hammatt 2003).

Lihue Plantation was the last plantation in Hawaiʻi to convert from railroad transport to trucking (Condé and Best 1973:167). "By 1957 the company was salvaging a part of their plantation railroad, which was being supplanted by roads laid out for the most part on or close to the old rail bed" (Condé and Best 1973:167). By 1959, the plantation had completely converted over to trucking. The Cane Haul Road is thought to date to the late 1950s and follows the alignment of the old railroad until just before the end of the bike path near ʻĀhihi Point.

Keālia Town slowly dispersed after the incorporation of Makee Sugar Company into Lihue Plantation in the 1930s. Many of the plantation workers bought property of their own and moved out of plantation camps. The plantation camps that bordered Kūhiō Highway were disbanded in the 1980s. The Lihue Plantation began to phase out in the last part of the twentieth century. In 1997, the entire *ahupuaʻa* of Keālia was sold off in an effort to downsize Amfac's landholdings and because Keālia is the most distant from the Lihue Plantation sugar mill, it was considered the least profitable (Honolulu Advertiser, 7 July 1997). The Lihue Plantation completely folded at the end of the twentieth century.

Section 5 Previous Archaeological Research

Previous archaeological studies in the vicinity of the project area are depicted on Figure 22 and summarized in Table 3. Previously identified historic properties in the vicinity of the project area are depicted on Figure 23 and summarized in Table 4. A synopsis of prior studies in the vicinity follows.

5.1 Early Studies in the Vicinity of the Project Area

5.1.1 Bennett 1931

The first attempt at a comprehensive archaeological survey of Kaua‘i was undertaken by Wendell Bennett of the Bishop Museum during the 1930s. In the vicinity of Keālia Ahupua‘a, Bennett's report identified Site 111, a "ditch, south of the Keālia Valley, inland," described as a "large, simple dirt ditch, about 6 feet in width and of varying depths which is traditionally referred to as a Hawaiian ditch" (Bennett 1931:128). Bennett also noted (but apparently did not locate) Site 112, described as "Kawelomamaia heiau, said to have been located where the Kawelomamaia stream runs into the sea north of Keālia" (Bennett 1931:129). Bennett recorded no sites within Keālia Ahupua‘a itself.

5.2 Recent Archaeological Studies in the Vicinity of the Project Area

5.2.1 Ching 1982

In 1982, Francis Ching conducted an archaeological reconnaissance of three sites for a proposed landfill project. The three sites were Kekaha in the Waimea District of Kaua‘i; Kīpū in the Līhu‘e District; and lastly Kumukumu in the Kawaihau District north of the current project area. In Ching's report, he states, "Of the three study areas, we expected to find archaeological remains at this one" (Ching 1982:2). He concluded that due to the proximity of the project area to the sea as well as a running stream, the area was suitable for *lo‘i* cultivation but during the reconnaissance, there were no significant findings. However, he did note the vegetation in the area: wild taro was noted growing near the stream as well as other vegetation (banana, *haole koa*, java plum, lily wai [water lilies], monkey pod, guava, *laua‘e*, swordtail fern, African tulip, *he‘e* ["octopus tree"], and assorted grasses and bushes) (Ching 1982:3).

5.2.2 Folk and Hammatt 1991

Folk and Hammatt (1991) documented the first of these inadvertent burial finds from SIHP # 50-30-08-1851 in 1991 and noted the presence of historic artifacts and traditional Hawaiian midden in the vicinity. They also noted the extensive disturbance from sand mining, which was responsible for uncovering the remains. They suggested "it is possible that the burials . . . are directly associated with the Land Commission Awardees" whose parcels were located in the immediate vicinity (Folk and Hammatt 1991:2). They recommended "further activity at the sand mining site should be restricted" and stated the area "should be left to vegetate naturally as is already occurring. . . ". As "all of the human bone observed was fragmented and disarticulated," it was not possible to determine whether the remains were pre-Contact or post-Contact or whether they were Native Hawaiian (Folk and Hammatt 1991:2).

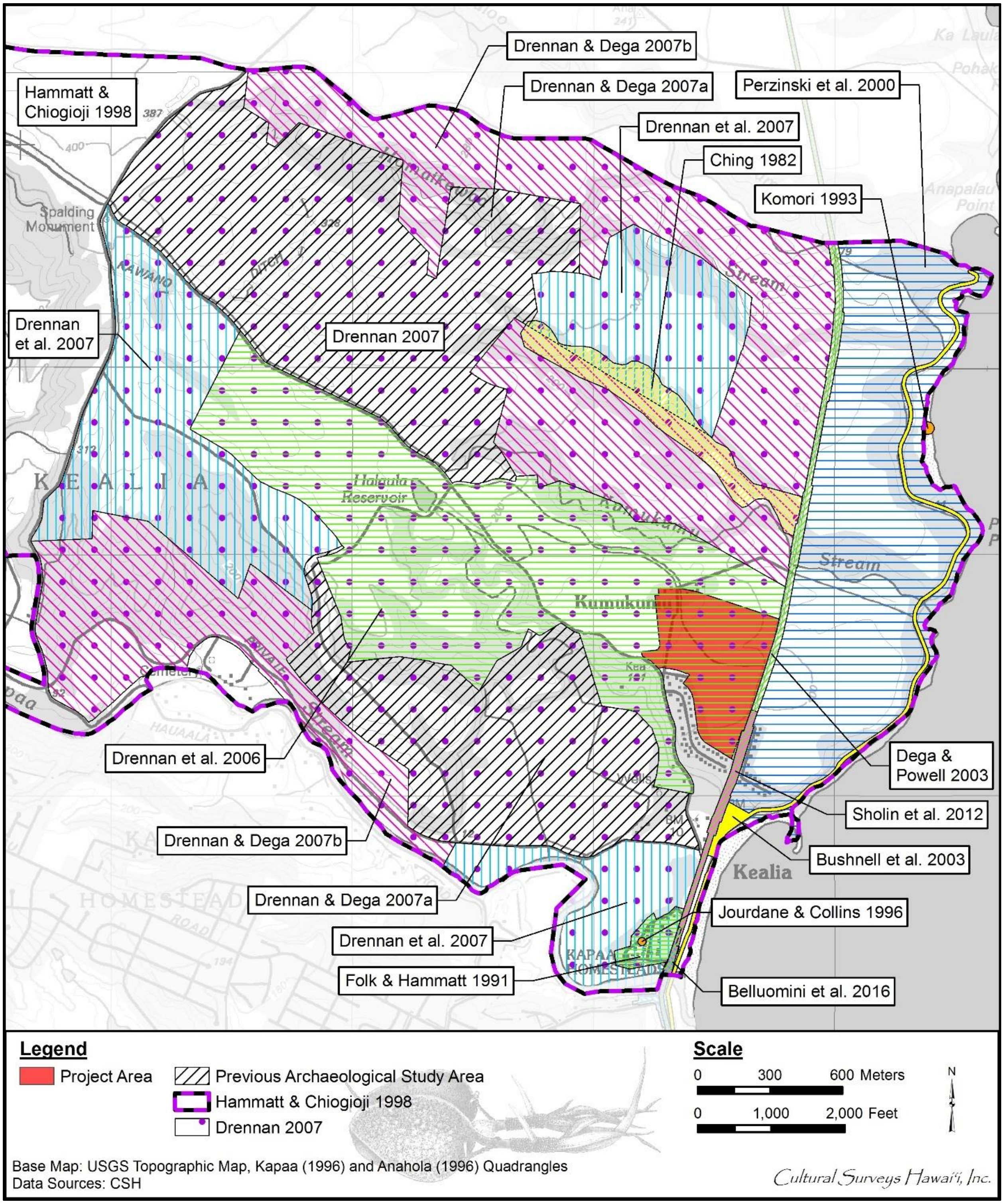


Figure 22. Previous archaeological studies in the immediate vicinity of the project area

Table 3. Previous archaeological studies in the immediate vicinity of the project area

Reference	**Type of Study**	**Location**	**Results (SIHP # 50-30-08 ****)**
Bennett 1931	Archaeology of Kauaʻi	Island-wide	Discusses terracing and irrigation ditches located along Kapaʻa Stream
Handy and Handy 1972	Native planters study	Archipelago-wide	Emphasizes agricultural production rather clumped along Keālia side of Kapaʻa Stream seaward of its confluence with Keālia Stream
Ching 1982	Archaeological reconnaissance	Kekaha, Kīpū, and Kumukumu, TMKs: [4] 1-2-002:001, 009, 021, 040; 3-4-006:012; and 4-7-004:01	No significant findings, however, wild taro noted growing near stream as well as other vegetation (banana, *haole koa*, java plum, lily *wai* [water lilies], monkey pod, guava, *lauaʻe*, swordtail fern, African tulip, *heʻe* [“octopus tree”]) and assorted grasses and bushes
Folk and Hammatt 1991	Archaeological inventory survey (recorded as an archaeological assessment)	Bend of Kapaʻa River, just inland of Kūhiō Hwy	Burial finds (SIHP # -1851); noted presence of historic artifacts and traditional Hawaiian midden in vicinity; also noted extensive disturbance from sand mining
Komori 1993	Burial report	Palikū (Kuna) Beach, “Donkey Beach”	Burial find, SIHP # -1899
Jourdane and Collins 1996	Burial report	Bend of Kapaʻa River	Identified additional disarticulated human remains associated with SIHP # -1851
Hammatt and Chiogioji 1998	Archeological reconnaissance survey and assessment	6,690.9 acres within Keālia Ahupuaʻa	No cultural resources identified within vicinity of project area
Perzinski et al. 2000a	Archaeological inventory survey	300-acre *makai* parcel at Keālia, TMK: [4] 4-7-004:006	Identified SIHP # -0789 within vicinity of project area including Cane Haul Rd (SIHP # -0789: Feature A), Keālia Landing (SIHP # -0789: Feature B), and a dynamite storage bunker (SIHP # -0789: Feature C)

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler, and Hammatt 2003	Archaeological inventory survey	Proposed Kapa‘a–Keālia bike path, Kapa‘a and Keālia Ahupua‘a	Identified three new cultural resources within vicinity of project area including a buried cultural layer with an associated human burial (SIHP # -2074), Old Kauai Belt Hwy bridge foundation (SIHP # -2075), and a possibly modern petroglyph (SIHP # -2076); identified a new sub-feature of SIHP # -0789: Fea. A, Kapa‘a Stream Cane Haul Rd Bridge (SIHP # -0789: Fea. A, Sub-Fea. 1)
Dega and Powell 2003	Archaeological monitoring	Kūhiō Hwy from Moloa‘a through Hanamā‘ulu	No cultural resources identified within vicinity of project area
O’Hare et al. 2003	Burial treatment plan	Keālia Ahupua‘a, TMK: [4] 4-7-004:001	Burial treatment plan for SIHP # -2074 (not included on Figure 22)
Drennan et al. 2006	Archaeological inventory survey, Phase I	Portion of 2,008-acre property in Keālia Ahupua‘a, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	No cultural resources identified within vicinity of project area
Drennan 2007b	Executive summary report on archaeology	All of 2,008-acre property in Keālia Ahupua‘a, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Summary report of Keālananai Development project including all four phases of project; 261 archaeological sites identified within vicinity of project area

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Drennan and Dega 2007a	Archaeological inventory survey, Phase II	Portion of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Six new plantation-era historic properties identified within vicinity of project area including railroad rails and foundations (SIHP # -7015), sugarcane plantation infrastructure including a metal tank, structural supports, cart tracks, and foundations (SIHP # -7017), irrigation ditches, sluice gates, and a bridge (SIHP # -7018), a bridge, foundations, and irrigation pipes (SIHP # -7019), concrete foundations and a culvert (SIHP # -7020), and bridge/transportation infrastructure, a culvert and drainage pipes (SIHP # -7021).
Drennan and Dega 2007b	Archaeological inventory survey, Phase IV	Portion of 2,008-acre property in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Total of 37 new historic properties comprised of 66 features identified within vicinity of project area; historic properties identified consisted of plantation-era findings and/or historic (SIHP #s -1115 through -1118, and -1120 through -1135 with sub-feature designation when needed); SIHP #s -1119 (terrace and upright) and -1136 (traditional petroglyph) are pre-Contact and/or historic
Drennan et al. 2007	Archaeological inventory survey, Phase III	386 acres in Keālia Ahupuaʻa, TMKs: [4] 4-7-003:002 por. and 004:001 por., part of Keālananai Development project	Six historic properties identified within vicinity of project area including plantation-era concrete staircase (SIHP # 7034), plantation-era staircase (SIHP # -7035), plantation-era concrete foundation, and brick and mortar structure (SIHP # -7037), human burials, burial pit outline and fire pit (SIHP # -7040), plantation-era red brick and concrete wall/foundation (SIHP # -7041), and Keālia Historic Town Complex (SIHP # -7042)

Reference	Type of Study	Location	Results (SIHP # 50-30-08 ****)
Sholin et al. 2012	Archaeological monitoring	Keālia Beach Corridor at Kūhiō Hwy	Reidentified two historic properties: SIHP #s -884, a cultural deposit and -7034, a concrete staircase, and identified five new historic properties: SIHP #s -2161, a secondary deposit with associated human remains; -2162, a secondary and primary deposit with associated human remains; -2163, a fire-pit feature; -2165, a cultural deposit; and -2166, a fire pit feature
Belluomini et al. 2016	Archaeological inventory survey	Kapaʻa Stream Bridge, TMKs: [4] 4-6-014:024 por., 033 por., 090 por., 092 por. Kūhiō Hwy and Mailihuna Rd ROW; TMK: [4] 4-7-003:001 por., and 4-7-008:042 por. Kūhiō Hwy ROW	Historic properties identified included two newly identified historic properties (SIHP # -2278 [Kapaʻa Stream Bridge], and SIHP # -2279 [plantation era water control complex]), as well as two previously documented historic properties (SIHP #s -0789A Sub-Fea. 1 [remnant portion of the original Keālia Bridge], and -2075 [historic bridge foundation])

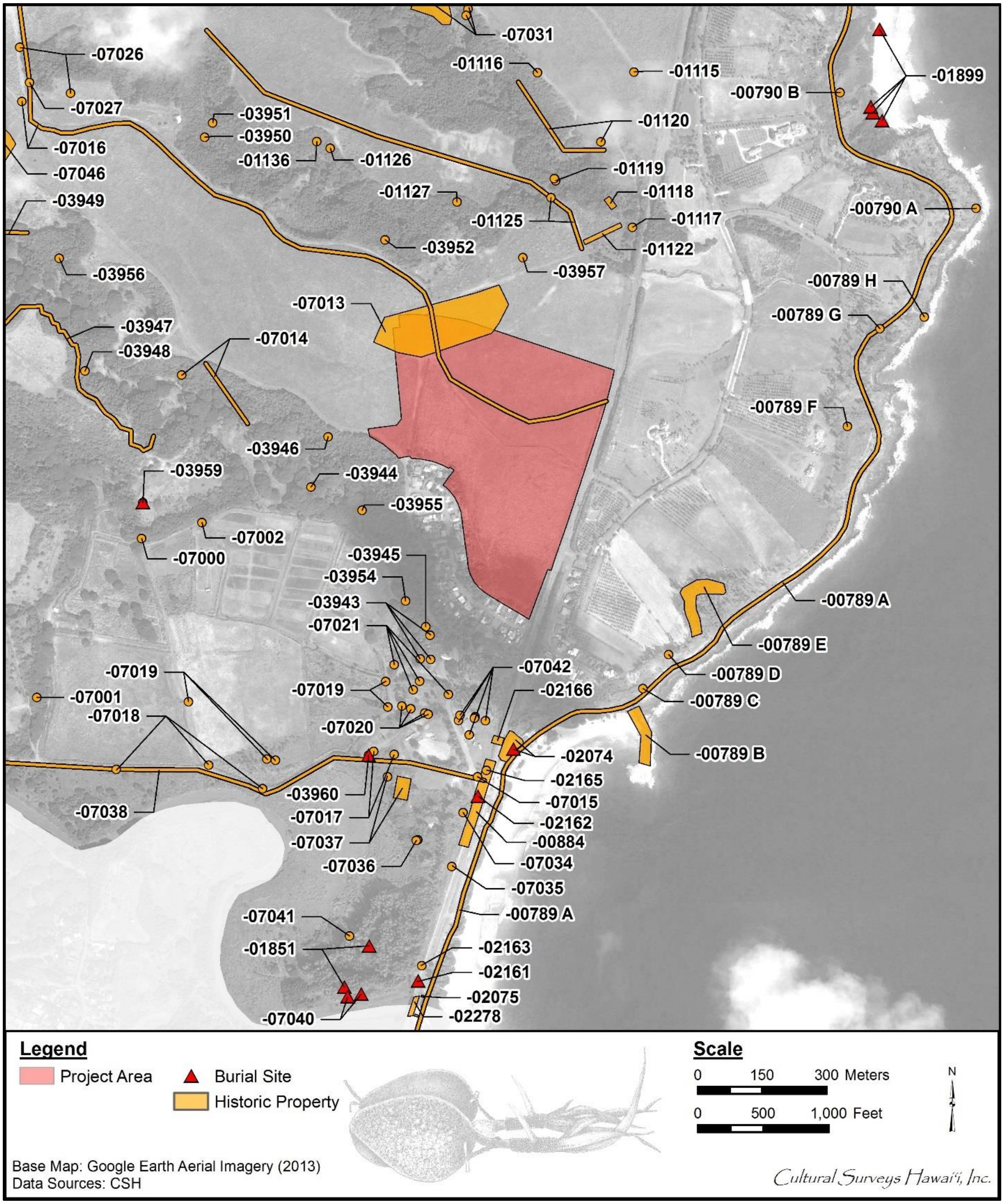


Figure 23. Previously identified historic properties in the vicinity of the project area

Table 4. Previously identified historic properties in the vicinity of the project area

SIHP # 50-30-08****	Site Type/Name	Reference
-00789a	Cane Haul Road	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Belloumini et al. 2016
-00789b	Keālia Landing	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789c	Dynamite Storage Bunker	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789d	Sem-circular terrace	Perzinski et al. 2000a
-00789e	Plantation-era terraces	Perzinski et al. 2000a
-00789f	Stone curbed trail segment	Perzinski et al. 2000a
-00789g	Kumukumu Stream Bridge	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00789h	Pier	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00790a	Military platform	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00790b	Foxhole	Perzinski et al. 2000a; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-00884	Pre-Contact human remains	SHPD communication; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Sholin et al. 2012
-01115	Culvert	Drennan and Dega 2007b
-01116	Culvert	Drennan and Dega 2007b
-01117	Bridge	Drennan and Dega 2007b
-01118	Animal husbandry complex of foundations, culverts, and an animal enclosure	Drennan and Dega 2007b
-01119	Terrace and upright stone	Drennan and Dega 2007b
-01120	Earthen ditch and historic petroglyph	Drennan and Dega 2007b

SIHP # 50-30-08****	Site Type/Name	Reference
-01122	Historic trash deposit	Drennan and Dega 2007b
-01125	Plantation road and bridge	Drennan and Dega 2007b
-01126	Linear rock mound	Drennan and Dega 2007b
-01127	Terrace	Drennan and Dega 2007b
-01136	Petroglyph	Drennan and Dega 2007b
-01851	Dune site with human burials, historic artifacts and pre-Contact midden deposit	Jourdane and Collins 1996; Folk and Hammatt 1991
-01899	Burials at Palikū Beach (Donkey Beach)	Komori 1993; Perzinski et al. 2000a, b; O’Hare et al. 2003; Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003
-02074	Buried cultural layer and associated human burial	Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; O’Hare et al. 2003
-02075	Old Kaua‘i Belt Hwy bridge foundation	Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler and Hammatt 2003; Belloumini et al. 2016
-02161	Cultural deposit with associated human remains	Sholin et al. 2012
-02162	A secondary and primary cultural deposit with associated human remains	Sholin et al. 2012
-02163	Fire pit	Sholin et al. 2012
-02165	Cultural deposit	Sholin et al. 2012
-02166	Fire pit	Sholin et al. 2012
-02278	Bridge (Kapa‘a Stream Bridge)	Belloumini et al. 2016
-03943	Historic complex of a remnant concrete staircase, concrete telephone pole, and a concrete foundation with a slab walkway	Drennan et al. 2006
-03944	Alignment	Drennan et al. 2006
-03945	Alignment	Drennan et al. 2006
-03946	Well/Cistern	Drennan et al. 2006
-03947	*‘Auwai*	Drennan et al. 2006
-03948	Mound, paving	Drennan et al. 2006

SIHP # 50-30-08****	Site Type/Name	Reference
-03949	*‘Auwai*	Drennan et al. 2006
-03950	Concrete foundation (Cistern)	Drennan et al. 2006
-03951	Trash dump	Drennan et al. 2006
-03952	Concrete structure and historic petroglyph	Drennan et al. 2006
-03954	Concrete and basalt boulder bridge	Drennan et al. 2006
-03955	Bridge	Drennan et al. 2006
-03956	Modified stream bank, concrete water diversion	Drennan et al. 2006
-03957	Culvert	Drennan et al. 2006
-03959	Burial	Drennan and Dega 2007a
-03960	Burial	Drennan and Dega 2007a
-07000	Terraces	Drennan and Dega 2007a
-07001	Terrace	Drennan and Dega 2007a
-07002	Wall (cement and basalt cobble)	Drennan and Dega 2007a
-07013	“New Kumukumu Camp” (defunct)	Drennan and Dega 2007a
-07014	Cement column pipe supports and concrete columns	Drennan and Dega 2007a
-07015	Railroad rails and foundation	Drennan and Dega 2007a
-07016	Railroad complex	Drennan and Dega 2007a
-07017	Sugar cane plantation infrastructure including a metal tank, structural supports, cart tracks, and foundations	Drennan and Dega 2007a
-07018	Irrigation ditches and sluice gates, and a plantation era bridge	Drennan and Dega 2007a
-07019	Plantation era bridge, foundations, and irrigation pipes	Drennan and Dega 2007a
-07020	Concrete foundations and culvert	Drennan and Dega 2007a
-07021	Bridge/transportation infrastructure, a culvert, and drainage pipes	Drennan and Dega 2007a
-07026	Historic trash scatter (two areas)	Drennan and Dega 2007a
-07027	Railroad bridge	Drennan and Dega 2007a
-07031	Mound and two historic trash deposits	Drennan et al. 2007
-07034	Concrete staircase	Drennan et al. 2007; Sholin et al. 2012
-07035	Staircase	Drennan et al. 2007

SIHP # 50-30-08****	Site Type/Name	Reference
-07036	Plantation era concrete block and basalt, mortar and brick structure	Drennan et al. 2007
-07037	Concrete foundation, and brick and mortar structure	Drennan et al. 2007
-07038	Railroad path	Drennan et al. 2007
-07040	Human burials, a burial pit outline, and a fire pit	Drennan et al. 2007
-07041	Red brick and concrete wall/foundation	Drennan et al. 2007
-07042	Keālia historic town complex	Drennan et al. 2007
-07046	Halaula Reservoir	Drennan et al. 2007

5.2.3 Komori 1993

SHPD staff investigated an inadvertent human burial in 1992 (Komori 1993). Located in a sand dune above Kuna or Palikū Beach also known as “Donkey Beach,” “where ‘recent flooding in the area caused a small gully to form in a sand dune about 4 meters inland of the vegetation line and about 45 meters from the ocean’, the burial ‘appeared to be over 50 years old’, comprising an ‘individual . . . placed in a flexed position, lying on its right side, long axis perpendicular to the beach facing into the eroded bank’(*Ibid*). The burial location was subsequently assigned site number 50-30-08-1899” (Perzinski et al. 2000a:17).

5.2.4 Jourdane and Collins 1996

In 1996, Jourdane and Collins of the SHPD staff documented the second inadvertent human burial from the same sandy deposits in the bend of the Kapa‘a River (also SIHP # -1851). The remains were apparently discovered by a Mrs. Gaines while she was “walking through the old Kealia Plantation Camp searching for bottles” (Jourdane and Collins 1996:1). The remains were also found in an area disturbed by extensive sand mining, seemingly quite close to the remains reported by Folk and Hammatt (1991). The remains documented by Jourdane and Collins were similarly fragmented and of unknown specific provenience, ethnicity, and age. The report noted

> This area has been extensively disturbed by sand mining after the plantation camp was abandoned. Aerial photos taken in 1971 show that extensive development had occurred in this area and shows the plantation camp housing and associated roads. [Jourdane and Collins 1996:1]

5.2.5 Hammatt and Chiogioji 1998

In 1998, CSH completed an archaeological reconnaissance survey and assessment for a 6,690.6-acre portion of Keālia Ahupua’a. The survey found areas located within floodplains of Kapa‘a and Keālia streams were previously inhabited by traditional Hawaiians. Much of the area surveyed was former plantation land considered to be of little archaeological concern. The study also suggests the area known as Keālia Beach is likely void of archaeological sites associated with traditional Hawaiian activities due to sugarcane being planted up to the shoreline and the shoreline being modified for a cane haul road (Hammatt and Chiogioji 1998). A study of Hawaiian traditional customs and practices for the Keālia Ahupua‘a accompanied the reconnaissance and survey assessment (Hammatt and Shideler 1998).

5.2.6 Perzinski et al. 2000a

In 2000, CSH completed an archaeological inventory survey (AIS) and subsurface testing of the approximately 300-acre Keālia *makai* parcel. Three historic properties were identified: SIHP # -0789, plantation era infrastructure and structures; SIHP # -0790, World War II structure and remnants; and SIHP # -1899, burials (Perzinski et al. 2000a). In the same year, CSH was contracted to develop a burial treatment plan for SIHP # -1899 (Perzinski et al. 2000b) for the burials identified during the AIS as well as the SHPD investigation of the inadvertent findings in 1992 (Komori 1993).

5.2.7 Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler, and Hammatt 2003

In 2003, CSH conducted an AIS for the Kapa‘a–Keālia bike and pedestrian path. Five newly identified sites (SIHP #s -2074 through -2078) and a new sub-feature of SIHP # -0789 (Feature A, Sub-Feature 1) were documented (Bushnell, Mann, Borthwick, Bush, Tulchin, Shideler, and Hammatt 2003). SIHP # -0789: Feature A, Sub-Feature 1 is identified as the *makai* Kapaʻa Stream Bridge for the Cane Haul Road and SIHP # -2075 is identified as the highway bridge foundation for the *mauka* Kapaʻa Stream Bridge. SIHP # -2074 included a buried cultural layer and associated human burial. A CIA for the Kapaʻa–Keālia bike and pedestrian path accompanied the AIS (Bushnell, Shideler, and Hammatt 2003). CSH completed a burial treatment plan for SIHP # -2074. The remains were discovered during subsurface testing along the coast where restroom facilities were to be built and a burial treatment plan was recommended for SIHP # -2074 (O'Hare et al. 2003).

5.2.8 Dega and Powell 2003

In 2003, Scientific Consultant Services (SCS) completed archaeological monitoring during Phase I of the Kauaʻi Rural Fiber-optic Duct Lines project. A portion of the study is located within the vicinity of the current project (Segment 17) extending along the western shoulder of Kūhiō Highway along the hills and plateaus toward Anahola. There were no significant findings (Dega and Powell 2003:25).

5.2.9 O'Hare et al. 2003

In August 2002, CSH conducted an archaeological inventory survey (Bushnell et al. 2003) and a cultural impact assessment (Hammatt and Shideler 1998) for the proposed Kapaʻa to Keālia Bike and Pedestrian Path project. The inventory survey included surface and subsurface investigations along the proposed path and at two coastal areas selected for restroom facilities. During the inventory survey, a cultural stratum with an associated pre-Contact Hawaiian burial (minimum number of individuals [MNI]:1) was identified. This cultural layer and burial was designated as SIHP # -2074. The OʻHare et al. (2003) report was prepared as a burial treatment plan for the human remains associated with SIHP # -2074.

5.2.10 Drennan et al. 2006

In 2007, SCS conducted four phases of an AIS in the Keālia Ahupuaʻa, Phase I (Drennan et al. 2006), Phase II (Drennan and Dega 2007a), Phase III (Drennan et al. 2007), and Phase IV (Drennan and Dega 2007b). During Phase I, 15 new sites were identified and documented. Nine were associated with the plantation era, one site appeared to be associated with traditional Hawaiian practices (habitation and/or agriculture), and the remaining five are interpreted as traditional Hawaiian agricultural sites that continued to be used during the plantation era (Drennan et al. 2006:29). The newly identified sites were designated as SIHP #s -3943 through 3957.

5.2.11 Drennan and Dega 2007a

During Phase II, 30 new historic properties comprised of 82 features were identified. The newly identified sites were designated as SIHP #s -3959 and -3960, human burials, and SIHP #s -7000 through -7027 (Drennan and Dega 2007a:ii).

5.2.12 Drennan et al. 2007

During Phase III, 19 new historic properties were identified comprised of 93 features. The newly identified sites were designated as SIHP #s -7028 through 7046. SIHP #s -7028 and -7040 contained human burials (Drennan et al. 2007:ii).

5.2.13 Drennan and Dega 2007b

During Phase IV, 37 new historic properties comprising 66 features were identified. The newly identified sites were designated as SIHP #s -1100 through -1136. A report was written in 2007 summarizing the archaeology conducted in the four phases of the proposed Keālanani project including subsurface testing (Drennan 2007b). Using the geomorphic model formulated by Dega and Powell in 2003 during the monitoring work, and later refined in 2005 (Dega et al. 2005), Drennan concluded Zone III was the primary zone of historical utilization based on previous archaeological studies and subsurface testing conducted during the four phases of the project. SCS wrote an advance data recovery plan (DRP) in 2007 specifically to recover further samples for SIHP # -3959, a habitation site and surface documentation of headstones for SIHP # -7028, an historic cemetery (Drennan 2007a). SCS also wrote a preservation plan for multiple historic properties: SIHP #s -7027, a railroad bridge; -7028, a historic cemetery; -7043, Spalding Monument; -1120 Feature 2 is a petroglyph of an English name and an image interpreted as a boat; and lastly -1136, a pre-Contact petroglyph (Drennan and Dega 2007c). The current project area is located in the Phase I.

5.2.14 Sholin et al. 2012

In 2012, T.S. Dye & Colleagues, Archaeologists, Inc. conducted archaeological monitoring at Keālia Beach corridor transmission line along Kūhiō Highway. During monitoring two historic properties, SIHP #s -884, a cultural deposit, and -7034, a concrete staircase, were reidentified. Five new historic properties were discovered and documented: SIHP #s -2161, a secondary deposit with associated human remains; -2162, a secondary and primary deposit with associated human remains; -2163, a fire-pit feature; -2165, a cultural deposit; and -2166, a fire pit feature. The inadvertent human remains were reinterred near the Keālia Beach corridor (Sholin 2012:1).

5.2.15 Belluomini et al. 2016

In 2016, CSH conducted an archaeological inventory survey for the Kapaʻa Stream Bridge Replacement project. During the AIS, two previously documented historic properties were reidentified: SIHP #s -0789A Sub-Feature 1, the remnant portions of the original Keālia Stream Bridge Crossing, and -2075, the remnant abutments of the former Kauaʻi Belt Road. Two new historic properties were discovered and documented: SIHP #s -2278, the Kapaʻa Stream Bridge, and -2279, a water control complex consisting of an earthen ditch (Feature A) and the remnant of a culvert (Feature B) (Belluomini et al. 2016).

5.2.16 Kamai and Hammatt 2017

In 2017, CSH conducted a literature review and field inspection for the proposed Keālia Subdivision project (this study is not pictured on Figure 22 or included within Table 3). The inspection focused on the entire 53.361-acre (22-hectare) parcel. The project area traversed the entire proposed subdivision starting from the northwest corner. The pedestrian survey was accomplished through systematic sweeps spaced 10 to 15 m apart due to the low vegetation. Historic properties observed within the project area are features associated with the "New Kumukumu Camp" and an old road (SIHP #s -07013 and -07016) (Drennan et al. 2006).

Five newly identified features were given temporary CSH numbers (CSH-1 through CSH-5). CSH-1 through CSH-4 appear to have been associated with SIHP # -07013. The five features are associated with plantation-era infrastructure and plantation-era water control efforts. During the fieldwork effort, surface remains of SIHP # -07016 were not identified. Due to the purpose of the study for the current project, descriptions for the identified historic properties remain very general.

Section 6 Community Consultation

6.1 Introduction

Throughout the course of this assessment, an effort was made to contact and consult with Native Hawaiian Organizations (NHO), agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the *ahupuaʻa* of Keālia. CSH initiated its outreach effort in April 2017 through letters, email, telephone calls, and in-person contact. CSH completed its outreach effort in February 2018. CSH attempted to reach 34 individuals and agencies. The organizations consulted include the Office of Hawaiian Affairs (OHA), the Kauaʻi and Niʻihau Island Burial Council (KNIBC), the State Historic Preservation Division (SHPD) (Burial Sites Specialist and History and Culture Branch), Queen Deborah Kapule Hawaiian Civic Club and the Kauaʻi Council of Hawaiian Civic Clubs (via the Association of Hawaiian Civic Clubs), and community members of Kawaihau District.

6.2 Community Contact Letter

Letters (Figure 24 and Figure 25) along with a map and an aerial photograph of the project were mailed with the following text:

> At the request of Helber Hastert and Fee (HHF) Planners and on behalf of Keālia Properties, LLC, Cultural Surveys Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Keālia Subdivision, Keālia Ahupuaʻa, Kawaihau District, Kauaʻi Island, TMKs: [4] 4-7-009:001 and 002. The project area is approximately 50 acres (including drainage detention basins). The project area is depicted on a portion of the 1996 Kapaʻa U.S. Geological Survey (USGS) topographic quadrangle and a 2013 aerial photograph (Figures 1 and 2).
>
> The proposed Keālia Subdivision project will consist of a 235-lot residential subdivision. Residential lots will range from 5,600 square feet to 7,300 square feet. The project will be built to County subdivision standards and will include water and wastewater improvements, drainage improvements and underground electric utilities. The proposed Keālia Subdivision project will be adjacent to an existing 36-lot subdivision which was built in the 1950s. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval.
>
> The purpose of this CIA is to gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to the cultural resources, cultural practices, and beliefs identified as a result of the planned project. We are seeking your *kōkua* (assistance) and guidance regarding the following aspects of our study:
>
> •**General history and present and past land use of the project area.**
>
> •**Knowledge of cultural sites- for example, historic sites, archaeological sites, and burials.**

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawai'i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KEALIA 3 bbeauchan@culturalsurveys.com www.culturalsurveys.com

April 2017

Aloha,

At the request of Helber Hastert and Fee (HHF) Planners and on behalf of Keālia Properties, LLC, Cultural Surveys Hawai'i Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Keālia Subdivision, Keālia Ahupua'a, Kawaihau District, Kaua'i Island, TMKs: [4] 4-7-009:001 and 002. The project area is approximately 50 acres (including drainage detention basins). The project area is depicted on a portion of the 1996 Kapa'a U.S. Geological Survey (USGS) topographic quadrangle and a 2013 aerial photograph (Figures 1 and 2).

The proposed Keālia Subdivision project will consist of a 235-lot residential subdivision. Residential lots will range from 5,600 square feet to 7,300 square feet. The project will be built to County subdivision standards and will include water and wastewater improvements, drainage improvements and underground electric utilities. The proposed Keālia Subdivision project will be adjacent to an existing 36-lot subdivision which was built in the 1950s. The property is currently designated within State and County agricultural districts, and will require an amendment to the State Land Use District Boundary and County Zoning District, followed by a County subdivision approval.

The purpose of this CIA is to gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to the cultural resources, cultural practices, and beliefs identified as a result of the planned project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- **General history as well as present and past land use of the project area**
- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials.**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as *mo'olelo* and traditional uses.**
- **Referrals of *kūpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**

Figure 24. Community consultation letter, page one

- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In advance, we appreciate your assistance in our research effort. If you are interested in participating in this study, please contact Brittany Beauchan at bbeauchan@culturalsurveys.com or by phone at (808) 262-9972. **We kindly ask for your response by, May 19, 2017.**

Mahalo nui loa,

Brittany Beauchan
Cultural Researcher

Figure 25. Community consultation letter, page two

- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as *moʻolelo* and traditional uses.**
- **Referrals of *kūpuna* or elders and *kamaʻāina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupuaʻa* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In most cases, two or three attempts were made to contact individuals, organizations, and agencies.

6.3 Community Contact Table

Below in Table 5 are names, affiliations, dates of contact, and comments from NHOs, individuals, organizations, and agencies contacted for this project. Results are presented below in alphabetical order.

Table 5. Results of Community Consultation

Community Member	Affiliation	Comments
ʻAha Pūnana Leo o Kauai	Hawaiian Language School	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Ahuna, Dan	Office of Hawaiian Affairs (OHA); Represents the islands of Kauaʻi and Niʻihau as an OHA Trustee	Letter and figures sent via email on 15 May 2017
Aiu, Danita	Chairperson, Kauaʻi Historic Preservation Review Commission (KHPRC)	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Ako, Uncle Valentine	*Kupuna*; *Kamaʻāina* of Kapaʻa	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017 Mr. Ivan Ako, son of Valentine Ako (90 yrs old), left a voice message on 12 May 2017 responding to the letter for his father. He informed CSH that he has some questions from his father about "what [we] mean by past

		history, and current cultural practices" outlined in the letter. Mr. Ivan Ako informed CSH he has returned to Hawaiʻi to look after his father Valentine. He advised that although his father is hard of hearing, he is very much active. Mr. Ivan Ako would also like to participate, along with his father, to assist with questions that his father may not hear correctly. Interview scheduled for 25 May 2017. Interview conducted 25 May 2017. CSH met with Uncle Valentine Ako on 29 August 2017 to edit his interview summary. Uncle Valentine Ako approved his interview summary on 29 August 2017.
Albao, Liberta	President of the Queen Deborah Kapule Hawaiian Civic Club (referred by OHA)	Letter and figures sent via email on 9 June 2017
Asquith, Adam	*Kalo* farmer (*mahiʻai*) at Keālia Farm; Kauai Taro Company	Joined Mr. Richard Kaui during his interview on 23 May 2017. Mr. Richard Kaui's interview was conducted at Keālia Farm, where Mr. Asquith is the farm manager. CSH followed up with Mr. Asquith via email on 1 June 2017. Letter and figures sent via email on 1 June 2017
Carvalho, Bernard Sr.	*Kamaʻāina*	CSH reached out via telephone on 24 April 2017, Mr. Carvalho indicated he did not wish to participate in the study.
Ching, Milton	*Kamaʻāina*	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Chong, Herman, Jr.	Descendant of P. Chong (referred by Aunty Beverly Muraoka)	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Crabbe, Kamanaʻopono	OHA Chief Executive Officer (Ka Pouhana)	Letter and figures sent via USPS on 10 May 2017 Dr. Crabbe replied to CSH via letter on 10 May 2017. A letter was also forwarded to Kaliko Santos via email:

		The Office of Hawaiian Affairs (OHA) is in receipt of your letter dated April 2017 letter, initiating consultation and seeking comments ahead of a cultural impact assessment (CIA) for the proposed Kēalia Subdivison project located in Kēalia, what looks to be old sugarcane fields. OHA notes that even in heavily disturbed areas such as those parcels utilized for sugar cane cultivation, intact cultural deposits and resources, including ancestral human burials have been discovered beneath tilled areas. *OHA recommends consultation be initiated with Liberta Albao—president of the Queen Deborah Kapule Hawaiian Civic Club, Jerry Nakasone—kamaʻaina from the Kēalia plantation camp area, and Puanani Rogers – Hoʻokipa Network-Kauaʻi.* *Thank you for the opportunity to comment.* (see Appendix A)
Freitas, Gerald	*Kamaʻāina*	Letter and figures sent via USPS on 24 April 2017 Mail returned; no mail receptacle, unable to forward.
Freitas, Jerome	*Kamaʻāina* (referred by Kenneth Ponce)	Mr. Freitas reached out to CSH via telephone on 24 May 2017. He informed CSH that Mr. Kenneth Ponce had told him to call, and suggested posting ads in the newspaper. He suggested it would be a good idea to reach out to as many individuals as possible, and that he would be willing to participate in a large, sit down gathering.
Garcia, Herbert and Evelyn	*Kamaʻāina*; former plantation workers (referred by Moana Palama)	CSH reached out via telephone on 24 April 2017. Speaking to Mr. Herbert Garcia, he provided CSH with his address to forward letter and figures. Letter and figures sent via USPS on 24 April 2017 Letter and figures sent via USPS on 10 May 2017
Hopman, Arius	Artist (referred by the Kauaʻi Historical Society)	CSH reached out via telephone on 5 May 2017 and left a message. Letter and figures sent via USPS on 8 May 2017.

Kaneakua, William	*Kamaʻāina*	Mr. Kaneakua previously participated in an interview with CSH for the Bushnell et al. (2002) report. Letter and figures sent via USPS on 29 April 2017 Letter and figures sent via USPS on 10 May 2017
Hoomanawanui, Kauanoe M.	Burial Site Specialist, SHPD (Hawaiʻi and Kauaʻi)	Letters and figures sent via email on 18 April 2017 Letter and figures sent via email on 15 May 2017
Hoʻopii ʻOhana	*Kamaʻāina*	Unable to locate email or mailing address
Kano, Yoshida "Dimples"	*Kupuna*	Letter and figures sent via USPS on 9 June 2017 Mrs. Yoshida Kano reached out via telephone on 28 June 2017, notifying CSH that she is willing to help out or provide information. She added, however, that most of the former Keālia plantation workers have since passed on.
Kauai Council of Hawaiian Civic Clubs	Association of Hawaiian Civic Clubs	Letter and figures sent care of Association of Hawaiian Civic Clubs. Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via email on 15 May 2017
Kauaʻi Historical Society		Letter and figures sent via USPS on 18 April 2017 The Kauaʻi Historical Society responded via email, providing CSH with scanned documents regarding the history of Keālia, links to historic plantation and government maps, and links to finding aids (see Appendix B). CSH replied via email on 2 May 2017 thanking the Kauaʻi Historical Society for their guidance and assistance.
Kaui, Richard	*Kamaʻāina* of Keālia; lives on *kuleana* parcel in the valley	CSH reached out to Mr. Kaui via telephone on 24 April 2017. Mr. Kaui agreed to participate in the interview, requested CSH call in mid-May to set up a formal interview. He provided CSH with his address to forward letter and figures. Letter and figures sent via USPS on 24 April 2017. Interview scheduled for 23 May 2017. Interview conducted on 23 May 2017.

		Interview summary approved over telephone on 30 January 2018.
Kaye, Kaulana	*Kama‘āina*	Letter and figures sent via email on 18 April 2017 Letter and figures sent via email on 15 May 2017
Kekua, Kumu Kehaulani	Kauai Heritage Center/Ka‘ie‘ie Foundation	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Kon, Arlene	Native Hawaiian Education Council	Letter and figures sent via email on 18 April 2017 Letter and figures sent via email on 15 May 2017
Milnes, Les	County Planning Inspector	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Muraoka, Beverly	*Kupuna*; *kumu hula* (retired)	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017 Mrs. Muraoka replied via letter on 15 May 2017: *Thank you for your letter dated April 2017 regarding Kealia Properties, LLC, CSH and Helber Hastert and Fee (HHF) Planners for a CIA for a proposed Subdivision, TMK: 4-4-7-9-001 and 002.* *I confess that my background and/or knowledge of this subject discussed herein are limited to the following:* *The proposed site may have been used for sugar cane and, therefore, may include irrigational ditches, ‘auwais, and other used water systems by the early settlers;* *The site may also possess high content of chemicals used for fertilizer, rodent control and mosquito sprays.* *Gathering of plants, leaves for medicine, and the like, may have been used by the old-timers but may not be available as was then thus, a botanist or horticulturalist should be consulted if these still can be found e.g. popolo, laukahi, ‘uhaloa, etc.*

		The site may also be in line of the 'night marchers' from Mt. Makaleha to Kealia Beach. [Night marchers, also identified as *huakaʻi po* or *oiʻo* (spirit ranks), are often referenced in many tales; spirits were said to "return to the scenes they knew on earth in the form in which they appeared while alive" (Beckwith 1970:164). The timing of their visits were generally confined to "certain sacred nights to visit the sacred places, or to welcome a dying relative" and lead their spirit to the land of Pō (Beckwith 1970:164)] *Most of the kupuna and/or elders of the Kealia I grew up with are now deceased; however, I give the following names for your contact. They are the Hoʻopii family, Herman Chong family, and the only person (in her 90's) would be former Realtor, Dimples Kano.* *As always, I would be pleased if any future comments for this project be allowed that may be impacted upon it, it may be granted to me.* *I noticed via the maps submitted the Halaula Reservoir is in direct path to the project. Please ensure no other project like the Kaloko Dam ever occurs. This includes the Kumukumu Stream.* (see Appendix C) *Again, I offer this limited knowledge in hope that ALL aspects are discussed thoroughly that the people may benefit therefrom.*
Nakasone, Jerry	*Kamaʻāina* from the Keālia Plantation Camp area	Unable to locate an email or mailing address
Oi, Tommy		Letter and figures sent via email on 18 April 2017 Email bounced back Letter and figures sent via USPS on 10 May 2017
Ornellas, Jerry	Expert, founder and president of East Kauaʻi Water Cooperative	Mr. Ornellas previously participated in an interview with CSH for the Bushnell et al. (2002) report Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017

Ponce, Kenneth, Jr.	*Kama‘āina*; descendant of Pedring and Crescencia Ponce	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017 Interview scheduled for 22 May 2017 Interview conducted 22 May 2017 Interview summary approved over telephone on 22 August 2017
Prigge, Joseph Jr.	*Kama‘āina*	Mr. Prigge previously participated in an interview with CSH for the Bushnell et al. (2002) report Letter and figures sent via USPS on 29 April 2017 Letter and figures sent via USPS on 10 May 2017
Reis, Timothy	Cultural practitioner and *mahi‘ai* in Keahapana (Keapana) Valley, Keālia Ahupua‘a; relative of the Bray ‘Ohana	Mr. Timothy Reis reached out to CSH via email on 5 June 2017: *I recently was made aware of a request for information, regarding a residential development project in the Kealia area.* *I am a farmer in the Keahapana Valley. I farm on parcel number 470030090000, with permission of Kenneth Bray through his daughters Chenoa Bray, Cholena Bray and Ginger Bray* [copied on email correspondence]. *On this property is a spring which feeds a taro patch which historically fed the Kaui Ohana.* *This message is to serve as notice to you of the Bray Ohana's interest in this area and the concern that the aproposed development could have on their cultural practices and those of their descendants.* *The source of water needed for the proposed 200+ homes could affect the aquifer that is the source of the spring on the property we farm.* *We request that you provide us with evidence that proves the proposed project will not negatively impact our cultural practices.* *If you have any questions or require additional information, please let me know.* CSH replied via email on 15 June 2017, requesting a telephone number to discuss the CIA further.

		Mr. Reis replied via email on 15 June 2017, providing the telephone number of Ms. Cholena Bray. CSH reached out to Mr. Reis via email on 17 November 2017: *. . . We are attempting to round out our CIA for the Kealia Subdivision project. I was hoping that we may be able to set up a formal sit-down interview with you. CSH's cultural advisor, Mr. Aulii Mitchell (copied on this email) will also be in attendance. We were hoping to visit Kauaʻi sometime near the end of this month or beginning of December, and perhaps meet with you during this period?* CSH reached out to Mr. Reis via telephone on 16 November 2017. Mr. Reis replied via email on 17 November 2017: *. . . As a reminder, I originally contacted you to notify you of the use of a spring that I felt could be impacted by the proposed development. I am the Hoaaina and was authorized to make contact in order represent and protect the land owner's interest. We requested proof that the approx. 2 million gallons a month (10,000 gallons x 200 homes) or 24 million gallons a year needed for the proposed project would not negatively impact our cultual practices. I recognize that what I am requesting may be beyond your company's responsibility. I and the land owner would be willing to meet with you and your company to discuss our established cultural practices in the Keahapana Valley. I have copied the land owner on this email.* CSH followed up with an email clarification on 17 November 2017: *E kala mai, I sent the last email a bit prematurely, as I'm still trying to work out schedules, and determine who among my colleagues will be assisting me on Kauaʻi. I will update you once I determine this. Please do not disregard the last messages, as we would like to follow up with you, per your request made in testimony before the LUC. I would just like to reiterate that we are hoping to set up a formal*

		interview, to round out the CIA, and address your comments as presented before the LUC. I want to also take the time to explain the role of CSH as it pertains to the CIA. The proposed Keālia Subdivision project is subject to State environmental law that requires assessing impacts to the natural environment and cultural practices. To meet this requirement, project proponents must retain neutral third party consultants to conduct studies related to this compliance process. CSH has been asked to conduct this study and reach out to the community. The purpose of our outreach efforts is twofold: to inform the community of the proposed project, and to identify, through consultation with knowledgeable individuals in the community, ongoing or past cultural practices occurring or that have occurred within the project area. Through community consultation, CSH can evaluate potential adverse effects on the cultural practices and cultural resources of the community and State. This is in compliance with Act 50 of State law. As outlined in Act 50, CSH is limited to only "identify[ing] and address[ing] effects on Hawaii's culture, and traditional and customary rights" (State of Hawaiʻi Act 50 2000). As we our still gathering information on cultural practices, in relation to the proposed project, it is extremely difficult to comment on potential negative effects to cultural practices at this time. Also, as of this time, an engineering report, evaluating the existing water system and proposed water system, is being drafted. This report will be included within the Draft EIS, available for review through the OEQC website. The consultant would also like to provide you with a hardcopy letter notifying that an EIS Preparation Notice has been drafted. Generally, this prep notice informs the public that an EIS is being drafted, what will be included within the EIS, and ways in which the public can speak to the project. Is it possible to receive a mailing address so we can send you relevant information as it becomes available? Or would you prefer

		correspondence to occur over email? Currently, I am available November 27, 2017 and December 1, 2017. Do any of these dates potentially work for you and your family? Mr. Reis replied via email on 6 December 2017 to coordinate a meeting time and provide a mailing address. CSH replied via email on 6 December 2017 to schedule an interview date. Mr. Reis replied via email on 7 December 2017 to confirm an interview date. CSH replied via email on 8 December 2017 confirming an interview for 21 December 2017. Interview scheduled for 21 December 2017. Mr. Reis reached out to CSH via email on 12 December 2017 to confirm interview location. CSH replied via email on 13 December 2017: *Would it be possible to meet you at the farm property and/Or visit the spring? If that's not possible, please let us know of any location that is most convenient for you.* Mr. Reis replied via email on 18 December 2017: *I would love to meet at our property, but it may not be safe. The property is under the canopy of a massive Monkepod Tree. The tree has termites and there are dead limbs that fall, usually when the wind blows. I would be more than happy to provide you with photos of our taro patch and the spring. We could meet at Kealia Beach, in the area of the subject properties, at one of pavilions. If the weather is bad we could meet at a coffee house.* CSH replied via email on 19 December 2017 to confirm interview location at Keālia Beach Pavilions. Interview conducted on 21 December 2017 at Keālia Beach Pavilions. Mr. Reis reached out to CSH via email regarding his interview summary on 19 February 2018: *After reading the attached Summary, I think you did an excellent job in documenting our correspondences. For the record, we might disagree on some aspects of "native tenant" vested rights and the process in which they were*

		exercised, but that is to be expected due to the complexity associated with this topic in relation to our current situation. In closing, I agree with the information provided in the Summary with the exception of the topic noted above. CSH replied via email on 19 February 2018 asking which section Mr. Reis disagreed with, and if he would like these edited or removed from his summary. CSH reached out via telephone on 20 February 2018 to confirm if Mr. Reis would like anything edited or removed from his summary. Mr. Reis replied via email on 28 February 2018: *No, you don't need to change anything in your Summary. I believe you have accurately documented correspondences and the land tenure system, as it is commonly understood. For the record, I needed to disagree with with the "native tenant" analysis based on the current interpretation.* Interview summary approved via email on 28 February 2018
Rodgers, Puanani	*Kamaʻāina*; Hoʻokipa Network	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Rodrigues, Hinano	Cultural Historian/Acting History and Culture Branch Chief, DLNR-State Historic Preservation Division-Maui	Letter and figures sent via email on 18 April 2017 Mr. Rodrigues replied via email on 19 April 2017: *The point of a CIA is solicit, obtain, document and discuss whether or not a project will have an impact on cultural practices in the project area. In order to make that determination, you must first determine whether or not there was a cultural or traditional practice in the past, is it ongoing, and if not, will there be a negative effect in the future. All that said, the most effective and efficient method would be to seek out people who currently live in the area. Canvassing the neighborhood is the ideal start. I've included my Kauaʻi Burial Site Specialist in this response in case she has anything to*

		contribute. She not only works there, she was raised there. Aloha no.
Santos, Kaliko	Community Outreach Coordinator, OHA; Nā Kuleana o Kānaka ʻŌiwi	Letter and figures sent via email on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Say, Barbara	*Kupuna*	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Smith, Kamealoha Hanohano	Board President of Kaiaulu Papaloa	Mr. Kamealoha Hanohano Smith reached out to CSH, on behalf of Kaiaulu Papaloa representing members of the Kealia Community, on 7 June 2017: *My name is Kamealoha Smith and I am the current Board President of Kaiaulu Papaloa. Kaiaulu Papaloa is now working with some Kealia Community members to address the Kealia Proposed Subdivision. The group wrote a letter and this letter is attached* (see Appendix D). *This is in response to the Cultural Surveys CIA letter to request for information.* *Please feel free to contact me. . . if you have any questions. We look forward to speaking to you in the near future. An original will be sent through mail today for your records.* CSH replied on 7 June 2017: *I am sending confirmation of my receipt of your email and the attached letter. I will reach out again sometime early next week to discuss the details and/or pose any questions. I am still processing this information, and want to make sure that I have taken the time to carefully review it, and have developed a thorough understanding of the information that you and the hui have presented. Mahalo for sharing this with me.* Kamealoha Smith on behalf of Kaiaulu Papaloa representing members of the Kealia Community, notified CSH via email on 12 June 2017 of the following: *. . . there will be a change in regards of the person you will be working with in our community. I will be passing this kuleana on to*

		an extremely qualified individual in our community. Once its official, I will have him contact you. I work as the Community Liaison for Rural/Indigenous Development. Kamealoha Smith on behalf of Kaiaulu Papaloa representing members of the Kealia Community, sent a follow up letter on 17 June 2017. The letter included new contact information and additional community concerns (see Appendix E): *This is a follow up to our letter of 7 June 2017. As a reminder, our Hui is a group of native Hawaiians, including the kupuna, with ties and interests in Kealia. Kaiʻulu [sic] is a nonprofit organization which has been selected by the Hui to communicate their interests on this matter. They have chosen this vehicle because they fear reprisal from the land manager and its contractors.* *Kaiʻulu [sic] will remain the buffer between the hoaʻaina and the landowner at this point, but the direct point of contact will now be Timothy Reis. . . Written correspondence can go to the Kaiʻulu [sic] address below.* *On another note, it is our understanding that you, and/or, the landowner have been in contact with State DLNR-SHPO on Kauai regarding this issue. This is of great concern because the current land manager for the Kealia property and development has familial relationships within this department. This is an obvious conflict of interest, compromises good faith discussions, and jeopardizes the process' compliance with State law.* *Can you please confirm who you have spoken with regarding this issue so that we understand who is now involved in what we had hoped could be a private discussion*. Dr. Hallett Hammatt, on behalf of CSH, replied via email and USPS on 10 July 2017 (see Appendix F): *We would like to explain the role of Cultural Surveys Hawaii (CSH). The proposed Kēalia Subdivision project is subject to State environment law that requires assessing impacts*

		to the natural environment and cultural practices. To meet this requirement, project proponents must hire neutral third party consultants to conduct studies related to this compliance process. CSH has been hired to prepare a Cultural Impact Assessment (CIA) and a Literature Review and Field Inspection (LRFI) for the subject parcel. It is CSH's responsibility to conduct an objective study, to gather information from concerned community members, and to compile the information gathered into a report that becomes part of the public record. Through the consultation process, as well as the public's review of completed studies, the public has an opportunity to speak to this project. *As part of our CIA it is standard practice for us to contact people in the community, as well as key stakeholders (including the government and its appropriate agencies). As part of this process, we also reach out to the Office of Hawaiian Affairs (OHA), the Kaua'i and Ni'ihau Island Burial Council, and the State Historic Preservation Division (SHPD) (Burial Sites Specialist and History and Culture Branch). The purpose of our outreach efforts is twofold: to inform the community of the proposed project, and to identify, through consultation with knowledgeable individuals in the community, ongoing or past cultural practices occurring or that have occurred within the project area. Through community consultation, CSH can evaluate potential adverse effects on the cultural practices and cultural resources of the community and State. This is in compliance with Act 50 of State law. As outlined in Act 50, CSH is limited to only 'identify[ing] and address[ing] effects on Hawaii's culture, and traditional and customary rights' (State of Hawai'i Act 50 2000). CSH can only go so far as to identifying 'significant effects,' and recommending mitigating actions based directly on stakeholder comments.* *In order for us to remain neutral third parties, we cannot directly advocate for, or represent the*

		hui or represent the landowner in any way. CSH cannot act as a mediator between the Keālia Hui and the landowner, nor can we actively participate in mitigation.
Solis, Kaahiki	Cultural Historian (Oʻahu, Kauaʻi, and Niʻihau)	Letter and figures sent via email on 18 April 2017 Ms. Solis replied via email on 19 April 2017; CSH replied via email on 19 April 2017.
Vasquez, Stanley	*Kamaʻāina*	CSH reached out via telephone on 24 April 2017. CSH left a voice message.
Vidinha, Wayne Reverend	Ke Akua Mana Church	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Wichman, Randy	Executive Director, Kauaʻi Historical Society	Letter and figures sent via USPS on 18 April 2017 Letter and figures sent via USPS on 10 May 2017
Yap, Keith	Vice-Chair, Kauaʻi Island Burial Council	Letter and figures sent via email on 18 April 2017 Letter and figures sent via email on 15 May 2017

6.4 *Kamaʻāina* Interviews

The authors and researchers of this report extend our deep appreciation to everyone who took time to speak and share their *manaʻo* and *ʻike* with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

Interviews were conducted in accordance with Federal and State laws and guidelines with individuals knowledgable of the general history, present and past land use, traditional gathering practices (both past and ongoing), and cultural sites of the project area and Keālia Ahupuaʻa. The following analysis of *kamaʻāina* interviews is intended to facilitate the identification of potential impacts to cultural resources, ongoing cultural practices, and/or cultural sites within the project area or its immediate vicinity. As the current CIA involves the study of Keālia Ahupuaʻa in its entirety, CSH recognizes the importance of discussing cultural resources, cultural practices, and cultural sites outside of the proposed project area.

6.4.1 Summary of Kenneth Ponce Interview

CSH interviewed Mr. Kenneth Ponce on 22 May 2017 at the Courtyard Kauaʻi in Kapaʻa, on the island of Kauaʻi, for the proposed Keālia Subdivision project.

Mr. Kenneth Ponce was born and raised in the Kapaʻa and Keālia area of Kauaʻi. He is the son of Mr. Antonio and Margaret Ponce, and the grandson of Mr. Pedro and Cresencia Ponce, former sugar plantation workers and early entrepreneurs within the Keālia area. Mr. Ponce is of Japanese-Filipino ancestry, and is a retiree of the Kauaʻi Fire Department.

Mr. Ponce, a *kamaʻāina* of Keālia, recalled the days of his youth; he spoke of the many hours spent surfing and fishing at Keālia Beach, hunting pheasant in the *mauka* lands of Keālia, watching chicken fights at Kumukumu Camp, and bathing at Waipaheʻe Falls. Today, Mr. Ponce resides with his family in Kapahi.

CSH inquired into his family's connection to the *ahupuaʻa* of Keālia. Mr. Ponce explained that his family's connection to the *ahupuaʻa* was established through the plantation experience. Keālia as well as nearby Kapaʻa, were once thriving plantation towns. His grandparents, Pedro and Crescencia Ponce, arrived on Kauaʻi in the early 1920s, brought as laborers to work in the cane fields.

The genesis of Hawaiʻi's unique *kamaʻāina* culture can be traced back to these populations of multi-ethnic working class people drawn together by the plantation experience. Workers like Pedro and Crescenia Ponce, "helped create the changes that saw Big Five control over Hawaii give way to multi-ethnic participation in a more democratic society" (Taniguchi in Nishimoto et al. 1984:Foreword). Pedro and Cresencia met during the territory-wide Filipino plantation strike of 1924 (Nishimoto et al. 1984:107).

> Pedro was first assigned to Hanamaulu Plantation, where he did *kālai,* or cutting of sugar cane. Just prior to the strike, he was given the job of irrigation ditchman, supervising nine co-workers near Wailua Falls. In 1924, Pedro decided to join the strike and moved to the Kapaa strike camp located in the Hee Fat building. He solicited food donations from nonstrikers and earned needed money planting coconut trees on private land.
>
> At Kealia Plantation, Cresencia worked briefly as a laundress, then as a plantation laborer, stripping and bundling sugar cane leaves. She later joined her sister at the Kapaa strike camp where she became acquainted with Pedro. [Nishimoto et al. 1984:107]

Following the strike, Pedro and Cresencia married; they were determined to begin their life together off the plantation. Mr. Ponce commented that during this time, his grandparents relocated to Mailihuna Road (south of the current project area). Their move to the rural, yet tightly knit community of Keālia provided them with a unique entrepreneurial opportunity. Pedro Ponce noticed that both Keālia and Kapaʻa Town lacked a barbershop. With skills acquired in the Philippines as a young boy, Pedro Ponce founded his own barbershop. The dynamics of the barber shop, where a "man having a shave, with a razor to his neck, creates a place of delicacy, of gentleness, of absolute trust" (*Economist* 2017; Ellams 2016), allowed for a high degree of intra-community socialization. The barbershop, as both hub and newsroom, allowed for Mr. Ponce to know "almost everybody" in the Kapaʻa and Keālia communities.

Mr. Ponce held fond memories of his grandmother, Cresencia Ponce. Cresencia was known throughout Kauaʻi as a practioner of *hilot* (ancient Filipino art of healing or traditional midwife). Mr. Ponce commented that she had used her gift to heal many people on the island. Women often sought Cresencia during difficult or complicated pregnancies. Cresencia was particularly skilled at fixing a baby that was "*huli*" (head-up breech position) or turned improperly in the *‘ōpū* (womb). Women struggling to conceive also sought out his grandmother; after she touched them they were able to conceive. His grandmother, a devout Catholic, believed her healing power "came from God and that it would be wrong to profit from it" (Nishimoto et al. 1984:108). In 1978, both Pedro and Cresencia were interviewed for *Hanahana: An Oral History Anthology of Hawaii's Working People* (Nishimoto et al. 1984). Cresencia described the history of her healing abilities in detail:

> This thing started when I was only thirteen or fourteen years old. I didn't like to take it on myself because I was still a child, but my parents wanted me to do it. My father said to me, 'Ning, I think you have been chosen by the Lord. You can help your own family and help others.'
>
> You see, my father was a healer. He was really very skillful. He never went to school like doctors, of course, but he was an excellent doctor.
>
> He would bring different roots and grasses home, wash them off, and clearly label them so that he would have medicines available for any kind of sickness. And the medicines would sometimes be applied to the outside of the body and sometimes, boiled with water and drunk.

Mr. Ponce commented that his grandmother also gathered and utilized plants for her healing practice; these plants were generally grown on the Ponce Family's lands. Regarding his family's land holdings, Mr. Ponce commented that "their [his grandparents] home overlooked Keālia Beach, and they owned several parcels of land *mauka* of Keālia Beach." In 1958, Mr. Ponce moved into a home right next door to his grandparents.

Mr. Ponce described to CSH what it was like growing up in Keālia in the early 1960s. The community of Keālia was quite small, with limited development and rural infrastructure. He noted, "There were no stop lights when I grew up here, there was no nothing. Just the main highway, just Kūhio Highway was in existence." However, the area was occupied by numerous plantation-style homes, as well as a subdivision. He explained,

> [The subdivison] was built in the early 1950s. So, it was built. I remember this when I was a kid. But, you see this is the upper elevation. There was another Keālia Camp on the lower [elevation], right across from the bridge. There [were]. . . maybe hundreds of homes.

Despite many families making their home in Keālia, Mr. Ponce recalled the relative isolation of the area. He and his friends would often have the beach all to themselves.

> Growing up there, we used to walk down Keālia Beach whenever we could. My grandparents used to fish, also down Keālia, so we used to fish. I used to go with my friends, summertime, whenever we could, to go body surfing and boogie boarding. We'd make our own plywood boogie boards and we'd stay there the whole day. It was just me and my friends and nobody else. Yes, the whole day.

Mr. Ponce also identified Kapa‘a Stream as a freshwater resource southeast of Keālia Beach. Mr. Ponce commented that this stream is occasionally confused as "Keālia River" by some local residents. This mistake may be attributed to the fact that Kapa‘a Stream forms a portion of the southern boundary of Keālia Ahupua‘a. However, the smaller Keālia Stream does share headwaters with Kapa‘a Stream; both originate from Pu‘u Eu, a peak in the Anahola Mountains.

Mr. Ponce would often fish with his grandmother in Kapa‘a Stream. They generally sought out *‘o‘opu* (freshwater goby), a favored eating fish for his grandmother. *Pāpio* (bluefin trevally) and *ulua* (giant trevally) were also caught near the mouth of Kapa‘a Stream. Freshwater *‘opae* (shrimp) were also collected from the stream and used as bait. Mr. Ponce also recalled picking *‘opihi* (limpet) at Keālia Beach. Mr. Ponce revealed that fish had once been plentiful in the waters off Keālia, particularly *pāpio*.

CSH inquired into traditional agricultural practices in the area, asking if Kapa‘a Stream was also utilized to irrigate *lo‘i kalo* (taro patches). Mr. Ponce shared that the area was predominately sugarcane, and that taro was not cultivated while he was growing up. However, he did note that taro is grown in portions of Keālia today. CSH asked if there were any additional freshwater resources within the project area. Mr. Ponce commented,

> Yeah, just below here, just below Keālia Road, this is a stream. I believe there’s also a spring here, and on the other side is Kapa‘a Stream . . . I know there’s water, because I used to go back here all the time, I guess it used to intersect with Kapa‘a Stream also. I know there’s water coming down here, yeah, and I know this is level, then it goes down. They might have water down here, but I know when it rains the water goes down here, and the water goes out to the ocean. But on this flat area, I don’t know, other than having the plantation bring in the water through all the irrigation ditches. I don’t remember up there [having a flowing] stream. It’ll be down on the slope side.

CSH asked if these waters were being used to irrigate farmland, or if former sugarcane lands had been converted to farmlands; Mr. Ponce shared that “it is called Keālia Farms, and I believe there’s a gentleman leasing a lot of acreage back in this area.”

While discussing potential *mauka* resources, Mr. Ponce shared that he and his father would hunt for pheasant in the upland areas. Although the lands belonged to the sugar plantation, they were allowed to hunt in the area. Mr. Ponce recalled,

> My father and I, when I was growing up, there were no gates, and we’d spend hours and hours hunting in all these lands. We’d traverse this whole area. We’d come back for lunch and then go out again. This was all just our backyard, and we’d go from *makai* to *mauka*, and hunt for hours and hours. The whole weekend we’d be gone. . . we’d use all the plantation, cane field roads. That’s how we went and did our hunting. The cane fields would go up all the way against the mountain side so we’d just go up to the bottom of all these beautiful mountains. It’s just very beautiful. The access was all open. Now, it’s all closed; back when I was growing up in this area, we could just traverse the whole Keālia area. It was unreal, it was amazing.
>
> . . . my father and I used to hunt pheasants, and we used to keep the feathers, and we used to eat the meat. My mom used to cook the pheasants. . . We gave [the feathers] to our relatives to makes *lei*s on O‘ahu. So, they’d make hat bands [*lei humu papa*]. My dad was also a taxidermist. He was self-taught, and he taught

> himself to mount the pheasants that he shot. He also mounted pheasants that people shot and brought over.

In pointing out the areas where he and his father had hunted, Mr. Ponce shared that a stable and a plantation camp were once located in the Kumukumu area of Keālia.

> . . . see, up this road [pointing to an aerial image of the project area]? Up in this area? They kept mules for the plantation in the stables. There were also plantation homes in the area. It was called Kumukumu Camp.

He commented on the demographics of the individuals living in the camp and the Keālia area,

> We had a lot of Portuguese families around us, a few Filipinos, very few Filipinos, Japanese, Hawaiians, we had a few Hawaiian families. Large families that had twenty kids.

He also recalled a hall located on the north side of the Kapa‘a Stream there. The hall (now demolished) was a space for the plantation workers to hold events:

> Now that I remember, right across Kūhio Highway, right at the end of the camp, next to Keālia River [Kapa‘a Stream] there was a hall, and we’d have parties there. It was like a town hall. It was super cool, we’d have parties there. Whenever people celebrated a birthday or whatever, we’d have a party there. . . there was a roadway just past Keālia Bridge, just past the bridge heading north, there’d be a sharp left turn to get to the hall.

Filipino cultural practices also continued to occur in the area of Kumukumu Camp.

> Next to where they kept the mules, I was saying there were homes next to the stable, they also had chicken fights. So, my father and I, we’d be there every weekend, back in the ‘50s, ‘60s, ‘70s, ‘80s. Yeah, I believe ‘80s, and we’d go fight chicken. I used to tag along with my dad, in that area, in that camp, was mostly Filipino families. Yes, I guess it was mostly ‘60s and ‘70s when it was really a big thing going up there and going to the chicken fights with my dad.
>
> It was a cultural thing that Filipinos brought over from the Philippines. My grandparents also were at the chicken fights, so they’d be there with us too. My grandmother, and my grandfather.

CSH inquired if Mr. Ponce had ever seen any cultural sites, or if he had been shown *wahi pana* in the *mauka* portions of Keālia, near Kumukumu. He noted that he was never informed of any cultural sites such as *heiau*, and never encountered any cultural sites while visiting the *mauka* areas of Keālia. However, he did recall the *wahi pana* known as Waipahe‘e Falls. He shared with CSH his memories of this storied place.

In his youth, Mr. Ponce was contracted to work in the private pineapple fields. He mentioned that in those days, all the old timers had 20-acre tracts of land that were purchased in the early ‘60s. These tracts were once located up Kawaihau Road, up in the Kapahi area, where the old pineapple cannery once stood. In 1957, the pineapple canning industry in Hawai’i peaked, and “of the Kauai companies, only Hawaiian Fruit Packers (HFP), which was formed in 1937 by the reorganization of a company initially started by a group of ethnic Japanese growers, survived into the 1960s" (Bartholomew et al. 2012). While recalling the cannery, he shared that the leftover pineapple cuttings were dumped into the waters off Keālia, further *makai* of the proposed subdivision. Mr. Ponce himself worked in the Kawaihau Road cannery, as well as the private fields. After a long and hot day of work, Mr. Ponce and his friends would reward themselves with a visit to Waipahe‘e Falls. He described the event,

> . . . Waipahe‘e Falls is a natural slide, and we'd go up there constantly, after we'd pick pineapple. Summer time, I'd be working in the pineapple fields, and we'd go up there, that was our recreation, because there was no McDonald's, there was no Burger King, there was nothing there, except the mom and pop stores. No stop lights, no nothing.
>
> That was our treat to go up there, and swim up at the falls, and slide down the falls. . . it's very, very beautiful. . . it's way up in the mountains, so it's just *uluhe* [false staghorn fern; *Dicranopteris linearis*], *awapuhi* [shampoo ginger; *Zingiber zerumbet*].

Prior to concluding the interview, CSH inquired if Mr. Ponce was aware of any burials that may be impacted by the proposed project. He commented that he had never seen any burials uncovered by either human or natural disturbance in the area. CSH asked Mr. Ponce if he had any additional concerns or recommendations regarding the proposed project. He commented that he personally does not believe the project will impact any view planes, including views of Kalale‘a, Waipahe‘e, and/or Makalea. He concluded by stating that he does not believe the project will have any cultural impacts:

> Actually, when I saw this project I had a good feeling about it. Because what they're doing is extending part of the existing subdivision. Like I said, I don't think it will impact anything. . .when I looked at it, I felt good about it, that somebody had a good idea to put a subdivision next to an existing subdivision. Right now, it's out of the *tsunami* (tidal wave) zone, so I think it's an asset.

6.4.2 Summary of Kupuna Valentine Ako Interview

CSH interviewed Kupuna Valentine Ako and his son Ivan Ako on 25 May 2017 at his home in Kapa‘a, Kaua‘i. Known affectionately as "Uncle Val," Kupuna Ako was born in 1926 in Hōlualoa, on Hawai‘i Island. He has resided in Kapa‘a, Kaua‘i for over 50 years, and moved to the island shortly after his marriage to Elizabeth Ka‘onohi Johnson. Together they raised four children: Blanche (Kepola), Valerie (Nani), Ivan (Kaho‘onani), and Julie (Mamo) in their home at Wailua House lots on Makani Road. They also have numerous grandchildren and great-grandchildren. Kupuna Ako was a curious child, and made it a point to ask questions and learn from the *kūpuna* around him about Hawaiian cultural practices, beliefs, and resources. He is knowledgeable about old fishing practices, *wahi pana*, and the traditional way of life which respects the environment, as well as numerous *mo‘olelo* regarding Hawaiian culture, history, and its people.

Kupuna Ako began the interview by sharing his *mana‘o* regarding the proposed Keālia Subdivison project. Kupuna Ako was especially concerned about potential subsurface finds. He stated that finds may consist of traditional Hawaiian cultural material, including burials. He recommended that both developers and on-site workers be aware of, and take care of any *iwi kūpuna* or *imu* (underground oven) found. He stated,

> My *manaʻo*, that should you folks develop, or come across *iwi* [bones], *iwi* and *imu*. You know our *kūpuna* never had anything to do their cooking in [such as pots]; they did all their underground cooking. You're going to find all those *imu*.

Years of learning and work experience have allowed Kupuna Ako to develop an understanding of proper burial protocol. He shared with CSH two personal *moʻolelo.* These *moʻolelo* recounted the significant events that shaped his understanding of how to properly care for human remains. His first *moʻolelo* related his experience in helping to recover the bodies of over 10,000 fallen soldiers from the Battle of Guadalcanal.

The Battle of Guadalcanal was fought from 7 August 1942 to 9 February 1943, and was the first prolonged Allied campaign in the Pacific Theater. The battle was fought across the southern Solomon Islands of Guadalcanal, Florida, and Tulagi. Following the 1941 attack on Pearl Harbor, the Solomon Islands became a focus for both Allied forces and the Empire of Japan. The islands were strategically situated at the center of vital shipping lanes in the Pacific. After a long and bloody campaign, with casualties numbering nearly 30,000 (7,100 casualties for Allied forces and 19,200 casualties for Imperial Japan), Guadalcanal was finally won by Allied forces. Kupuna Ako recalled,

> [Beginning in 1947], I was in the Solomon Islands for over two and a half years. You know, it was unique, and they did it [in] secret. There were 700 non-violent prisoners in Oʻahu Prison. They made a deal with those prisoners, if they go to Guadalcanal and be stevedores, to transport all those bodies, they [would] agree [to commute their sentences]. So, for two and a half years we were down there. They had a camp for them, and they had 140 Filipinos to exhume the bodies. Over 10,000 [bodies]. It was so sad you know. I used to go down there, and the embalmers they get all [the] caskets, they get [a] Navy blanket. They find [a] dog tag, [but] no more head, so they roll it all up, and put it inside the casket. So, I was down there and we exhumed all that.

Kupuna Ako's second *moʻolelo* recalled his time spent as a construction supervisor for the historic Coco Palms Hotel. In 1978, Kupuna Ako oversaw the ground disturbance occurring at the hotel. During ground disturbance, the remains of 86 individuals were encountered. He shared,

> . . . *iwi* I excavated are from Coco Palms, but they were all sitting down facing east. I dug them all by hand. I had a good relation[ship] with Mrs. Guslander, the owner. She and I worked together, but I took care of all 86 bodies that I exhumed.

Although these historic events were significant for Kupuna Ako, his "cultural" education truly began in his formative years. He credits his *kūpuna* for instilling in him traditional cultural values as well as traditional knowledge:

> [I learned from] the *kūpuna*, my *tutu*s [grandparents], and all the *kumu* [teachers]. You know those days, the younger people never used to like *kūkākūkā* [discussion] with the *kupuna*s because they relate all in Hawaiian. But, I would sit down with them, and just sit down and listen. There were times when I couldn't comprehend what they were relating. Then, they would tell me, '*e keiki, ʻike ʻoe*? [child, you know?]' Or, they say do you understand? I would say, '*Aʻole.* [no]' And in broken English [they would explain]. So, I would find a lot of caves in Kona [Hawaiʻi

> Island], that nobody know until today. But, I will not reveal [their location] because of exploitation. I'm just thankful I was able to comprehend what they described to me. I was a very curious child, from the time I was young. They would tell me, oh a certain place, where from land there is a cave. I would ask them, ‘how would I find it?’ They say you go up in a particular area, and you're going to find the crabs come out of the lava rocks. I found ‘um. When I found it, and I was satisfied, I went and told the *kupuna*s, and they said, ‘yeah,’ and to leave alone. So, all this *mana‘o* I've gathered has helped me. I'm not afraid of exhuming a human being.

Drawing upon traditional knowledge, Kupuna Ako recommended that in the event of an inadvertent discovery of human remains, these remains will be properly curated and reinterred within Keālia Ahupua‘a. Kupuna Ako is strongly opposed to the relocating of *iwi kūpuna* to different *ahupua‘a.* Kupuna Ako also recommended that reinterment sites remain inconspicuous, with thoughtful or culturally appropriate landscaping.

Kupuna Ako lamented changes in traditional land management practices. Under the traditional land tenure system, Hawaiians had access to natural resources under the general supervision of *konohiki* (headman of an *ahupua‘a* land division under a chief). Upon reflecting on the adoption of Western land management practices, primarily private land ownership, Kupuna Ako acknowledged its negative effects. He shared,

> I'm familiar with land transactions, and the worst thing that ever happened to us Hawaiians was when they initiated the Great Māhele, adverse possession, and quiet title. My dad was an attorney and he learned the American system, and applied it against his own people. As an example now, the *kūpuna* come see my dad because we were one of the wealthy families in the village. He like buy one shoes. My father said, ‘yeah, I'll give you, but I like one interest in your property.’ But my dad knows that the guy no can pay back. In the meantime, he stay paying the tax for that guy. In adverse possession, that's when you pay the tax for ten years, and in 11 years you can claim. . .

Kupuna Ako's son, Ivan also shared his *mana‘o* regarding changes to land management practices and access rights. He shared with CSH, “even though we knew it was private land, a lot of us had access to it because we were family and we came from that area.” Elaborating further, he explained the tacit understanding between sugar plantation owners and the community in regards to accessing resources,

> . . . it was all sugar cane. It was all private property, but if you were known to come from that area, it was always OK for us to go fishing. My dad used to always go down to the beach and pick *limu kohu*, and all that kind of stuff.
>
> So, it was sort of an unspoken, ‘yes, you guys have permission,’ even though this is private. That's one of the issues coming up.
>
> The politics is so different. When I left 25 years ago, the plantations were still pretty much the rulers of what's happening on the island, because they had so much influence. But when the plantations left, all these new land owners came in, and they became the influential ones.

The need to maintain access to cultural resources is of the utmost importance to cultural practitioners. Additionally, these resources exist in a symbiotic relationship with the natural environment; degradation of the environment would invariably lead to degradation of cultural resources. Without healthy and abundant raw materials, it becomes increasingly difficult to perpetuate the culture.

Kupuna Ako continues to engage in cultural practices, and still makes *‘inamona* and *kūlolo* for consumption. *‘Inamona* is a condiment or relish consisting of roasted *kukui* nut and *pa‘akai*. He noted that the process of making this condiment is very time-intensive. Traditionally,

> The hard-shelled nuts were roasted on the embers of a fire or on hot stones to cook the kernels, care being taken to turn them from time to time to prevent the shells from burning. When one was cracked as a test, it was sufficiently cooked if the kernel had turned brown. The nuts were cracked and the kernels ground in a small stone mortar *(poho ‘inamona)* with a stone muller, salt being added to taste. In these modern days, some people add pepper. The *‘inamona* was served in the stone mortar or in small wooden or gourd receptacles or simply placed on a freshly plucked ti leaf. A small pinch was taken now and then with the fingers as a relish to the other food. Caution must be exercised in its use, as too much *kukui* oil has purgative properties. [Buck 1964:73]

Kūlolo is often described as Kaua‘i’s “dessert staple” (Toth 2015), and consists of mashed taro, coconut meat or milk, and sugar. Traditionally,

> [*kūlolo*] was made from grated raw taro which was probably once mixed with shredded coconut meat but which is now mixed with coconut cream. The mixture was wrapped in ti leaves and cooked in the earth oven. The raw taro was evidently grated on flat blocks of rough-surfaced coral. The preparation is referred to in Hawaiian accounts as ‘he mea ‘ono loa ‘ia’ (a very delicious food). [Buck 1964:21]

Kalo (taro), one of the main ingredients in Kupuna Ako’s *kūlolo*, is currently grown in Keālia. Mr. Ivan Ako shared that the local Keālia Farms, headed by Adam Asquith, contains numerous *lo‘i kalo* (taro patches). He added that Mr. Asquith also helps out local Keālia farmers, and is concerned about water (availability and quality) within the *ahupua‘a*.

Following discussion of traditional food items, Kupuna Ako shared *mo‘olelo* of an ancient race of giants (believed to have not been Hawaiian because mandibles were not of the rocker form) in the neighboring *ahupua‘a* of Kapa‘a and Wailua, within the larger *moku* of Kawaihau. The current project area is also situated within the *moku* of Kawaihau. He recalled excavating at Coco Palms, and observing the remains of extraordinarily large humans.

> You know the same type of human that I excavated [at Coco Palms in Kapa‘a], but the Lydgate Park, get a subdivision over there. They call it Kahalani. We found the same kind of people, but they were laying down flat, and they had *puka* [hole] on the head. Evidently, they may have had fought. In Ka‘u [Hawai‘i Island], there’s a place they call the Valley of the Giants. Same type of people. . .

Numerous *mo‘olelo* record the existence of giants (i.e., The *mo‘olelo* of the Giant Guard (Pukui and Curtis 1949); the *mo‘olelo* of Pōhaku o Kaua‘i (Armitage and Judd 1944:100; Westervelt

1915); the *moʻolelo* of the Giant Gods (Skinner 1900). For Kauaʻi Island, the *moʻolelo* of Kanaka Nunui Moe (Wichman 1985) and the Battle of the Giants (Knudsen 1946) are particularly salient.

Within the *moʻolelo* of Kanaka Nunui Moe, it is revealed that a giant resides in the low hills of Kawaihau behind Kapaʻa Town (Wichman 1985:14). The people of Kawaihau were said to have loved this giant; his gentle demeanor and generosity won him the hearts of the people. However, this giant was always sleepy, and found it difficult to stay awake for more than a "hundred years at a time" (Wichman 1985:14):

> When he could no longer fight against the drowsiness overpowering him, he would sleep using a small hill for a pillow. Because of this, the people called him Kanaka-nunui-moe, the sleeping giant. When he slept, Nunui slept for hundreds of years while the winds blew dirt over him and seeds were dropped there by the birds. The gentle showers sent by Ka-hale-lehua, goddess of the gentle rains, fed these seeds and a forest grew up over the giant. [Wichman 1985:14]

The Sleeping Giant is also known as the *wahi pana* of Nounou. From the top of Nounou, the coastline of Keālia is visible.

According to Kupuna Ako, the skulls recovered from Lydgate Park exhibited signs of trauma. He surmised that this may be associated with ancient warfare. Such warfare has been recorded in the legend of the Battle of the Giants. The legend, collected from an "old kanaka fisherman" from Kauaʻi, states the following,

> Hundreds of years ago a race of giants lived here in Hawaii. One great giant lived here in Mana and one lived on Niihau. One day they looked across the channel at one another and began to talk. First they bragged about their strength and size. Then they began to call each other names, and finally they got so enraged that they each grabbed a rock and hurled it at the other. The Kauai giant tore off a chunk of the pali back of Mana and it landed on Niihau, right on top of the other giant, and killed him instantly. His bones are lying underneath that hill, and if you dig in there you will find them. . . [Knudsen 1946:189–190]

The interview concluded with Kupuna Ako echoing an additional concern. While describing his concern, he recalled the tragic dam breach at Kaloko Reservoir that resulted in the deaths of seven individuals. The Kaloko breach was also considered an environmental disaster. He warned of a large reservoir at Kumukumu, above the current project area. He also noted that neither the State nor the County currently maintain the reservoir, adding that this reservoir, should it breach, would have a significant impact on Keālia *waena* (central) and Keālia *kai* (seaside).

6.4.3 Summary of Richard Kaui Interview

CSH interviewed Mr. Richard Cummings Kaui on the lands currently managed and cultivated by Keālia Farms on 23 May 2017 for the proposed Keālia Subdivision project (Figure 26 and Figure 27). The parcel currently cultivated by Keālia Farms consists of 20 acres located within Keālia Waena. Mr. Adam Asquith, owner of Keālia Farms, also attended the interview.

Mr. Kaui maintains a longstanding and familial relationship with Keālia. He is particularly connected to Keapana (or Keahapana). His connection to Keālia may be traced back through the generations, and through the many ancestors born and raised within the *ahupuaʻa*. As noted by the

Figure 26. General overview of Keālia Farms property with Nounou visible in background, view to northwest.

Figure 27. General overview of *loʻi kalo* located at Keālia Farms within Keālia Waena, view to southwest

geographer Edward Relph (1976:231), "there is a deep association with and consciousness of the places of birth and childhood. This association. . .[is] a vital source of individual identity, cultural identity, and security (Andrade 2014:7). His attachment to Keālia is evident within his personal stories as well as the *moʻolelo* of his ancestors. These stories act as anchors, drawing him to the *ʻāina* and filling him with love for it (Andrade 2014:8–9).

Historical documentation, namely in the form of land records, provided additional evidence of his *ʻohana* connection to the *ahupuaʻ*a; this connection was maintained during a period of significant land and cultural change within the Hawaiian Kingdom, and still continues today. Mr. Kaui's *kūpuna* were awarded LCA 8061, and Mr. Kaui himself still maintains his family estate. The interview began with Mr. Kaui emphasizing the significance of Keālia to both past and present populations of *kamaʻāina*, and the need to maintain its lands for future generations:

> This area here was really one gathering place. . . People all used to gather together, share what they get, and just live happy. It was happy. This valley was a happy valley. Keapana Valley. So, when Adam [Asquith] came here to grow he did the right thing. He scratched the *ʻāina* . . . but that's the kind of people we need to have so that our children might be able to do the same thing. We got to keep them in this picture. . . But you know, you gotta get dedicated people, and somebody strong, work hard. Because taro is a big business, plus it's hard work. Nothing easy about it, and that's why I'm concerned about our kids today. You know, maybe we can set up something from this survey for the children. Because they're the leaders to come. That's my heavy concern.

In nurturing future leaders, the transference of knowledge and skills remains of the utmost importance. The passing on of knowledge and skills, upon the land itself, was one of the most effective means of connecting children to both their culture and natural resources, while simultaneously assuring "that a people's cultural legacy continues" (Chun 2011:2). It may be inferred from Mr. Kaui's above statements that *nā keiki o ka ʻāina* (the children of the land) represent a productive force, constituting the next generation, and as the next generation, hold the power to unite society.

For Mr. Kaui, the children are a symbol of "hope and redemption for the future" (Stahl 1986:83), however, access rights (to lands within Keālia and Kawaihau) need to be ensured for such redemption to occur. This issue was touched upon, emphasizing that the "alienation of land" (Walker 1995:4 in Andrade 2014:10) may prove to be the greatest challenge facing future generations of cultural practitioners. Also included in the discussion were the many challenges facing future generations of Hawaiʻi's children, including the rising cost of homes and the decline of agricultural lands. With most incomes dedicated to owning or renting a home, it often becomes difficult to cover other expenses such as food, taxes, and health care. Mr. Asquith noted the rising cost of living will soon force many *kamaʻāina* to return to the land; a "return to the land" (agriculture) would allow local families to supplement their incomes and diets.

Mr. Kaui articulated the importance of creating and maintaining a space whereby the traditions of the land can be perpetuated by the youth. An emphasis was placed on looking forward, "*nānā ma mua*," and leaving a sustainable legacy for the children of the area. This belief is best encapsulated by the *ʻōlelo noʻeau*, "*E mālama ʻia nā pono o ka ʻāina e nā ʻōpio*" ("the traditions of the land are preserved by the youth").

CSH asked Mr. Kaui to elaborate on his own childhood, on the invaluable years spent learning to work and care for the lands within Keālia Ahupuaʻa, and the elders who encouraged such learning. Mr. Kaui shared that he was born on 11 August 1941 at Līhuʻe Wilcox Hospital. His father was originally born and raised in Keahapana Valley, and was 100% Hawaiian. His mother, originally from Maui, was a member of the Cummings ʻOhana. She was of Hawaiian (75%), Irish, English, and German ancestry.

He recalled that his mother was a housewife and his father was a local policeman. Although involved in law enforcement, his father was also a skilled *mahiʻai* and *lawaiʻa* (fisherman). His father was dedicated to continuing a long tradition of farming and fishing within the *ahupuaʻa*. He shared that his father would venture into the *loʻi* at night and plant according to the Hawaiian moon phases. By laying his lines in the day, he would be able to place his *huli* (planting material) in a straight row by night. By morning, Mr. Kaui would awaken to a newly planted patch. On the day of the interview, Mr. Kaui was picking up *huli* from Keālia Farms for his *loʻi* at home.

For many generations, Keālia was renowned for its community of farmers and fisherman. Previous studies have revealed that Keālia,

> . . . was home to a large, settled population of farmers and fishermen, who exploited the coastal areas abundant natural resources, as well as the land that contained nutrient rich soil immediately inland and *mauka* (upland) from the coasts. [Drennen et al. 2007:12].

Mr. Kaui also spoke of the richness of Keālia, providing CSH with a general history of the area:

> In the ancient days, what they mostly used to do was fish. Yeah, because the river was filled with fish, and the mountains had so much animals, so that's all they used to do, you know, was trade off. Then they come down to Keālia and make salt, where that landing was. Because when the waves come, it settles, and that's how they get their salt. Big salt bed here was, plenty people don't know that. But we know that.
>
> The salt was pure white. Really, really salty. Because it's from the ocean yeah. It's not like that Hanapēpē one, it's salty but not as salty as this one. So, when you mix ʻum with the *alae* dirt, sort of cut ʻum down. . . But over here had their own salt by the landing. Because get ponds, eh. So, when big waves come, the salt settles. Then they just go and pick them up.

In continuing this tradition of farming, fishing, and gathering, Mr. Kaui's father was able to supplement his family's diet. Mr. Kaui described his father's yields, as well as the communal meals they shared in:

> But, you know our valley, where I'm at, Keapana, when I was growing up, we always get together every Friday. My dad used to pound four bag taro and give all the family. We all eat lunch together, it was a weekly thing. Visitors come, you feed them. That was the ritual before. You know, naturally tourists, when they come, they no can eat the taro or the *poi* because they're not used to [it]. But, my dad had a way with ʻum, he used to mix the fish with the *poi* or the taro and they eat ʻum. And they never did eat ʻum [before], but they like it. But the *poi* is a little bit hard because they not used to [it]. But, it's a terrific food [source].

Mr. Kaui also discussed his grandfather, noting that he used to roam the entirety of the *ahupuaʻa*, assisting many of the Hawaiian families in the area with maintenance work. In recalling his grandfather, Mr. Kaui discussed the traditional sharing of resources. The equitable division of resources ensured all members of the community shared a common commitment to each other and to the *ʻāina*. Mr. Kaui explained the system,

> So, as far as the place itself, the *ahupuaʻa*, it really was a gathering place. Keālia Valley. Because they all used to get together, somebody catch fish, they bring, they all share. Somebody kill pig, they all share. That's how it was. No money was involved. Just like trading.

CSH inquired if this system of exchange had continued into the mid-twentieth century. Mr. Kaui shared that this system continued well into the plantation days. By continuing to share natural resources (and maintain these resources in ecologically-sound, traditional ways), both *kamaʻāina* and *malihini* were able to preserve the *ahupuaʻa* as a cultural *kīpuka*. Cultural *kīpuka* in this instance refers to,

> . . . rural communities that have been bypassed by major historic forces of economic, political, and social change in Hawaiʻi. . . cultural *kīpuka* are communities from which Kānaka ʻŌiwi culture can be regenerated and revitalized in the contemporary settings of Hawaiʻi. [McGregor 2010:210]

For residents of Keālia, the abundant natural resources were especially valued. Similar to various other cultural *kīpuka*, "the ability to provide for families through subsistence fishing, hunting, and cultivation" was also treasured (McGregor 2010:210). Mr. Kaui expounded on this valued way of life,

> We had our own animals, we had our own taro, we had our own *poi*, and my dad used to catch all the fish. We had our own cow, so we had two milking cows. So, we had everything except money. Nobody had money. But, you just was rich in that way. . .

Mr. Kaui revealed that the community faced the forces of economic, political, and social change head on; despite these powerful forces, Mr. Kaui's father was able to protect "the natural resources and subsistence livelihoods" (McGregor 2010:210) of community residents. Mr. Kaui shared,

> Before when the plantation first came here . . . they came to my dad. If my dad was the type that he really wanted money, could get money. My father wasn't like that. His main concern was food to feed the people. So, the plantation bosses asked him, 'Mr. Kaui, how much we owe you to run the water through your place.' My dad told them, 'you don't owe me nothing, all I like is permission if I can use that water too, for my *kalo*.' All they did was shake hand like this. Then that thing [deal] went last for about 50-60 years, without signing nothing. But, he never go for the money. Otherwise we would've been rich, but he never care. The water was more valuable than money. See, that's how things was before, no contract signed, just by the heart. It's unreal, you know, you can't find those kind of things today.

Mr. Kaui also expanded upon the context in which traditional Hawaiian values were being maintained. As McGregor notes, *kīpuka* and rural communities such as Keālia, though grounded in traditional Hawaiian values, operated within "contemporary settings" (McGregor 2010:210).

These contemporary settings invariably included immigrants of various nationalities. Mr. Kaui shared with CSH the ways in which immigrants contributed to the local Keālia community.

> . . . had plenty Portuguese people living here, had about maybe 30 families. Portuguese, some Puerto Ricans, very few Japanese. It was mostly Portuguese. This area was occupied by the Portuguese people, they were the bakers. They used to teach all the Hawaiian people how to bake. So, my mom got affiliated with them, and she became a tremendous baker. Learned how to make sweet bread, *malasada* [fried doughnut]; I mean you eat that, you no like eat any other thing. That was the real McCoy. Yeah, the Portuguese people here were really talented in terms of baking. Good bakers. That’s why they get that big oven in that pasture over there. They used to make the bread over there. Amazing. This place was a happy place!

CSH inquired into the history of the sugar plantations in Keālia, in addition to the relationship of the community with plantation owners. During the height of the plantation era, the lands of Keālia were completely covered with cane. According to Mr. Kaui, the cane fields extended to the base of the mountains. He also shared that he has seen “black paper” in Keālia Uka. Mr. Kaui explained that black paper was utilized for sugar planting:

> Before they used to put them in the rows [of cane]. Way back in the beginning, but then after that they went stop that. That way, they no need weed. After that they went to . . . spray. Otherwise was all black paper like pineapple.

Traditional farming continued alongside large-scale commercial sugar production. Mr. Kaui recalled *lo‘i kalo* existing in portions of Keālia during the 1960s. His own family had 14 taro patches prior to the shutting off of their water by the sugar plantation. Their taro patches were fed via *‘auwai* (water channels) connected to Kapa‘a Stream. His description of the *‘auwai* revealed aspects of his family’s relationship with plantation management:

> This *‘auwai* here was flowing beautiful when my dad was alive. So, when my dad died, my aunty went to the plantation office and put a ridiculous price on what they owe them. So, the boss told her, ‘you have no jurisdiction here; I didn’t deal with you.’ So, what they did, they broke the flume, throw the pump in the river, and that’s how was. Just shut us right off. They never like do ‘um, but they had to. I even went plead with them, I told them,’gee I coming up, I no like you guys do that’ Then the floods came, broke the main place, and took that back.

Following the loss of the water, the Kaui ‘Ohana were able to sustain their patches for a short period of time by utilizing water from a nearby spring and small stream.

CSH asked Mr. Kaui if he had knowledge of potential cultural sites, including burials, that may be impacted by the proposed development. He was not aware of any cultural or archaeological sites within the project area, however, he cautioned that burials may be encountered during ground disturbance:

> Before, those days, not like today, you can just bury your own family or friend, you never need to go to the mortuary. So, you know probably is graves around without all us knowing about them because so many Hawaiian people was living up here, all over this place.

In regards to cultural practices, Mr. Kaui noted he was aware of *hula* (dance) occurring within Keahapana Valley. Certain families would visit the valley and perform *hula*. Families like Mr. Kaui's own *'ohana* would also engage in traditional Hawaiian arts. Members of Mr. Kaui's *'ohana* were particularly skilled musicians. He recalled family gatherings where many Hawaiian songs were performed. He reminisced,

> . . . sometimes we gather Fridays or Saturday, and all the family take their instrument and just sing all day. Just sing and dance, just one happy thing. . . All Hawaiian songs . . . slack key, *ukulele*, guitar. Even the bass, the pan they had, they make they own homemade string and pluck ‘um, but was nice.

Mr. Kaui made sure to impart the significance of Keālia, a significance derived directly from the sacred. He concluded by noting that Keālia was an *'āina momona* (fertile lands). The richness of the lands effectively dissuaded violent conflict. Mr. Kaui explained,

> This land here you guys surveying is really one sacred valley. Because in the olden days, you know they say only *ali'i*'s roamed the area, and truthfully it's what it was. Because that harmony, nobody was sacrificed or anything like that. It was a different thing in this valley, everybody meant something to each other. So, they're not going to kill you, or do things like that to you. Certain area, like Wailua, they had eh? You do something wrong, you run there, they save you. . . it just was a peaceful valley and a loving place.

It has been noted that *wahi pana* may consist of natural formations such as streams, peaks, and rock formations or man-made structures such as fishponds and *'auwai*; quite notably, *wahi pana* may also refer to Hawaiian land divisions such as *ahupua'a* or *'ili*. Mr. Kaui's revelation that the entirety of the *ahupua'a* is considered sacred may index the community's understanding of Keālia as *wahi pana*. Regarding additional *wahi pana* within the *ahupua'a*, Mr. Kaui shared that several trails lead to Waipahe‘e Falls; the falls and swimming hole are located *mauka*, in the Anahola Forest Reserve. He described the area in detail:

> Quite a few trails up here. This was a huge area and goes all the way up to the slides up here. This whole area. All Hawaiians used to live up here. Before they had, the place they called Slippery Slides, was a famous place. Certain times, people go, maybe they do something wrong, or never do something wrong, you hear a drowning happened. ‘Cause there was no lifeguard, you just go on your own. Because the plantation had that place at one time.

Mr. Kaui commented that many people would visit the area to gather a purple variety of *liliko'i* (passion fruit; *Passiflora edulis*). Mr. Asquith also shared that the waters from Waipahe‘e are brought down to his *lo'i* via old sugarcane irrigation. A small waterfall on his property also derives its waters from Waipahe‘e (Figure 28). Although a beautiful locality, several drownings have occurred at Waipahe‘e Falls. The area is also prone to flash floods. The state closed off the site to the public in 1979.

Mr. Kaui's discussion of *wahi pana*, prompted Mr. Asquith's discussion of sacred places. Mr. Asquith also identified Keālia Ahpua‘a as a sacred place, highlighting the importance of being *pono* (moral, proper, fair) in such a sacred place. Mr. Asquith shared that he understands *pono* as a state of being, of maintaining a state of balance or harmony. He shared,

> The most important lesson is to be *pono*, in the sense of finding the balance. Even though it was a sacred place people could survive because they could access those areas. There was a balance. Even during the plantation days, there were just handshakes. Everyone gets what they need, strike the balance. But they will also tell you, post plantation, there hasn't been much of a balance. Partly, the big picture balance was encapsulated in *nānā ma hope* (look to the past) and *nānā ma mua* (look to the future). What he's seeing disappear is the opportunity for future generations to be a part of that balance.

Mr. Asquith elaborated on the notion of balance. He highlighted that the rules of landowners, such as rules that prohibit hunting, the utilization of water for farmlands, or the collection of wood for *imu* (underground oven), creates an imbalance. Mr. Asquith added that certain families maintain access and gathering rights to areas in Keālia. These rights were ensured and gifted to the people, including Mr. Kaui's *‘ohana* and descendants, by Kamehameha III:

> Imagine, his rights to the area were a gift from Kamehameha III, forever. I grant you guys the right to access this land forever. Now you're asking him if it'll be alright to give that gift away that the king gave you. . . Who is he to give it away for the coming, for the next generation? But, it is in context of the whole valley. So, it is very difficult to predict what the future generations will need from those 100 acres [the proposed project area], right? Much easier to look at the valley, the rest of the property, and go oh, we can have a better idea of what the future generations are going to need from the rest of the property. If they voluntarily give away the gift in this area, how can they make sure that the future generations can exercise this gift on the rest of the property. . . But fortunately, according to Uncle Richard and others, most of the resources that he does know that we've used, are in other areas. But they can't necessarily access those [areas or resources], even now. So, that's the [catch-22] . . .

Mr. Asquith recommended that the project area be evaluated based on its past use, its current use, as well as its potential future use. He shared that Keālia Farms was originally "fallow" cane fields, adjacent to the current project area. However, after years of hard work and planting, he now has 50 acres cultivated in taro. His revitalization of the lands and cultivation of the Hawaiian staple crop *kalo*, have helped to make the area culturally significant once again. He explained,

> Where we farm, there hasn't been taro there for over a hundred years. If you would've asked someone during the plantation era, they [would've said] 'ahh, whatever, nothing going on.' Ho, 50 years [later], we get 50 acres of taro feeding everybody. So, that's the difficulty of asking the question about one point in time.

He believes that if you "put people back on the land" growing taro and producing food, then the land becomes significant again. Echoing similar sentiments, both Mr. Asquith and Mr. Kaui expressed a desire for some sort of agreement to be reached that ensures future generations will have access to undeveloped parcels in Keālia Ahupua‘a in perpetuity.

Mr. Kaui ended his interview by recommending that consultation occur between landowner and the community. He hopes this will result in the creation and/or preservation of a space that allows future generations to engage with their culture, in whatever way they choose. Mr. Kaui also recommended that lands within Keālia Waena, outside the current project area, be reopened and planted in *kalo*. Mr. Kaui concluded by once again emphasizing his focus on *nā ʻōpio*, the future generation, "well my main concern is to try see if we can get something for the kids. That's my main concern."

6.4.4 Summary of Tim Reis Interview

In summer 2017, Mr. Timothy Reis, a cultural practitioner and educator, reached out to CSH via email regarding the cultural impact assessment for the proposed Keālia Subdivision project. Included within this initial communication was a request to provide him with evidence that the proposed project would not impact his cultural practices:

> I recently was made aware of a request for information, regarding a residential development project in the Kealia area.
>
> I am a farmer in the Keahapana Valley. I farm on parcel number 470030090000, with permission of Kenneth Bray through his daughters Chenoa Bray, Cholena Bray and Ginger Bray.
>
> On this property is a spring which feeds a taro patch which historically fed the Kaui Ohana.
>
> This message is to serve as notice to you of the Bray Ohana's interest in this area and the concern that the aproposed [*sic*] development could have on their cultural practices and those of their descendants.
>
> The source of water needed for the proposed 200+ homes could affect the aquifer that is the source of the spring on the property we farm.
>
> We request that you provided us with evidence that proves the proposed project will not negatively impact our cultural practices.
>
> If you have any questions or require additional information, please let me know.

CSH attempted to coordinate a telephone call with Mr. Reis to explain the role of CSH, the CIA process, and the difficulty in assessing adverse impacts without identifying the nature and scope of cultural resources, practices, and beliefs (as facilitated through consultation and/or formal interviews). Shortly thereafter, CSH was notified by Kamealoha Hanohano Smith, on behalf of Kaiāulu Papaloa, that Mr. Timothy Reis would be the voice for a *hui* consisting of Native Hawaiians with direct ties to Keālia Ahupuaʻa. Mr. Smith notified CSH with the following:

> As a reminder, our Hui is a group of native Hawaiians, including the kupuna, with ties and interests in Kealia. Kaiʻulu [*sic*] is a nonprofit organization which has been selected by the Hui to communicate their interests on this matter. They have chosen this vehicle because they fear reprisal from the land manager and its contractors.
>
> Kaiʻulu [*sic*] will remain the buffer between the hoaʻāina and the landowner at this point, but the direct point of contact will now be Timothy Reis.

Due to the lack of differentiation between the interests of the *hui* and the interests of Mr. Reis, CSH attempted to address both parties within a letter dated 10 July 2017:

Figure 28. General overview of waterfall and small pond utilized for irrigating the Keālia Farms *lo‘i kalo*

> We would like to explain the role of Cultural Surveys Hawaii (CSH). The proposed Keālia Subdivision project is subject to State environment law that requires assessing impacts to the natural environment and cultural practices. To meet this requirement, project proponents must hire neutral third-party consultants to conduct studies related to this compliance process. CSH has been hired to prepare a Cultural Impact Assessment (CIA) and a Literature Review and Field Inspection (LRFI) for the subject parcel. It is CSH's responsibility to conduct an objective study, to gather information from concerned community members, and to compile the information gathered into a report that becomes part of the public record. Through the consultation process, as well as the public's review of completed studies, the public has an opportunity to speak to this project.
>
> As part of our CIA it is standard practice for us to contact people in the community, as well as key stakeholders (including the government and its appropriate agencies). As part of this process, we also reach out to the Office of Hawaiian Affairs (OHA), the Kauaʻi and Niʻihau Island Burial Council, and the State Historic Preservation Division (SHPD) (Burial Sites Specialist and History and Culture Branch). The purpose of our outreach efforts is twofold: to inform the community of the proposed project, and to identify, through consultation with knowledgeable individuals in the community, ongoing or past cultural practices occurring or that have occurred within the project area. Through community consultation, CSH can evaluate potential adverse effects on the cultural practices and cultural resources of the community and State. This is in compliance with Act 50 of State law. As outlined in Act 50, CSH is limited to only 'identify[ing] and address[ing] effects on Hawaii's culture, and traditional and customary rights' (State of Hawaiʻi Act 50 2000). CSH can only go so far as to identifying 'significant effects,' and recommending mitigating actions based directly on stakeholder comments.
>
> In order for us to remain neutral third parties, we cannot directly advocate for, or represent the hui or represent the landowner in any way. CSH cannot act as a mediator between the Keālia Hui and the landowner, nor can we actively participate in mitigation.

CSH was notified in November 2017 of Mr. Timothy Reis' comments before the Land Use Commission, and of his request to speak to CSH regarding traditional cultural practices, including the use of water for the cultivation of *loʻi kalo* and *māla ʻai*. According to Land Use Commission Meeting Minutes dated 8 November 2017,

> Mr. Reis requested clarification on the process involved with the proposed project and the environmental impact statement. Mr. Tabata described how the environmental impact statement (EIS) information was being gathered and took Mr. Reis' contact information to provide follow up information.

CSH reached out to Mr. Reis via email on 16 November 2017, and continued correspondence throughout the months of November and December. On 17 November 2017, CSH attempted to address Mr. Reis' request for "proof that the approx. 2 million gallons a month (10,000 gallons x 200 homes) or 24 million gallons a year needed for the proposed project would not negatively impact [his] cultural practices:"

> As we our still gathering information on cultural practices, in relation to the proposed project, it is extremely difficult to comment on potential negative effects to cultural practices at this time. Also, as of this time, an engineering report, evaluating the existing water system and proposed water system, is being drafted. This report will be included within the Draft EIS, available for review through the OEQC website.

On 7 December 2017, a formal interview date was confirmed with Mr. Reis for 21 December 2017. CSH interviewed Mr. Timothy Reis at Keālia Beach Park on 21 December 2017 for the proposed Keālia Subdivision project. Following introductions, Mr. Reis offered clarification on the initial confusion regarding the interests of the *hui* (in regard to access rights throughout the *ahupua‘a* of Keālia) and his interests (in regard to potential impacts to the aquifer and *pūnāwai*):

> I guess there was some confusion in the early part, there were a couple concerns brought forward to you. One was through a *hui*, and then mine was a separate one, and I kind of got wrapped into both of them. Yeah, I'm not representing that *hui* here today, it's just me as an individual. It's just me as an individual, dealing with our water usage on that piece of property. Yeah, it's been awhile, and there was a big concern brought forward that's outside the purview of anyone who's going to be involved in this [CIA]. So, it's a bigger problem that needs to be tackled at a later date, but it was something some people wanted to voice, and bring forward as an issue. I do feel it's a legitimate issue, but like I said it's beyond the scope of any of our responsibilities. It's not what we're really talking about, or need to bring to the table [right now]. So, I'm here to address my family's interest in this.

Mr. Reis maintains a familial relationship with Keālia. He is particularly connected to lands included within LCA 8061 (TMK: [4] 4-7-003:009, currently owned by the Bray, Kaui, Kanehoalani, and Ornellas families). His connection to Keālia has been long-standing, established by many ancestors who have come to live and work on those lands. Although born and raised in California, he returned to Kaua‘i approximately 10 years ago. Through *aloha ‘āina* work, Mr. Reis has developed an emotional closeness to the land, best encapsulated by the term *hoa‘āina*. In differentiating *hoa‘āina* from *maka‘āinana*, it is necessary to note that

> Hoa is translated as friend, companion, peer and fellow (Pukui & Elbert 1986:73). The relationship of friend and companion to that land contrasts greatly with both commoner and tenant. This emotional closeness of the people to the land is expressed in many of the songs, stories and chants of the Hawaiian people and the word hoa‘āina used to describe themselves is a perfect example of this emotional closeness. [Andrade 2004:12]

While discussing his attachment to the lands of Keālia, Mr. Reis shared his genealogy with CSH: "My father is Kimo Reis, who lives here on the island. He is of Hawaiian ethnicity. Aboriginal Hawaiian, and his mother is Margaret Kaui, and his grandmother's grandfather was David Nalani Nahiku, who married Wilhelmina Cummings."

In recounting his *mo‘okū‘auhau* (genealogical succession), Mr. Reis highlighted how these familial ties have borne him back to the land of his *kūpuna*:

> But, my *wahine* [partner] and I have had a child, and she is of the Kaui line. That's my genealogy here. I was born in San Jose, California. I was raised in California for most of my life. I didn't know what it meant to be a Hawaiian, and it wasn't until I was 30 years old, and I came back, that I started to learn about the history of this place. Learning my genealogy really, trying to explain it.

Mr. Reis understands the *moʻolelo* of Keālia as representative of its genealogy, linking present generations to the past. He shared with CSH, "That's just one of my personal frustrations of the [environmental review] process, in actually protecting our *moʻolelo,* and that's really what it is. Whether we know the stories or not, that's our *moʻolelo*, that's our genealogy."

In understanding the term "*moʻolelo*" as it is applied by Mr. Reis, it is useful to look at word structure, in this case the root word "*moʻo*." Mary Kawena Pukui defines *moʻo* as a dragon or lizard, as well as a succession or series, especially a genealogical line (Pukui and Elbert 1986:253). Hence a *moʻolelo* "is a progression of words strung like vertebrae along a cord of meaning" (Wianecki 2012). Likewise *moʻokūʻauhau*, indexes an understanding of the lizard or dragon's "interlocking bones as symbolic of their own sacred lineage" (Wianecki 2012):

> The dragon is a major force of life. . . Its head peers into the future, the white dawn yet to come. Its front feet are the ʻopio (youth), reaching, touching, examining. Next come the makua (parents), the stable hind legs of the dragon, and beyond them, the kupuna (elders). The kupuna form the spine, the collective song of all that came before. They tell how other dawns were and how this dawn will be. [Sam Kaʻai cited by Wianecki 2012]

For Mr. Reis, it was his *kūpuna*, their call, that drew him back to the land:

> My *wahine*'s father [Mr. Kenneth Bray], was taught *kiʻi* (image or statue) carving, and he was a recognized *kahuna kālai kiʻi* (expert image carver) here on Kauaʻi. I began learning under him for about a year before I moved off island. Then I continued carving, 15 *kiʻi* outside of his teaching. That really started me on my path to understanding the *kānaka maoli* (full-blooded Hawaiian person), the cultural side of who I was. Since then I feel like I have received direction from *kūpuna* here in Keahapana, about seven [or] eight years ago, my life changed very drastically. I am an avid fisherman, an accomplished fisherman, and I used to fish all the time. Something happened in my life, I was pretty distraught, pretty broken, and I was on the property where we happen to have our family burials, and I had asked them for *ʻike*, for wisdom, and sometimes I wished that I hadn't actually done that. What I was told was, '*Pau* (finished) fish. Go *mauka*.' I think what they were telling me was, 'you can fish, we know you can fish, we know you can do that, you can harvest from the ocean, but you need to learn what is *mauka*.' I didn't fully understand that at that point in time. That led me on a path to studying endemic plants, native plants. Their uses, today I'm an aspiring *poʻe kākoʻi* (adze maker). I've developed a method of creating *poi* pounders using stone implements. Which I actually held a project, or pilot program at Kawaikini School teaching 16 kids the method that I created to make that stone implement.

Through the practice of carving stone implements such as *poi* pounders, Mr. Reis has been able to reconnect with his heritage. While making the implements, he realized the necessity of actively employing traditional tools within everyday life and practice. As *nā mea makamae* (precious things), these tools are especially valued for the ways in which they demand engagement and practice. They are more than just artifacts, they are "markers and makers of cultural identity" (Cipolla 2008:196).

The enculturation potential intrinsic to the practice of *kākoʻi* itself soon became apparent to Mr. Reis. He realized the importance of passing down the traditions associated with the creation of stone implements. The transmission of such cultural knowledge would not only provide a young student with the skill sets necessary to produce a work, but also expose them to traditional and contemporary Hawaiian values:

> Within that journey I've recognized certain aspects of doing these art forms, and I suspect it's across the board in Hawaiian arts. Certain things are refined. Practicing patience, perseverance . . . preparation, problem-solving strategies are all, in my opinion, nurtured and promoted in these works. Working with wood and stone, there's no guarantee of what's inside. You oftentimes run into flaws, so you have to learn to adapt and work with those things. . . That's why I took it to Kawaikini, because I thought if our children would be taught in a manner exposed to these art forms, they would be unknowingly exposed to these [values]: patience, perseverance, dealing with problems, strategizing. And I thought those would all be good things for that individual or that child throughout their life if, through the education system, they were exposed to that for twelve years. That's actually kind of my goal to be able to produce a work, and great programs, and make them available to the education system. I think the Hawaiian cultural education system is in its infancy now, and in the future, there would be room for that type of inclusion or implementation of that kind program. The toughest part is bringing Neolithic cultural practices into today and making them relevant. Because it's such a different [environment and society], we don't use stone tools anymore, we don't need to use *olonā* [*Touchardia latifolia*] nets anymore. . . but how is it relevant? I think that ties into the *ʻāina*-based learning. . . That's kind of my path that I am on, and really for me, my drive is giving the next generation something that I didn't have today.

In discussing the importance of a Hawaiian cultural education system, Mr. Reis underscored the potential benefits to *kamaʻāina* children. By establishing an education system that connects students to *ʻāina* and culture, "social and emotional learning (SEL) skills and academic mindsets to succeed in college, careers and communities locally and globally" (Department of Education 2015) will be gained. CSH inquired into the feasibility of an *ʻāina*-based learning model being employed within Keālia Ahupuaʻa. Mr. Reis commented by informing CSH that all *ahupuaʻa* have potential to teach and to be utilized in such a manner; for *nā ʻōpio* (the youth), a cultural education works to instill a sense of belonging and responsibility; to teach them *aloha*, and encourage them to strive for excellence. Mr. Reis explained,

> Here in this *ahupuaʻa*, this *ahupuaʻa* has been tied up by a large landowner for a very long time yeah, and it has changed hands. It's predominately cattle; the Waipaheʻe area, was a playground for my *kūpuna*.. . . As far as [how cultural

> practices are maintained and an *‘āina*-based learning approach] develops in this *ahupua‘a*, it has potential.

While discussing the potential benefits in synthesizing Hawaiian culture with Western educational practices, Mr. Reis cautioned against development in which the “cultural realities” of a locality (Minerbi 2003:1) are not taken into full account. In accounting for “cultural realities,” especially within culturally and historically rich *ahupua‘a* such as Keālia, it is necessary to understand,

> There are many cultures in a place, including the culture of the native people and those of the newcomers. Elite, popular, minority, and indigenous cultures may all be present in one locality. The tapestry of culture has many threads, with each culture importing its ways, language, cultural landscape, and building styles, interacting with the preexisting culture, and evolving into a complex and layered system of local cultures. . . All these cultural realities need to be accounted for in conflict resolution and planning. [Minerbi 2003:1]

Mr. Reis explained,

> All the *ahupua‘a* have potential, it just depends on who is driving the development and the intent, and that’s kind of where we are at today. [We are] wanting to see more of the Hawaiian culture included in that. They want to build homes up here, and in all honesty, I don’t think it’s a bad idea or bad location. I really don’t. It’s on the side of the road, there’s nothing but cows there, as far as cultural resources, they’re not present on the property. So, I understand their choice, I understand it’s probably going to be built.

In sharing his concerns regarding the planning process and proposed development, Mr. Reis made clear that his primary concern is for his “cultural practice.” Mr. Reis engages in numerous cultural practices; formerly a *lawai‘a*, Mr. Reis is now a *mahi‘ai*, *kālai ki‘i* (wood carver), and *kālai pōhaku* (stone carver). Not only does he continue to farm on the parcel, he also shapes adzes and stone tools there as well. He shared,

> My concern is with my cultural practice. Like I said, I went down this road of learning the stone tools, learning the *poi* pounders. You can’t buy a *poi* pounder here on Kaua‘i. That to me, is an injustice. That’s what I’m trying to fix. That naturally led me, from being flown here, not grown here, having to learn *kalo*, because it’s part of that. I work for Adam, who is right across the street, who has 25 acres, who is a leasee of the guy who owns the land [current project area], he’s a *kalo* farmer. I work with him, and it’s funny how it worked out that I got to learn *kalo* that way. So, down on their property, we have a *lo‘i*, and we‘re growing *kalo*. The importance of farming *kalo*, the tools, making the tool, is my life mission, to be able to pass that on to my daughter and son, so that I can feel that it’s not lost. . . I have heard of a couple *kumu hula* [hula teacher] that have taught their *haumāna* [students] to make *poi* pounders, but it’s not as widespread as it should be. So, in me doing what I’m doing, I can feel secure if I can pass it on to my *keiki* [children]. I’ve done my part and that includes their [his *‘ohana*’s] *lo‘i*, down on their land, which is fed by a spring.

Mr. Reis noted that the stone tool is best employed when used in the preparation of *pa‘i‘ai* (hard, pounded but undiluted taro). Although *poi* (Hawaiian staff of life) may be made with breadfruit, sweet potato, banana, or taro, the Reis Family prepares *poi* made of taro. Regarding his family's production of *poi*, he shared,

> Farming *kalo* down there, in my research, I came across La‘amaikahiki. In his name chant, it actually references the *kalo* of Keahapana. It's either the big *kalo* or lots of *kalo*, but in our *‘ohana* it was you grow *kalo* to pound *poi*, and that's predominately what they did. They used it for *poi* instead of cooking it or eating it other ways.

Due to the reliance on *pa‘i‘ai* (for *poi*), Mr. Reis realized he must devote his labor to the cultivation of taro. A return to the cultivation of taro (as well as other food crops) required Mr. Reis to pursue agricultural activity within the *mauka* portions of the *ahupua‘a*.

In returning *mauka*, Mr. Reis focused on the northern corner of a parcel of land within Keahapana Valley. The parcel, LCA 8061, is located approximately 1.64 km east of the current project area (Figure 29) and was originally awarded to Waianae, on behalf of Hainau (also identified as Kainau). Hainau was Waianae's wife, and the original claimant for the land. The parcel became available to Hainau by way of a series of resolutions adopted by the Hawaiian Privy Council on 19 October 1849. These resolutions laid the groundwork for the Kuleana Act of 1850, in which the rights of native tenants were confirmed and protected. Under this act, the claimant (Hainau) was required to provide two witnesses who knew the claimant and the boundaries of the land and could testify that the claimant had lived on the land for a minimum of two years and that no one had challenged the claim. The land also had to be surveyed. Native tenants or naturalized foreigners who could prove occupancy on the parcels before 1845 could be awarded lands they occupied or cultivated as Kuleana Awards. No commutation fee was necessary to apply for a Royal Patent for a Kuleana Award, as the commutation fee had presumably already been paid by the *ali‘i/konohiki* (chief/supervisor) to whom the *ahupua‘a*, or *‘ili* in which the native tenant claimed his own small parcels had been awarded (Chinen 1958:8–31).

For Hainau, the following is recorded within the Native Register (Figure 30) (translated below):

> The Land Commissioners, greetings: I hereby state my claim for land, four taro lo‘i and a kula which adjoins them. I have another kula far mauka. There are four mala of noni, three mala of wauke and two-house sites. [Waihona ‘Aina 2000]

Native Testimony (Figure 31) records the following for Hainau's *kuleana* parcel (translated below):

> No. 8061, Hainau
>
> Koikoi, sworn, he has seen this claim in the ili land of Kapuna.
>
> Section 1 - House lot with 4 loi and a pasture together.
> Mauka by Konohiki pasture
> Anahola by Konohiki pasture
> Makai by Makole's loi
> Puna by Kealia River.

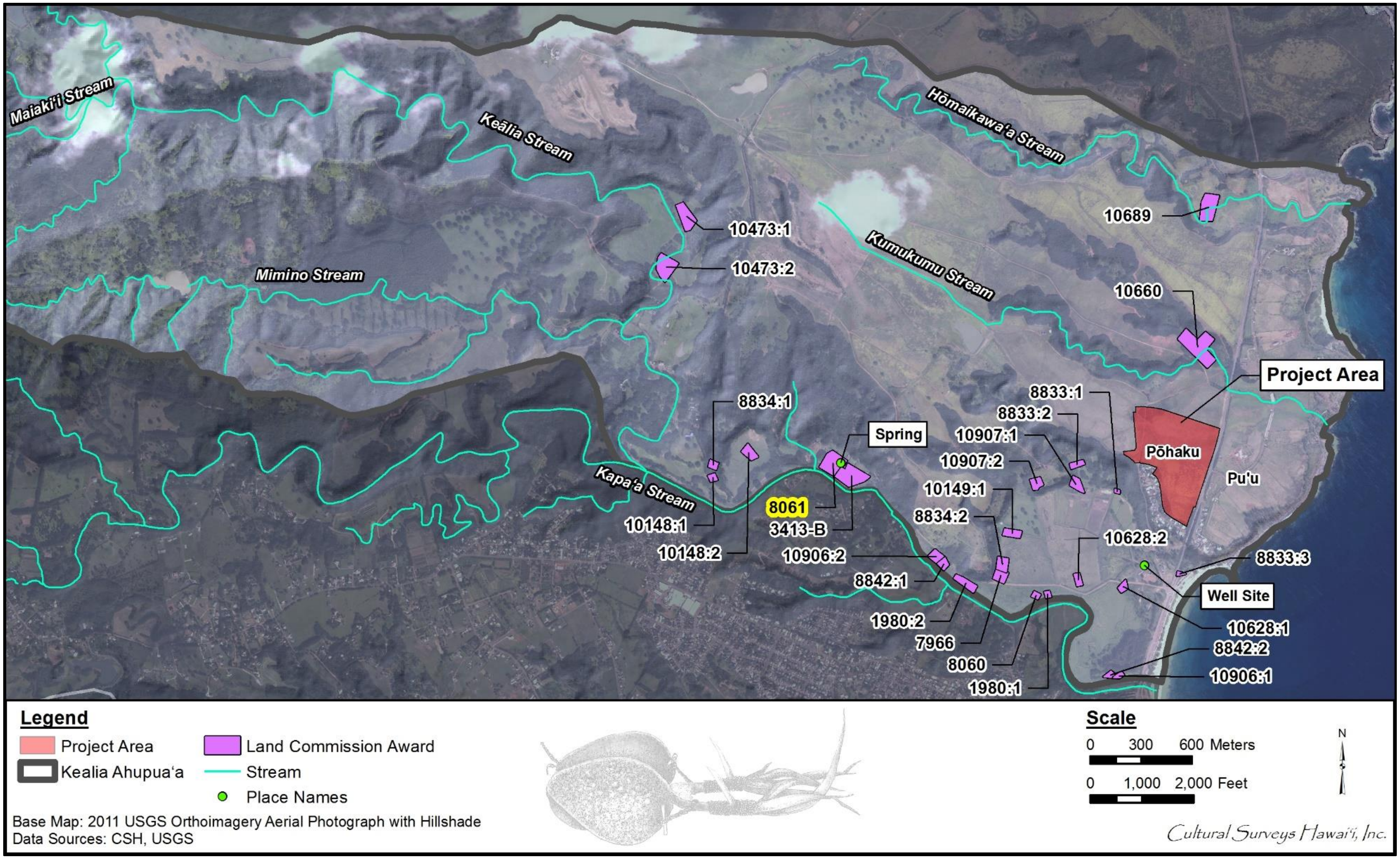
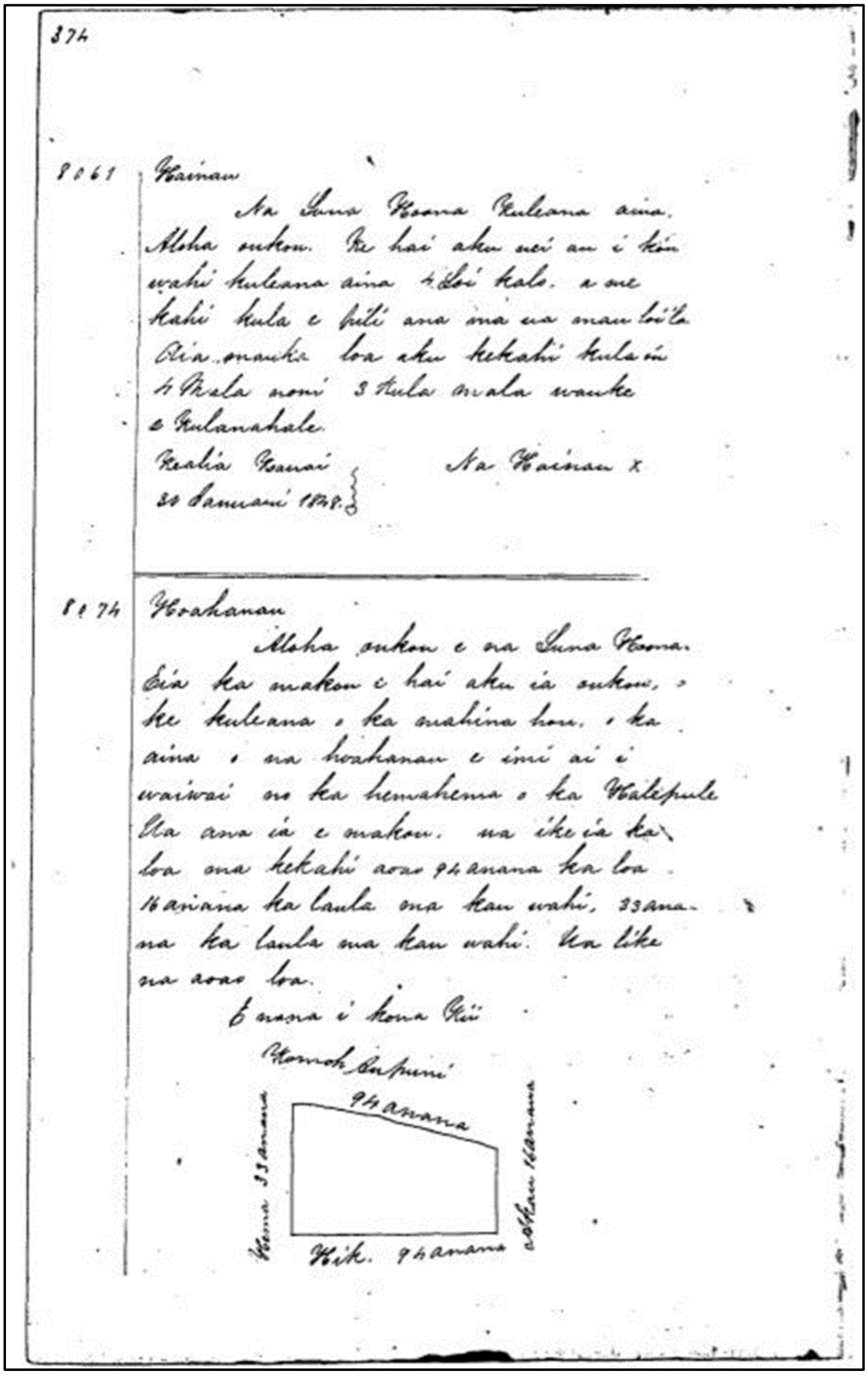


Figure 29. A 2011 USGS Orthoimagery aerial photograph depicting LCA 8061, where Mr. Reis and his family currently cultivate *kalo* and various other food plants, and maintain a spring. The map also depicts the location of the potential well site, *pōhaku*, and a *pu'u*, as identified by Mr. Reis during consultation.


374

8061 Hainau
Na Luna Hoona Kuleana aina.
Aloha oukou. Ke hai aku nei au i ko'u
wahi kuleana aina 4 Loi kalo. a me
kahi kula e pili ana ma na mau loi la
Aia mauka loa aku kekahi kula ia
4 Mala noni 3 Kula mala wauke
o Kulanahale.
Kealia Kauai   Na Hainau x
30 Ianuari 1848.

8074 Hoahanau
Aloha oukou e na Luna Hoona.
Eia ka makou e hai aku ia oukou, o
ke kuleana o ka mahina hou. o ka
aina o na hoahanau e imi ai i
waiwai no ka hemahema o ka Halepule
Ua ana ia e makou. ua ike ia ka
loa ma kekahi aoao 94 anana ka loa
16 anana ka laula ma kau wahi, 33 ana-
na ka laula ma kau wahi. Ua like
na aoao loa.
E nana i kona Kii
Kamoh Kapuni

Figure 30. Image of Helu 8061 within the Native Register (pg. 374, volume 9; Office of Hawaiian Affairs 2015)

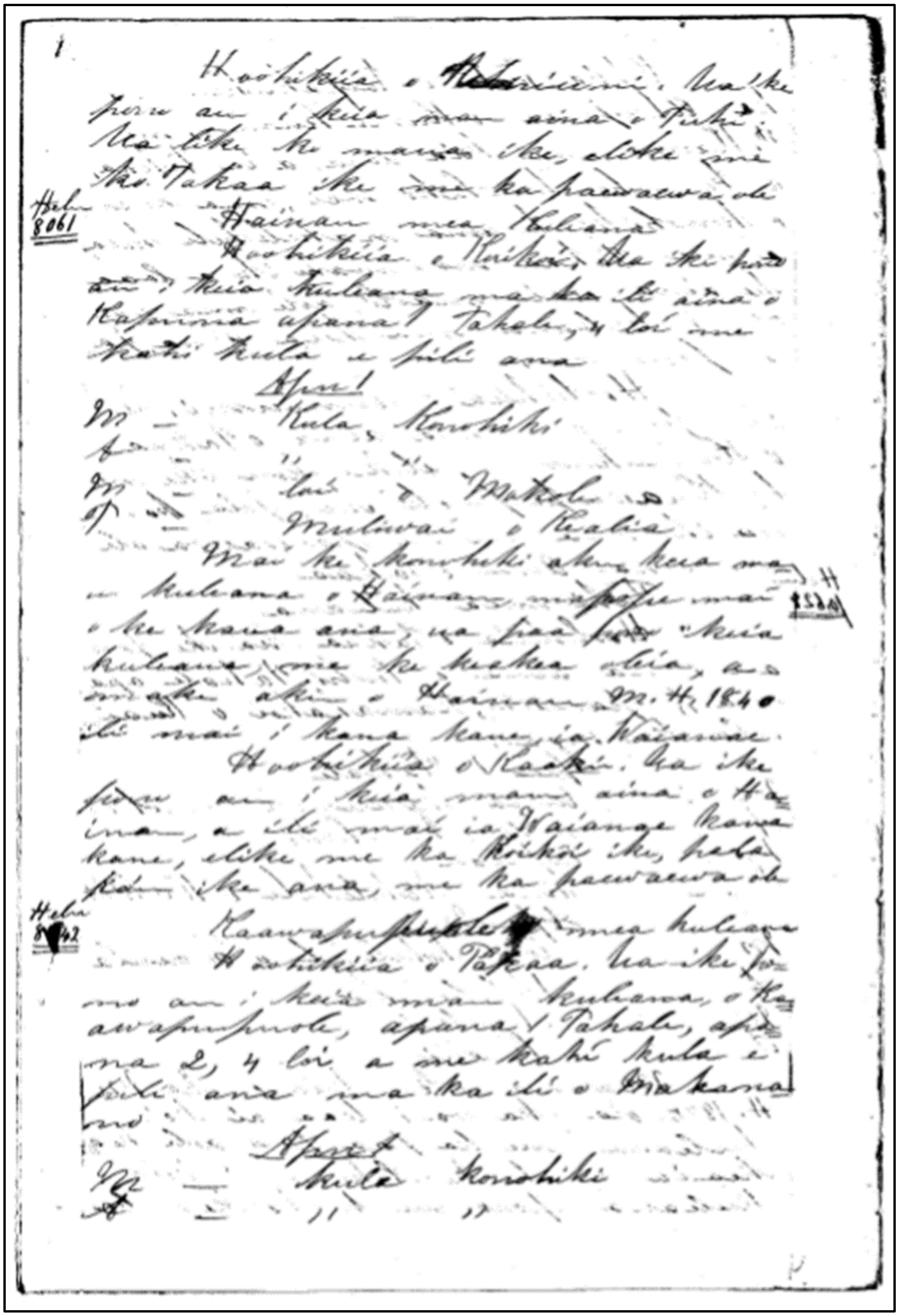


Figure 31. Image of Helu 8061 within Native Testimony (pg. 114, volume 12; Office of Hawaiian Affairs 2015)

> Land from the Konohiki after the war, no disputes. Hainau died in 1840, and the land bequested to her husband, Waianae. Kaaku, sworn, verifies Koikoi's testimony.

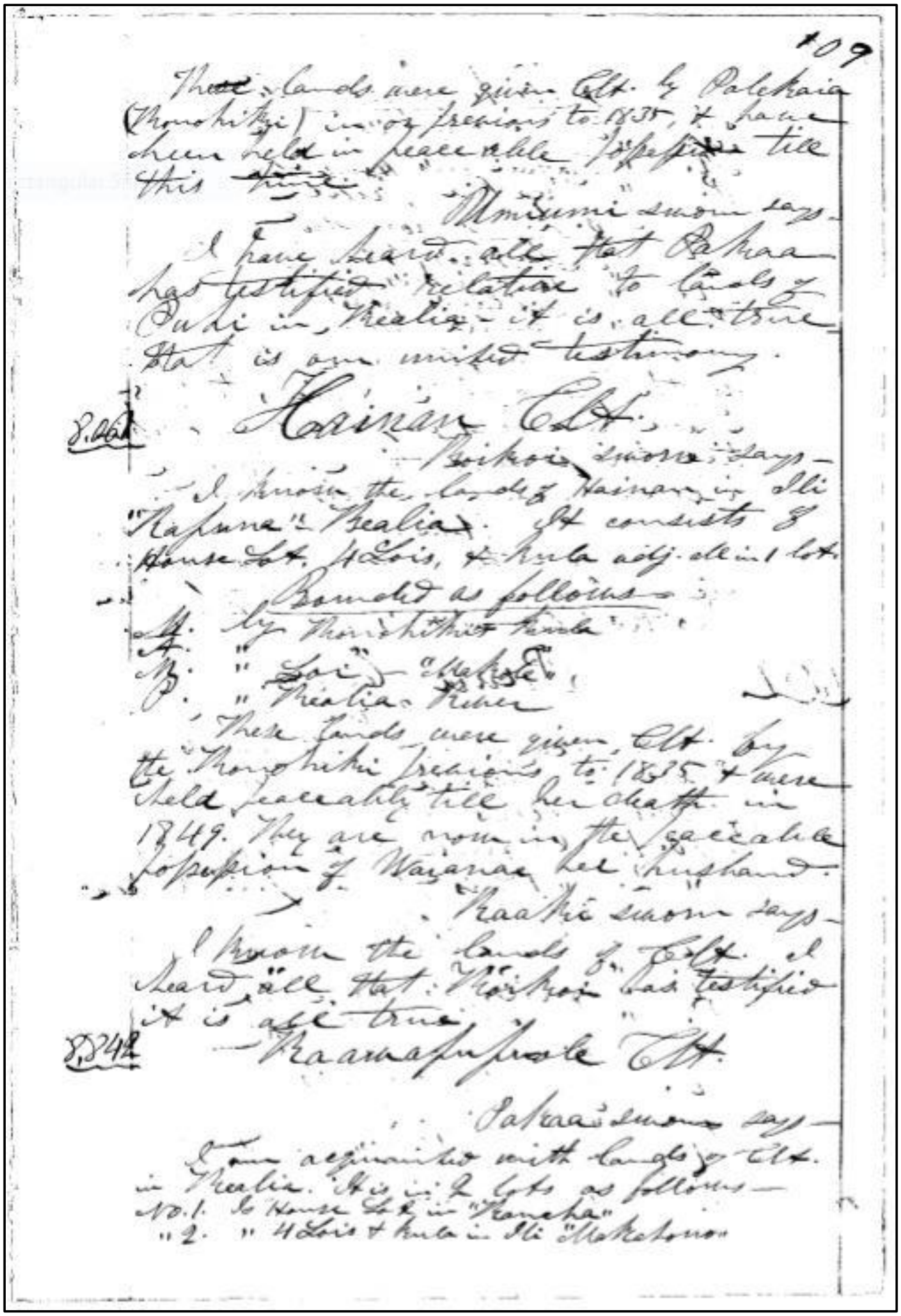
Foreign Testimony (Figure 32) records the following for the same parcel

> No. 8061, Hainau, Claimant
>
> Koikoi, sworn, says I know the lands of Hainau in ili Kapuna Kealia. It consists of house lot, 4 Lois, & kula adjacent all in 1 lot.
>
> Bounded as follows:
>
> Mauka by Konohiki's kula
>
> Napali by Konohiki's kula
>
> Makai by loi 'Makole'
>
> Puna by Kealia River.
>
> These lands were given, Claimant by the Konohiki previous to 1835 & were held peaceably till her death in 1849. They are now in the peaceable possession of Waianae, her husband.
>
> Kaaki, sworn, says I know the lands of Claimant I heard all that Koikoi has testified. It is all true.

A review of Hainau's testimony reveals aspects of traditional life as they were practiced in the mid-nineteenth century. Particularly salient are the descriptions of resources contained within that *kuleana* parcel (habitation and agricultural plots claimed by the common people). These resources allowed for the continuation of traditional practices. According to Kuykendall (1938) and Malo (1951) (cited in Andrade 2004), traditional practices included

> . . . cultivating formal fields, both wet and dry, for food production; use of water for irrigation and home consumption; hunting of birds, gathering of plants for consumption and production of necessities; the raising of pigs, dogs, and chickens for meat; building of structures for a variety of practical uses as well as ritual buildings; and access to the ocean and stream areas for fishing and gathering of sea vegetables. [Andrade 2004:3–4]

Mr. Reis and his *ʻohana* still cultivate wet and dry fields for food production, utilize spring water, gather flowers for burials, and raise pigs for meat. Mr. Reis listed the natural resources contained within his family's parcel; besides *kalo*, they also cultivate *maiʻa* (banana; *Musa x paradisiaca*), *noni* (Indian mulberry; *Morinda citrifolia*), cacao (*Theobroma cacao*), cinnamon (*Cinnamomum*), and heliconia (*Heliconiaceae*). The *kalo* and *noni* grown within the parcel today are particularly significant, largely due to their historical antecedents. These native plants were amongst the original crops cultivated by Hainau and Waianae. Mr. Reis additionally revealed that the variety of *kalo* grown on their property is known as the "Keahapana variety." While clearing the land, Mr. Reis discovered an untouched "*puka* of *kalo*," presumably an heirloom varietal. He saved that plant and utilized the *keiki* growing around it within his own *loʻi.*


109

These lands were given Clt. by Palekaia (Konohiki) in or previous to 1835, & have been held in peaceable possession till this time.

Umiumi sworn says.

I have heard all that Pahaa has testified relative to lands of Puai in Kealia, it is all true that is our united testimony.

8,061 Hainan Clt.

Koikoi sworn says—

I know the lands of Hainan in Ili "Kapuna" Kealia. It consists of House Lot, 4 Lois, & kula adj. all in 1 lot.

Bounded as follows—

M. by Konohiki's kula
M. " Loi "Makole"
? " Kealia River

These lands were given Clt. by the Konohiki previous to 1835 & were held peaceably till her death in 1849. They are now in the peaceable possession of Waianae her husband.

Kaaiki sworn says—

I know the lands of Clt. I heard all that Koikoi has testified it is all true.

8,342 Kaawapuhole Clt.

Pakaa sworn says—

I am acquainted with lands of Clt. in Kealia. It is in 2 lots as follows—
No. 1. Is House Lot in "Kaneha"
" 2. " 4 Lois & kula in Ili "Makelono"

Figure 32. Image of entry No. 8061 within Foreign Testimony (pg. 109, volume 12; Office of Hawaiian Affairs 2015)

Mr. Reis elaborated on the history of agricultural activity occurring on his family's parcel:

> . . .the original plan [was to use the land] as a flower garden for the *‘ohana* who came and visited, to be able to come and cut. But over the years, people raiding it, and pigs [foraging], it kind of got diminished. The cacao trees we use for propagation stock, starting from seeds and air layers. The cinnamon tree we just collected seeds from. It's kind of like a seed bank right now. Along with the *lo‘i*, there's bananas and other fruits, edible plants and flower plants. We don't water anything, we don't need to water, there's no irrigation down there, so that spring provides all of that, as well as the name of this valley, Keahapana, ‘white breath,’ is one of the interpretations, and because there's a fog in the valley every morning. So, everything gets a light watering every morning. It's a phenomenal growing area, and I definitely see why our *kūpuna* decided to settle in there with fresh water springs and the abundance. The ability to not have to water.

The "white breath" mentioned by Mr. Reis may be indicative of fog drip. In the early morning hours, one may observe a layer of fog hovering within Keahapana Valley. Generally, there is approximately 0.05 to 0.5 g of liquid water in a cubic meter of fog. Studies in other localities have shown that fog drip can add as much moisture as rain. "When fog comes in contact with vegetation. . . the water condenses and covers the plants. Eventually, the water collects and drips down, watering the plants, the ground and the surrounding habitats" (Catalina Island Conservancy 2017). Plant resources within the Reis parcel are also supplied with water by way of a spring.

Upon mention of the spring, CSH inquired into the history of the water source, traditional names, and its discharge or flow. Mr. Reis noted there are *mo‘olelo* associated with the spring, however, he does not know if the spring was given a name. Stories regarding the spring have been passed down to him through his *wahine*'s father, Mr. Kenneth Bray. He shared with CSH a story about Mr. Bray's original attempts to locate the spring:

> The story told to me was that [Mr. Kenneth Bray's] mother, Johanna Kaui, who grew up on the property, showed him where the spring was. When he was a young man, 18 or 19, he went down there and started clearing the land and reconnecting with his culture. He dug where the spring was, but the spring was no longer there.

In 2008, Mr. Reis began his efforts to relocate the spring. He recalled that a corner of the property, known as "Johanna's Corner," had been neglected for a long period of time and was largely covered in *hau* (*Hibiscus tiliaceus*). Mr. Reis recalled,

> The *hau* was left to grow. As I started the *ki‘i* carving, in the path of learning the culture, I said ‘hey you got land down there, let's plant some stuff. Let's go clean up, let's go *mālama ‘āina* down there.’ And it was a swamp, just a swamp, mushy, *hau* was growing, and we didn't know about this spring. So, we started clearing and as we cleared, I realized that there was water coming out of the ground. I could tell, as we cleared, clean water was coming in, so we started to inquire with her dad about the land. And that's when he started to share about what was down there. We were told that there was a *lo‘i* down there. There is a massive monkey pod tree (*Albizia saman*) on the property that has stories associated with it. But what I believe has happened is that the monkey pod's roots have disrupted the spring that was originally there, and it's either blocked it in some areas, or the spring is either

> following the roots along different routes. But there is an abundance of water that is coming out of that corner of the property and that's one of the reasons why my woman's grandmother chose that corner.

The spring, located approximately 121 m northeast of Kapaʻa Stream (Keālia River), is in a relatively wide flatland (see Figure 29). According to Handy and Handy (1972:423), "where Kealia and Kapaʻa Streams join inland there are wide flats that were terraced." According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the majority of the parcel contains Hanalei silty clay, 0 to 2% slopes (HnA). According to Foote et al. (1972):

> This soil is on stream bottoms and flood plains. Included in the areas mapped on Kauai along the Waimea River and in Waipaoiki Valley are small areas where the surface layer is 8 to 10 inches of reddish-brown silty clay. . .
>
> Permeability is moderate. Runoff is very slow, and the erosion hazard is no more than slight. The available moisture capacity is about 2.1 inches per foot of soil. Roots penetrate to the water table. Flooding is a hazard. [Foote et al: 1972:38]

The USDA adds that "this soil is excellent for the production of wetland crops. The water table is seasonal in most areas and ranges from about 2 to 5 feet in depth and saturated as shallow as the surface" (USDA SSURGO 2001). Mr. Reis further described the location of the spring, detailing the setting in which it once functioned:

> [Those *kūpuna* who remember the spring] were after the actual, untouched usage of the spring. They, in their childhood, would remember a little different scenario. That monkey pod tree could be, gosh, 200 years old, at least 150 years old. At the time, my cousin was telling me that during their childhood, there were flumes set up. It's kind of recessed the property, it's at river level, and there were flumes set up that would trickle water down. It would leak water, and that water would make it wet down there too, and that water would go down into the *loʻi*.

In describing the spring and its environs, Mr. Reis revealed that feral animal activity has had a negative impact. Wild pigs would often trample the spring, resulting in Mr. Reis having to clean and dig out the water source on multiple occasions. Exasperated, he dug the spring completely out (approximately "four feet down"), "rocked the bottoms and rocked the sides," and installed a metal culvert. He explained,

> I put in a culvert to stop the pigs from caving it in. Now there's always water in it. There's about two feet of water in this culvert, it's about a two and a half to three-foot-wide in diameter culvert. Vertical in the ground, you open the lid, and there's clean water in there. The access, there's a small *puka* in the culvert, that just kind of leaks into the *loʻi*. As it fills up, it keeps the *loʻi* fed. Then I can take water from there to wash my hands, or water other things around, so I do use the water from the spring.

When questioned about seasonal water fluctuations, Mr. Reis commented that he has observed how nearby ground disturbance activities have decreased the volume of flow:

> You know, now that I have established that culvert, that's something that I do look at, because I have a line [marking the current water level]. I can watch it and monitor it. Like I said, before, the pigs would come in, and it was hard to tell [the volume of water]. My uncle, who controls the property, has done some excavation on the property, and on two occasions he has dropped the level of the spring by ripping a big trench on his side, which filled with water. Good for him, that's what he wanted. But, it lowered my spring, so that's kind the reason that I'm raising the issue. Because I've experienced how another person's activity can directly affect mine. . . It forced me to dig my *lo‘i* lower, it forced me to dig my spring access lower. . .

Mr. Reis understands that ground water in Hawai‘i is a public trust, and through first-hand experience, knows that adverse effects at one location (such as a well site) may impact available resources in another location. Identifying the proposed well site on an aerial image of Keālia (see Figure 29), Mr. Reis commented that approximately 24 million gallons of water a year will be drawn from it to support the proposed subdivision. The pumping of such a large volume of water has generated concern about potential adverse impacts to ground water resources, cultural resources, and cultural practices.

> So, we have a situation now, where these guys want to develop, and like I said I don't know if I'm actually opposed to the development in particular and its location. But, I'm here and they're here [points to map], and if their [water] take drops it below my take, and I no longer have that ability [to sustain food and flower crops], it's too late. We cannot stop feeding these 300 homes water, I mean for you and your cultural practice. That's why I'm doing what I'm doing now, I'm being proactive, putting my concerns forward, I just need to have it on the record that this is what I'm doing, and why I'm doing it, and if your development is going to put an end to that, so we need to have a serious discussion in regard to that. So, I don't know if they can provide evidence of what I'm seeking. And it very well may be the case that it doesn't, you know, but I'm not willing to take the chance to wait to see if it does, because I know that it's irreversible. So, yeah that's why I'm here, why you guys are here, and I appreciate your time, I really do.

CSH inquired if Mr. Reis had any recommendations in regard to mitigative measures should he observe impacts to his freshwater resources. Mr. Reis commented,

> If it comes to a point where I start to witness that there is a problem, the reality is it's probably too late. There's probably nothing that's going to be done to stop it or reverse it just because, like I mentioned, once they build it and start pumping water, they're not going to stop pumping the water. I guess they could build a water treatment plant, *mauka*, and take it from another source up there, but it's going to cost them X amount of millions of dollars, which they're not going to want to eat for one lone *kānaka* down there. I understand the reality of the situation we're in. I'm doing this to get on the record. . . that these people were notified of my use in the area. Basically, what I'm doing is setting up a scenario that provides me with a rock solid legal argument. And what just compensation is, to deny my children of their inherent birthright as a protected person under international law, I don't know

> what that looks like, but that's the argument I'm going to make yeah. We're in an occupation, not everyone knows that, not everyone agrees with that, but I've done enough research to understand the facts, and there is a legal argument. I'm here to protect the birthright of my children. They can disregard it all they want, and do what they want, but there's consequences. We all get to choose right? And there's benefits and consequences to all that we do. I'm just here to use my *leo* (voice), and pray to *Akua* (God), and just hope that we can work something out. Unfortunately, like I said, I don't know if they can provide evidence that their pumping is not going to impact me. 'Oh you're on a different land, your land goes this way, here's the ground survey, we have evidence of this.' I don't know if they can do that, they'll probably just trickle down through that. We'll see what happens.

CSH inquired if Mr. Reis had any additional concerns regarding impacts to cultural resources contained within the project area. He noted he has observed culturally significant *pōhaku* all along the eastern side of Kauaʻi, from Keālia Ahupuaʻa all the way to Anahola Ahupuaʻa. Mr. Reis is well versed in the geology of not only Kauaʻi, but of the entire Hawaiian archipelago. He has devoted much time, as *kālai pōhaku*, to the study of the earth's physical structure and processes. As a student of the earth sciences, he has often gone out to monitor earth moving activities, analyzing the types of rocks exposed during ground work. Of particular interest to Mr. Reis are the *pōhaku* that appear to have been shaped or altered by humans. He shared with CSH,

> Ok so because of my interest in rocks, [the project area] is screaming significant to me. I'll tell you why. . . I did read a *moʻolelo* about a chief in Anahola, somebody was sick and they had to send for somebody on the north shore, a practitioner to heal this person. I think his house site was in Anahola. As you leave here, I would ask you to drive in this direction to Anahola, as you go down the hill and come back up the other hill, the next hill, if you look to the right, in the side hill that they cut to make the road you will see four *pōhaku* sticking out of the dirt, and they are in a straight line. It's very peculiar to me. What I believe is that it's an archaeological site that was cut through to make the road. One of the reasons that I believe that is not only the line of *pōhaku* sticking out, that was probably the floor of some sort of structure. But if you were to look directly across the highway, there are rocks obviously there. So, going this [way], rocks sticking out of the side hill, can't miss it. On the other side, over that hill *makai*, there's a property there that recently underwent a facelift. It was full of *hau*, machines went in there and tore it down. I'm the guy that shows up after the State and county people disturb things, rocks popping up. I'm in there looking for things. They did that and there were lots of *pōhaku* in the side hill. Some of them had whole round holes in them, it's next to an old dry riverbed. So, my concern in regard to archaeological sites, I don't have any evidence to tell you what was there. . . But there was something there, at one point in time. . . I'm going to guarantee that they're going to find things, lots of things, lots of rocks there. The Anahola solar farm, that was the case. I read the cultural impact statement, it was wonderful, talking about the worship of the sun, but when it came to the actual site, it was one page, I think their impact statement was 30 pages. One page talked about the site, but I know, from my personal experience when I witnessed the excavation, there were five mountains of rocks

> that were over 14-16 feet tall. And what caught my attention were the mounds of rocks blocking the driveway, which were all peculiar, large, interesting shaped, flat, thin stones that were piled up. As I looked further I could see that there were all these mountains of rock everywhere, and the impact statement didn't capture any of that.

Mr. Reis went further, recommending that education and cultural sensitivity training be incorporated within pre-construction planning. He suggested that those working on the project be educated on the types and varieties of traditional Hawaiian cultural material. He also recommended that a field guide be generated and utilized as a reference for onsite construction workers and archaeological monitors. This field guide would be generated in conjunction with stakeholders and/or cultural descendants of Keālia. In addition to education and cultural sensitivity training, Mr. Reis recommended that prior to any ground disturbance, a survey of the project area should be conducted with ground penetrating radar (GPR). He shared,

> What I would like to see moving forward in the process, ground penetrating radar. Unfortunately, that cost falls on the developer. But if you want to develop the property, you need to ensure before you start digging, that you're not going to turn up a bunch of rocks. And educating people, and that's what we're really lacking. The educated machine operators, you start digging, and you start pulling up rocks and they're all in a row, maybe it's time to stop. My research will hopefully tell me, if you dig up a piece of olivine basalt, far from a shore, you might be digging into a house site, or that might be a tool. That type of rock isn't supposed to be there. Understanding that structures, *heiau*, had uniformity with and amongst the type of stone that was used to increase the *mana*. That's very simple. You go to a place, and they're all the same type of stone, that's an indicator of something. We just don't have, the guys on the ground, don't have that [kind of] education.

Mr. Reis concluded by reiterating the importance of preserving and protecting cultural resources and cultural practices for future generations.

6.5 Summary of *Kamaʻāina* Interviews

Based on Mr. Kenneth Ponce's, Mr. Valentine Ako's, Mr. Richard Kaui's, and Mr. Tim Reis' reviewed and approved summaries, the following is a synthesis of findings within Keālia Ahupuaʻa.

Mr. Kenneth Ponce was interviewed by CSH on 22 May 2017 at the Courtyard Kauaʻi in Kapaʻa, on the island of Kauaʻi. Mr. Ponce, a *kamaʻāina* of Kapaʻa, is a retired firefighter from the Kauaʻi Fire Department. As a third generation resident of the Kapaʻa-Keālia area, Mr. Ponce discussed with CSH his relationship to the *ahupuaʻa* of Keālia and provided descriptions of plantation life (ca. 1960s) within the area. Mr. Ponce described to CSH the influence of his ancestors, Pedro and Crescencia Ponce, within Keālia and Kawaihau at large. The impact of Hawaiʻi's plantation workers, in particular their contributions to the island's unique *kamaʻāina* culture, was evaluated.

Mr. Ponce's testimony reaffirmed the ways in which the actions and experiences of plantation workers "helped create the changes that saw Big Five control over Hawaii give way to multi-ethnic participation in a more democratic society" (Nishimoto et al. 1984). Within Keālia, these workers became an integral part of the community, emblematic of the ever-evolving social fabric of the Hawaiian Islands. Mr. Ponce’s ancestors were also identified within an oral history anthology of Hawai‘i’s working people (Nishimoto et al. 1984); Pedro Ponce was identified as the “striker” and Crescencia Ponce as the “healer.” While both were Visayan immigrants from the Phillipines, it wasn’t until after the “territory wide Filipino plantation strike of 1924” (Nishimoto et al. 1984:107) that the two were finally able to meet, marry, and establish a family and business within the Keālia-Kapa‘a area.

Discussion of the natural resources available within Keālia were often accompanied with personal *mo‘olelo.* Among these personal stories were recollections of Crescencia Ponce’s healing gifts. Mr. Ponce’s grandmother, Crescencia, was known throughout Kawaihau District as a religious woman who was especially skilled in matters relating to obstetrics; Mr. Ponce remarked that she often helped childless women conceive, and assisted women during difficult pregnanies. Mr. Ponce also remarked that as a *hilot* (also known as *manghihilot*), Crescencia would gather herbs to utilize in her healing practices (akin to an *albularyo* [herbalist]). Mr. Ponce described some of the native vegetation within the *mauka* portions of Keālia Ahupua‘a, but did not assign cultural significance to these resources or link them to any specific cultural practice.

According to Mr. Ponce, *mauka* portions of Keālia, near Kumukumu, were once occupied by homes belonging to plantation camp workers. In discussing plantation camp demographics, Mr. Ponce identified the ethnic groups once living in close proximity to the current project area. These groups were the Portuguese, the Filipinos, the Japanese, and the Hawaiians. Regarding the Kumukumu area, Mr. Ponce recalled that chicken fights were once held there. Mr. Ponce identified the chicken fights as a traditional cultural practice introduced by Filipino plantation workers.

Mauka of the plantation camp homes, the landscape primarily consisted of sugarcane. Within these *mauka* lands, Mr. Ponce and his father hunted for pheasants. The bird was eaten and the feathers sent to relatives on O‘ahu; feathers were later used to make *humu papa*. Currently, the fallow sugarcane fields have been converted to pasture land. In discussing current site conditions, Mr. Ponce pointed out that some portions of Keālia Ahupua‘a are being leased by Keālia Farms.

The current Keālia landscape is reflective of the intensive land modifications that occurred as a result of the sugar and pineapple industries of the late nineteenth to early twentieth century. Mr. Ponce added that he had once worked in the pineapple fields as a young man. According to Mr. Ponce, “old timers” consisting of former plantation workers and private workers had acquired 20-acre tracts in the *mauka* portions of Kapahi and Kapa‘a Ahupua‘a, near Kawaihau Road and the former Hawaiian Fruit Packers pineapple cannery; by the 1960s, land use primarily consisted of private or agricultural land holdings. These 20-acre tracts were often cultivated with pineapple; some of the private owners of these tracts—“old timers”—were Hawaiian Fruit Packers employees who sold their fruit back to the cannery (De Silva 2016). Mr. Ponce also recalled how leftover pineapple cuttings were dumped into the waters just north of Keālia Beach.

Mr. Ponce also recalled the historic plantation social hall located on the north side of Kapa‘a Stream, just within the limits of Keālia Ahupua‘a. The hall played host to many plantation workers and their families and was utilized for numerous celebrations and *lū‘au*. Although these celebrations were described as “good fun,” Mr. Ponce noted that by the 1960s the community of Keālia was quite small, with limited “modern” development and rural infrastructure. The only large development within the area was a residential subdivision located immediately southeast of the current project area.

In discussing cultural practices within the *makai* portions of Keālia Ahupuaʻa, Mr. Ponce recalled accompanying his grandmother, Crescencia Ponce, on fishing trips to Kapaʻa Stream. Kapaʻa Stream remains a freshwater resource for the residents of Keālia. Mr. Ponce commented that this stream is occasionally confused as "Keālia River" by some local residents. This mistake may be attributed to the fact that Kapaʻa Stream forms a portion of the southern boundary of Keālia Ahupuaʻa. However, the smaller Keālia Stream does share headwaters with Kapaʻa Stream; both originate from Puʻu Eu, a peak in the Anahola Mountains.

Mr. Ponce shared that his family would eat whatever was caught from the stream or ocean. When he and his grandmother fished in the stream, their catch would consist of *ʻoʻopu*. *Pāpio* and *ulua*, once plentiful in the waters off Keālia, were generally caught near the mouth of the stream. Freshwater *ʻopae* were also collected from the stream and used as bait. Mr. Ponce also recalled picking *ʻopihi* at Keālia Beach.

Mr. Ponce also discussed the cultural practice of *heʻe nalu* (surfing). As a young man, Mr. Ponce surfed near Keālia Beach. In his youth, he and his friends would often spend the entire summer surfing, swimming, and fishing down at Keālia Beach. Summers spent at the once "empty" Keālia Beach, accentuated the rural, "country" feel of the Keālia community.

CSH inquired if Mr. Ponce was aware of any *wahi pana* or cultural sites located within or in close proximity to the current project area. Regarding *wahi pana*, Mr. Ponce shared descriptions of Waipaheʻe Falls. Described as Kauaʻi's "Slippery Slide," Mr. Ponce and his friends would often cool off in its waters after a long day of work in the pineapple fields. He also fondly recalled a song by Braddah Iz entitled "Waipaheʻe Falls," and recommended that CSH research this *mele*. Mr. Ponce, however, could not recall any cultural sites within the project area and stated that he had never heard of burials being encountered within or in the vicinity of the project area. In general, he supports the project and does not believe it will impact any view planes.

Although Mr. Ponce did not recall any burials being uncovered by either human or natural disturbance within Keālia, Kupuna Valentine Ako was quick to warn about the presence of burials within coastal portions of the Kawaihau District.

CSH interviewed Kupuna Valentine Ako and his son Ivan Ako on 25 May 2017 at his home in Kapaʻa, Kauaʻi. Kupuna Ako began the interview by sharing his *manaʻo* regarding the proposed Keālia Subdivison project. Kupuna Ako shared his concerns about potential subsurface finds, including traditional Hawaiian cultural material (i.e., *imu*) and burials. He recommended that developers and on-site workers be made aware of the possibility of inadvertent finds, and should these finds be encountered, proper protocol be followed. He also stated that should *iwi kūpuna* be inadvertently discovered during ground disturbance, these remains must be reinterred within the *ahupuaʻa* of Keālia. He made clear that any *iwi kūpuna* discovered within the *ahupuaʻa* of Keālia should not be removed from the *ahupuaʻa* of Keālia. Kupuna Ako also recommended that reinterment sites remain inconspicuous, and landscaped with appropriate vegetation.

Years of learning from his *tūtū*, coupled with personal work experience, has allowed Kupuna Ako to develop an understanding of proper burial protocol. He shared with CSH two personal *moʻolelo.* The first of these *moʻolelo* recounted how he had helped recover the bodies of over

10,000 fallen soldiers from the Battle of Guadalcanal in the Solomon Islands. Kupuna Ako's second *moʻolelo* recalled his time working for Mrs. Guslander at the Coco Palms Hotel in neighboring Kapaʻa. As a construction supervisor for the hotel, Kupuna Ako oversaw the exhumation and reinterment of 86 individuals. Kupuna Ako noted these individuals were found sitting up and facing east. These individuals were described as being "giant" in size; Kupuna Ako also noted they may not be Hawaiian or Polynesian, as mandibles were not of the rocker form.

Upon discussing the *ahupuaʻa* of Keālia, Kupuna Ako lamented changes to traditional land management practices within the area. Kupuna Ako reviewed with CSH Hawaiian legal land terms. During this review, Kupuna Ako discussed the process of adverse possession. Kupuna Ako's son, Mr. Ivan Ako also elaborated on land use practices during the height of the plantation era. During this period, Keālia was covered in sugarcane and its lands were privately owned by the plantations. Although the sugar plantation (Makee Sugar Company and later the Lihue Plantation Company) was the recognized landlord, the access and gathering rights of both lineal and cultural descendants remained recognized. Mr. Ponce's testimony, however, indicated access and gathering rights extended beyond individuals of Hawaiian ancestry, and included any tenant of the *ahupuaʻa*, regardless of birth or race.

The importance of maintaining natural resources, for the perpetuation of cultural practices was noted. Kupuna Ako shared with CSH that he continues to make traditional food items such *ʻinamona* and *kūlolo*. For these foods, Kupuna Ako relies on natural materials such as *kukui*, *paʻakai*, and *kalo*.

The interview was concluded by Kupuna Ako noting an additional concern. He recalled to CSH the tragic dam breach at the Kaloko Reservoir that resulted in the deaths of seven individuals. The impact of the dam breach upon the natural environment and marine ecosystem was particularly severe. Kupuna Ako warned that a large reservoir is located *mauka* of the current project area. Should the dam at this reservoir breach, both Keālia *waena* and Keālia *kai* would be negatively impacted.

The reservoir in upper Keālia was constructed by the Makee Sugar Company around the end of the nineteenth century. Under the direction of Col. Z.S. Spaulding, the plantation was remarkably successful, producing nearly 5,000 tons of sugar. To support this agricultural industry, water was brought in via a ditch system that led from "the mountain watershed and emptied into Hōmaikawaʻa Stream" (Drennan and Dega 2007:4). In 1934, the Lihue Plantation Company took over the Makee Plantation:

> By the time Lihue Plantation acquired Makee, it had 7200 acres in cane with another 2200 acres planted by independent planters, primarily homesteaders. It had a well-developed water collection and delivery system, too, which delivered an average of some 30 mgd and included Anahola, Kaneha and Kapaa ditches. Altogether it had a total reservoir capacity of 700 million gallons. [Wilcox 1993:73]

Mr. Richard Kaui recalled his family's own dealings with the Makee Plantation (later the Lihue Plantation Company), including the negotiations related to water distribution. CSH interviewed Mr. Kaui on 23 May 2017 at Keālia Farms, Kauaʻi. During the interview, Mr. Kaui recalled the relationship between *kamaʻāina* and the plantation. The relationship was one of trust; *kamaʻāina* were allowed access to natural and cultural resources. Such deals were generally made with only a "handshake"; signed contracts were deemed unnecessary. Mr. Kaui revealed that a deal was brokered by his father, thereby allowing the Lihue Plantation to move water across the Kaui property on the condition that the Kaui ʻOhana could also utilize this water to feed their *loʻi kalo*. Mr. Kaui recalled that an *ʻauwai* was utilized to feed 14 *loʻi kalo* within his family's *kuleana* parcel (LCA 8061). During the 1960s, a disagreement occurred between his aunty and the Lihue Plantation. As a result, the plantation broke a flume and pump, and cut off the active flow of water through the Kaui ʻOhana's property. Although Mr. Kaui indicated that his family's taro patches were fed via *ʻauwai* from Kapaʻa Stream, the flume destroyed by the plantation may in fact be SIHP # -3953. This historic property was identified in an AIS report, "Phase I of a Portion of 2,008 Acres in Keālia, Keālia Ahupuaʻa, Kawaihau District, Island of Kauaʻi, Hawaiʻi [TMK: (4) 4-7-003:002 (Por.) and 4-7-004:001 (Por.)]" (Drennan et al. 2006). SIHP # -3953 consists of,

> . . . of an earthen ditch (the Kakaukua Ditch) located on the north side of Kapaʻa Stream. . . This site is situated immediately adjacent to and north of Kapaʻa River/Stream. Site -3953 measures approximately 1,610 m long by 5.0 to 6.0 m wide by 2.0 m, and follows the contour of the slope. It is associated with *kuleana* (farm lots) awards and house lots, from the mid-l800s. This site may be associated with LCA 10148: 1, house lot awarded to Mamaki. . . Site -3953 has been interpreted as an irrigation ditch which appears to have been constructed during the pre-Contact period, but also used during the historic Plantation Era . . . [Drennan et al. 2006:47]

Mr. Kaui's family continued to farm, although on a much smaller scale, by relying on a spring and small stream (located immediately northeast of their property). Although the sugar plantation negatively impacted their production, *kalo* still remained at the very heart of their agricultural activity.

Kalo continues to figure largely within Keālia. During the interview, Mr. Adam Asquith, owner of Keālia Farms, sat in to observe. Keālia Farms spans 20 acres, with portions of the property planted in *kalo*. Mr. Kaui's father was responsible for planting *kalo* and making *poi*. He often offered *poi* to *malihini* visiting the Keālia area. His preparation was such that those unaccostumed to the flavor of *poi* soon took a liking to it. The Kaui ʻOhana historically utilized *kalo* and *poi* as a staple in their diets. Mr. Kaui still cultivates *kalo* for consumption. Throughout the interview, CSH was reminded of the importance of *kalo* to not only the Kaui ʻOhana, but to the history of Keālia.

The abundance of *kalo* and food crops made Keālia an *ʻāina momona*. According to Mr. Kaui, Keālia's significance was derived directly from the presence of *aliʻi*. During the pre-Contact period, *aliʻi* roamed Keahapana Valley. Tracing their lineage to the gods, *aliʻi* were *kapu*, or essentially an extension of the sacred. As overseers of resources, food remained plentiful for all those residing within the *ahupuaʻa*. Mr. Kaui also noted that human sacrifice was never practiced within Keahapana Valley, most likely attributable to social "harmony" and equitable distribution of resources. In identifying Keahapana (and Keālia at large) as "sacred," Mr. Kaui revealed the spiritual connection of *kamaʻāina* to both place and past. In this way, both Keahapana Valley and Keālia Ahupuaʻa may be understood as *wahi pana*. Other *wahi pana* identified by Mr. Kaui included *mauka* trails leading to traditional Hawaiian habitation areas, Waipaheʻe Falls (Slippery Slides), and a Portuguese earthen oven. Although non-Hawaiian, the earthen oven is a physical reminder of Keālia's rich plantation history.

The effect of the sugar plantation upon the social milieu of Keālia has been measured by the degree to which cross-cultural exchange has occurred. Mr. Kaui's testimony supported the belief that high levels of cross-cultural exchange did occur (as evidenced by material culture, food items, and intermarriage). Mr. Kaui shared personal *moʻolelo* of his family's relationship with various other ethnic groups. Ethnic groups that settled in Keālia included Portuguese, Puerto Ricans, and Japanese. The Portuguese taught his mother how to make *pão doce* and *malasada*. Rather than succumb to xenophobia, these multi-ethnic communities frequently interacted and shared with one another. Mr. Kaui fondly remembered plantation-era Keālia as a "happy place."

Throughout the interview, Mr. Kaui emphasized the importance of Keālia Ahupuaʻa and the need to maintain its lands for future generations. The phrases "*nānā ma hope*" and "*nānā ma mua*" were mentioned on multiple occasions, with emphasis on their interconnectivity. The traditions of the past are best preserved by looking forward to the future, to *nā keiki o ka ʻāina*. CSH understood both statements to be best encapsulated by the *ʻōlelo noʻeau*, "*E mālama ʻia nā pono o ka ʻāina e nā ʻōpio*." Mr. Kaui discussed the need to find dedicated people to work the land, recultivate *kalo*, and "set up something . . . for the children." Mr. Kaui views the children as "future leaders" and shared with CSH that he hopes consultation will remain ongoing between the landowner and the community. Open dialogue would work to preserve access rights to undeveloped parcels within Keālia Ahupuaʻa (as outlined under HRS §7-1), and thus ensure the creation/preservation of a space wherein future generations can engage with their culture in whichever way they choose.

Mr. Timothy Reis also iterated a concern about the ability of future generations to engage with their culture. CSH interviewed Mr. Reis on 21 December 2017 at Keālia Beach Park. Throughout consultation, Mr. Reis made clear that much of his work as a cultural practioner has been motivated by a desire to preserve and protect cultural resources and cultural practices for future generations. Regarding cultural practices, Mr. Reis identified himself as *lawaiʻa* (formerly), *mahiʻai*, *kālai kiʻi*, and *kālai pōhaku*.

Mr. Reis has maintained familial ties to the *ahupuaʻa* of Keālia. Through his grandmother, Ms. Margaret Kaui, Mr. Reis can trace his lineage to the Kaui ʻOhana. His *wahine*, a daughter of Mr. Kenneth Bray, also maintains connections to the Kaui Line. Throughout discussion with CSH, Mr. Reis illuminated how his work as a *kālai pōhaku* has borne him back to the lands of his ancestors.

Under the guidance of Mr. Kenneth Bray, a *kahuna kālai kiʻi*, Mr. Reis first learned how to carve wood. He then went on to learn how to carve stone implements. While engaged in the creation of stone implements, Mr. Reis realized the need to actively employ such tools. Constituting *nā mea makamae*, these tools are essential to understanding traditional Hawaiian foodscapes. In actively utilizing tools such as *pohaku kuiʻai*, one must have a supply of natural resources. In this case, taro was an essential component to the practice of making *paʻiʻai* and *poi*. For Mr. Reis and his *ʻohana*, *poi* is integral to their diet, identity, and culture. His family's cultivation of *kalo*, solely for the production of *poi*, indexes wider cultural associations of Keālia Ahupuaʻa. One such cultural association is contained within the Chant of Puna (uttered by Prince Kila to his grandfather Māweke, whilst on a mission to retrieve Laʻamaikahiki). Mr. Reis made mention of the "name chant" of Laʻamaikahiki (see the Lahainaluna student version of the chant in Section 1.4.5 and the Akina version of the chant in Section 3.4.1). This name chant is significant for Mr. Reis in that it clearly identifies the association between Keahapana and *kalo*.

In recognizing the connection between resources and practice, Mr. Reis began to cultivate *kalo* within this family's lands. Mr. Reis currently farms on lands owned by the Bray, Kaui, Kanehoalani, and Ornellas families (TMK: [4] 4-7-003:009). The parcel upon which he works is located approximately 1.64 km east of the current project area. This parcel is a *kuleana* (LCA 8061), originally awarded to Waianae, the husband of Hainau. Within the Native Register, Hainau claimed four *loʻi kalo*, a *kula* adjoining the *loʻi*, four *māla* of *noni*, three *māla* of *wauke*, and two house sites. Mr. Reis still cultivates *kalo* and *noni* within the parcel. His "work" on the land is not limited to just agriculture. He shapes adzes and stone tools on the property as well.

While elaborating on his cultural practices, Mr. Reis raised concerns about potential impacts to the aquifer and the *pūnāwai.* Supplying water to his crops is of the utmost concern to Mr. Reis. He went on to describe a *pūnāwai* located within their property. Mr. Reis did not identify the *pūnāwai* by a specific name, and went on to note that such knowledge was not provided to him. Although known to be located within a corner of the property known as "Johanna's Corner," the *pūnāwai* no longer remains in its original location. According to Mr. Reis, the *moʻolelo* surrounding the spring relates how Mr. Bray was shown the spring by his mother, Johanna Kaui, when he was a young boy. Upon entering his late teens, Mr. Bray attempted to locate the spring again, but it was no longer there. Mr. Reis described the area as a "swamp," largely overgrown with *hau*. Besides *hau*, a large monkey pod tree was also located nearby. Mr. Reis believes the roots of the monkey pod have disrupted the original spring source:

> But what I believe has happened is that the monkey pod's roots have disrupted the spring that was originally there, and it's either blocked it in some areas, or the spring is either following the roots along different routes. But there is an abundance of water that is coming out of that corner of the property and that's one of the reasons why my woman's grandmother chose that corner.

Nonetheless, water remains abundant within that corner of the property. The abundance of water may be attributable to soil type. Soils contained within the parcel consist of Hanalei silty clay, 0 to 2% slopes (HnA). Generally confined to stream bottoms and flood plains, this soil is "excellent for the production of wetland crops" (USDA SSURGO 2001). "The water table is seasonal in most areas and ranges from about 2 to 5 feet in depth and saturated as shallow as the surface" (USDA SSURGO 2001). According to Foote et al. (1972):

> Permeability is moderate. Runoff is very slow, and the erosion hazard is no more than slight. The available moisture capacity is about 2.1 inches per foot of soil. Roots penetrate to the water table. Flooding is a hazard. [Foote et al: 1972:38]

Mr. Reis went on to point out the location of the spring on a 2011 USGS Orthoimagery Aerial Photograph overlaid with LCA data (see Figure 29). In describing the spring and its environs, Mr. Reis discussed the impact of feral animal activity over the years. The spring has been trampled and in-filled by wild pigs for years. Only recently, however, he dug the spring completely out (approximately "four feet down"), "rocked the bottoms and rocked the sides," and installed a metal culvert.

There is usually 2 ft of water within the approximate 2 ½ two to 3-ft-wide culvert. A small hole, drilled into the side of the culvert, allows water to drain into the *loʻi*. CSH was unable to visit the spring, nor was provided pictures of the spring. CSH inquired into seasonal water fluctuations. Because Mr. Reis has only recently established the culvert, he was unable to comment on water level patterns over the long term. He did note, however, that the spring has been impacted by localized ground disturbing activity. His uncle had once dug a trench near the spring:

> My uncle, who controls the property, has done some excavation on the property, and on two occasions he has dropped the level of the spring by ripping a big trench on his side, which filled with water. . . it lowered my spring. . .

In raising his concerns about impacts to the spring and his cultural practices, Mr. Reis provided estimates on the amount of water to be drawn from the proposed well site. He calculated that approximately 24 million gallons of water a year will be drawn to support the proposed subdivision. He is particularly concerned about the volume of water that will be drawn from the well site (identified by Mr. Reis on Figure 29). It is understood that a well can be drilled into the aquifer and water drawn out; however, pumping too much water faster than the rate of recharge may result in an aquifer yielding less water and potentially running dry. Ground water, as a public trust within the State of Hawaiʻi, also constitutes a cultural resource. CSH noted Mr. Reis' concern for this cultural resource. However, as the hydrogeology of Keālia (specifically, Keahapana Valley) remains outside the scope of the current CIA, CSH was unable to comment on potential negative impacts to groundwater resources during the interview. However, CSH did inform Mr. Reis (via email) that, ". . . an engineering report, evaluating the existing water system and proposed water system, is being drafted. This report will be included within the Draft EIS, available for review through the OEQC website."

CSH inquired if Mr. Reis had any recommendations for mitigative measures. Mr. Reis commented that he believes it would be too late to remedy the situation once the proposed subdivision is constructed.

Mr. Reis is also concerned about preserving the *moʻolelo* of Keālia as he identifies it as an aspect of his genealogy. As he shared with CSH, "that's our *moʻolelo*, that's our genealogy." The connections between *moʻolelo* and geneology are established aspects of traditional thought (Pukui and Elbert 1986:253; Wianecki 2012). Essentially, Mr. Reis underscored the interconnectivity of *moʻolelo* and one's *moʻokūʻauhau*.

Mr. Reis also understands Keālia Ahupuaʻa as a culturally and historically rich *wahi pana*, well suited to supporting a Hawaiian cultural education system. Mr. Reis also went on to point out that culturally significant *pōhaku* may be contained within the project area. Mr. Reis recommended that GPR be utilized prior to ground disturbance in an effort to survey the project area for potential subsurface cultural deposits. Mr. Reis also recommended that education and cultural sensitivity training be incorporated within pre-construction planning. In addition to this training, a field guide should be generated in conjunction with stakeholders and descendants of Keālia, to be utilized in the field by construction workers and archaeological monitors.

Section 7 Traditional Cultural Practices

Timothy R. Pauketat succinctly describes the importance of traditions, especially in regards to the active manifestation of one's culture or aspects thereof. According to Pauketat,

> People have always had traditions, practiced traditions, resisted traditions, or created traditions . . . Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change resulting from multiple influences, including modernization as well as other cultures. It is well known that within Hawaiʻi, a "broader 'local' multicultural perspective exists" (Kawelu 2015:3) While this "local" multicultural aspect is deservedly celebrated, it must be noted that it has often come into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section, and understood to represent survivance or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences helps inform nuanced understandings of entanglement and of a "living [Hawaiian] contemporary culture" (Kawelu 2015:3). This section strives to articulate traditional Hawaiian cultural practices as were practiced within the *ahupuaʻa* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity" (Cipolla 2013) and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section integrates information from Section 1.4 and Sections 3–6 to further examine cultural resources and practices, both past and ongoing, identified within or in proximity to the project area. Such an analysis is conducted in order to determine whether the proposed project will potentially affect or physically alter cultural resources, practices, or beliefs, isolate cultural resources, practices, or beliefs from their setting, and/or introduce elements which may alter the setting in which cultural practices take place (OEQC 2012:13). Although, this analysis is designed to identify and describe cultural resources, practices, and beliefs located within the "potentially affected area" (OEQC 2012:12), interviewees did not identify specific traditional cultural practices, either past or ongoing, within the current project area. Interviewees also did not identify specific cultural resources within the current project area. However, interviewees did indicate there is a potential for subsurface cultural deposits within the current project area. Additionally, one interviewee articulated a concern about potential impacts to ground water resources, which could in turn, negatively impact his cultural practices. Regarding this concern, HHF provided the following information:

> The Proposed Action has estimated water demand of 118,000 gallons per day (gpd), with maximum daily demand of 17,250 gpd. [The] existing water service agreement

> with Kealia Water Company allows for drawing up to 300,000 gpd. Two existing wells will be used. The existing and proposed pumpage is well within the pump capacity approved by the DLNR Commission on Water Resource Management.

However, as these concerns relate to potential impacts to the environmental welfare of the community, they lay beyond the purview of the current CIA. The results of an engineering report evaluating potential impacts of the proposed project’s water system on the community, and mitigative measures should be included in the Final Environmental Impact Statemnet (FEIS). Excerpts from interviews are incorporated throughout this section where applicable.

7.1 Gathering of Plant and Food Resources

Located on the northeast side of the island of Kaua‘i, the *ahupua‘a* of Keālia is a fairly large alluvial plain with irregularly shaped gulches and small valleys in the uplands, through which small tributary streams run from the major Kapa‘a Stream. These streams empty into the ocean at the southern border of the *ahupua‘a.*

The lack of traditional rain names associated with Keālia Ahupua‘a is indicative of historic environmental conditions within the area. Handy and Handy (1972) attest to these drought-like conditions, recalling Keālia as “rather dry” (Handy 1972:423). Due to these conditions, *maka‘āinana* living within the *ahupua‘a* were forced to modify nearby freshwater resources. The modification of freshwater resources was not limited to the Keālia area; sometime after AD 1100, complex agricultural irrigation systems were developed across the island chain. The Keālia landscape was altered by early Hawaiians with the construction of well-engineered lateral ditches (State of Hawai‘i Commission on Water Resource Management 1993:9). One such ditch was documented by Wendall Clark Bennett in 1931. Bennett describes the ditch, located just south of Keālia Valley, as

> . . . about 6 feet in width and of varying depths. . . a deep cut about 100 feet long made through a low ridge alongside of which the ditch ran. The lands to be irrigated were on the other side of this ridge and so the cut was made to a depth of 10 or 15 feet through loose rock and subsoil. [Bennett 1971:n.p.]

Labor for such large scale or intensive agricultural or construction projects was provided by the *maka‘āinana*. Keālia Ahupua‘a was “home to a large, settled population of farmers and fishermen” (these individuals were the literal backbone of the *maka‘āinana*), “who exploited the coastal areas abundant natural resources, as well as the land that contained nutrient rich soil immediately inland and *mauka* (upland) from the coasts” (Drennen et al. 2007:12).

Historic documents from the late eighteenth century are amongst the first written observations of Keālia and the greater Puna (Kawaihau) environment. Captain George Vancouver, sailing off the east coast of Kaua‘i during his third voyage to the Hawaiian Islands in 1793, described the area in detail.

> This part seemed to be very well watered, as three other rapid small streams were observed to flow into the sea within the limits above mentioned. This portion of Attowai, the most fertile and pleasant district of the island, is the principal residence of the king, or, in his absence, of the superior chief, who generally takes up his

> abode in an extensive village, about a league to the southward of the north-east point of the island. [Vancouver 1798:221–222]

His written observations provide key insight into the potential scope of resource extraction occurring in the Puna (Kawaihau) District during the early post-Contact period. Both *lo‘i kalo* and *kula* would have been required to support the “extensive village” observed by Vancouver. Although not specifically named, the village identified by Vancouver may have been located somewhere along the northeast coast, an area spanning from Keālia to Moloa‘a Bay. A well-functioning agricultural and aquacultural system would have been essential not only for Keālia, but for the entire northeast portion of Puna (Kawaihau) Moku as well.

The production (and consumption) of *kalo* or taro was vitally important to Keālia Ahupua‘a. The reliance upon this staple crop is evidenced by the remnants of *‘auwai* within the *ahupua‘a* as well as the large number of *lo‘i kalo* identified within LCA records. According to these records, the majority of land claims were made on lands adjacent to Kapa‘a Stream (also known as Keālia River). Other *kuleana* lands were situated adjacent to smaller streams or *‘auwai* north of Keālia River. Sixty-seven cultivated *lo‘i kalo* were claimed as *kuleana*; within the claims, numerous references were made to uncultivated *lo‘i* as well as to the boundaries of cultivated *lo‘i* that were not claimed. Both physical and documentary evidence attest to the importance of *kalo* to communities of Native Hawaiians living in Keālia during the mid-nineteenth century.

Captain James King, visiting Hawai‘i in 1779, noted that “the natives of these islands are, in general, above the middle size and well made; they walk very gracefully, run nimbly and are capable of bearing great fatigue” (Shintani 1993:10). Accordingly, the high level of physical activity and physical fitness described by Captain King was a normal part of Hawaiian life, and largely attributable to the availability of plant and food resources such as *kalo*, *‘uala*, *niu*, *mai‘a*, *limu* (seaweed), and *i‘a* (fish). Besides the observed contributions to stamina and health, *kalo* was also a revered staple food, believed to have derived from the first-born son of Wakea and Papa.

> . . . the supreme god Kane ‘in the form of Wakea (a form associated with the earth) produced two sequential offspring: the first became kalo (taro) plant, the second became Hāloa, the ancestor of man . . . thus, in kinship terms, the taro is the elder brother and the senior branch of the family tree, mankind belongs to the junior branch, stemming from the younger brother.’ [Trask 2012:75]

Kalo is still cultivated in portions of Keālia today. Kupuna Valentine Ako also shared that he relies on *kalo* to make *kūlolo*. Mr. Richard Kaui also continues to cultivate *kalo* within his family’s *kuleana* parcel. During consultation with CSH, Mr. Kaui was picking up *huli* from Mr. Adam Asquith, the owner of Keālia Farms. In discussing the planting of *kalo*, Mr. Kaui recalled that his father was a skilled *mahi‘ai* and *lawai‘a*, dedicated to continuing a long tradition of farming and fishing within the *ahupua‘a*. He shared that his father would plant according to *kaulana mahina* (the Hawaiian lunar calendar). The utilization of *kaulana mahina* signifies a certain level of expertise, of skilled knowledge connected to place. In this case, Mr. Kaui’s ancestors, as *kama‘āina* or *hoa‘āina* of Keālia Ahupua‘a, were highly attuned to their environment.

Mr. Kaui’s *kuleana* parcel, LCA # 8061 (1.64 km east of the current project area), is also utilized by Mr. Tim Reis for the cultivation of plant and food resources. Mr. Reis currently cultivates the “Keahapana” variety of *kalo* (possibly an heirloom varietal), in addition to *mai‘a*, *noni*, cacao, cinnamon, and heliconia. The *kalo* and *noni* grown by Mr. Reis is particularly significant. These native plants were amongst the original crops cultivated by Hainau and Waianae, the original claimants of LCA # 8061. Ground water via a *pūnāwai* is a valuable resource currently utilized by Mr. Reis to irrigate his *lo‘i kalo*. Although, this *pūnāwai* remains approximately 121 m northeast of Kapa‘a Stream (Keālia River), within the *‘ili* of Kapuna, Mr. Reis is concerned that the pumping of fresh water for the proposed subdivision will tax the aquifer, eventually impacting his supply of ground water. *Kuleana* parcels within Keahapana Valley are also provided with water by various other means (i.e. fog drip).

Within the current project area soils consist of the Ioleau and Lihue Series, and generally suited for irrigated sugarcane, pasture, and pineapple. In contrast, soils near LCA # 8061 and LCA #3413-B are of the Hanalei, Kolokolo, Ioleau, and Lihue Series. Notably, Hanalei soils are used in the cultivation of *kalo*. They consist of “somewhat poorly drained to poorly drained soils on bottom lands” (Foote et al: 1972:38). The water table is seasonal in most areas, encountered anywhere between two to five feet below surface; the water table can be “saturated as shallow as the surface” (USDA SSURGO 2001). Water for crops is also available via fog drip. In discussing the meaning of Keahapana, Mr. Reis revealed that it translates to “the white breath,” and is a direct reference to the fog that blankets the valley in the early morning hours. Generally, there is approximately 0.05 to 0.5 g of liquid water in a cubic meter of fog.

Traditional Hawaiian diets were sometimes supplemented with land-based protein. Only three animals were traditional domesticates within ancient Hawai‘i; these were the *pua‘a* (pig), *‘īlio* (dog), and *moa* (chicken). All three of these animals were introduced by Polynesian wayfinders to the islands, and later raised by the *maka‘āinana* as food sources. These animals also figured largely within religious practice as they were deemed acceptable offerings for the gods (Hommon 2013:78). By the mid-nineteenth century, *pua‘a* was the only traditional domesticate still being raised for consumption within Keālia. Māhele documents from the period indicate that the *kama‘āina* of Keālia were raising turkeys and goats as well. From the ocean, the *kama‘āina* of Keālia could rely on a variety of “molluscs, crustaceans, and echinoderms” (Edmondson 1946:7) as an additional source of protein. Ivan Ako, son of Kupuna Valentine Ako, noted to CSH that they once gathered *limu kohu*. Interviewee Kenneth Ponce also recalled collecting *‘opihi* along the Keālia coastline.

Animal protein sources such as meat and fish were flavored with either salt or relishes such as *‘inamona*. Kupuna Valentine Ako still relies on *kukui* and *pa‘akai* to make *‘inamona*, however, he did not disclose from where or from whom he gathers his ingredients. Keālia, literally translated as “the salt encrusted,” was noted for its salt ponds. Mr. Kaui recalled this cultural association, sharing that,

> Then they come down to Keālia and make salt, where that landing was. Because when the waves come, it settles, and that’s how they get their salt. Big salt bed here was, plenty people don’t know that. But we know that.
>
> The salt was pure white. Really, really salty. Because it’s from the ocean yeah. It’s not like that Hanapēpē one, it’s salty but not as salty as this one. . .

Large waves would often flood the coastal flats of Keālia, resulting in the formation of shallow ponds. After a time, the water would evaporate, leaving a thin layer of white salt. None of the interviewees identified the gathering of *pa‘akai* as an ongoing cultural practice; currently, coastal

Keālia is primarily utilized for recreation. According to John Clark, "salt from the deeper pockets was gathered to satisfy a variety of domestic, medicinal, and ceremonial needs" (Clark 1990:11).

Another noteworthy resource in Keālia were *loko ʻia*. Four fishponds were mentioned within Māhele documents. Unfortunately, only two of these ponds, Loko Akiana (LCA 8060) and Loko Waipunaula (LCA 8833) have been explicitly identified. Loko Akiana (LCA 8060) is believed to have been in the *ʻili* of Akiana, and Loko Waipunaula (LCA 8833) is believed to have been in the *ʻili* of Waipunaula. Freshwater resources were not only raised, but also caught in the rivers and streams. A *kahe ʻoʻopu* was claimed by one individual (LCA 2381), but was not awarded. Mr. Ponce also recalled fishing in the Kapaʻa Stream (Keālia River). Joining his grandmother on fishing expeditions, they would haul in *ʻoʻopu* and *ʻopae*. Near the mouth of the stream, *pāpio* and *ulua* were also caught. Both freshwater and marine resources were utilized to supplement the diets of Keālia's *kamaʻāina* families.

Food also played a vital role in the treatment of the sick. For Keālia, there exists a *moʻolelo* that speaks to this concept. When visitng the *ahupuaʻa* of Keālia, both Hiʻiaka and Wahineʻōmaʻo cook *lūʻau* to help feed, and thereby heal, an old man and his sick wife. Malo additionally notes that when a *kahuna lapaʻau* was first sought for help, he would inquire into the disease and then proceed to restrict certain articles of food from the sick man (1951:107). Once the patient agreed to follow this dietary regimen, the *kahuna* would then administer the treatment (Malo 1951:107 in Shintani 1993:35). The original claimant of LCA 8061 (a *kuleana* parcel currently associated with the Kaui, Bray, and Reis ʻOhana), Hainau, identified a grove of *noni* within her lands. *Noni* is used for the treatment of boils, bruises, sores, wounds, broken bones, and concussions (Abbott 1992:99-100). It has gained popularity as a curative tonic within recent years. *Wauke* was also identified within LCA 8061. Although generally used in making *kapa* and cordage, the plant can be used in the treatment of *ʻea* (respiratory illness) and *paʻaoʻao* (general ailment) in adults (Chun 1994:253-254 cited in Bishop Museum 2018). CSH observed culturally significant *lāʻau* (plants; also medicine) along Keālia Beach. These resources consist of *naupaka kahakai*, *kaunaʻoa*, *pōhuehue*, and *niu*. During consultation, no comments were provided regarding the utilization of particular plants for *lāʻau lapaʻau*, nor the presence of culturally significant *lāʻau* within the project area.

Following the overturning of the *ʻai kapu* (literally "sacred eating;" under this code of conduct men and women could not share meals together and certain foods were forbidden to women), the types of food sources, and the ways in which they were prepared and consumed (and by whom) was significantly altered. Western-style hunting of introduced game animals was adopted during the early nineteenth century. Over the next century and a half, western-style hunting would become increasingly relied upon as a means to supplement diets, especially for low-income or working class *kamaʻāina* families. Interviewee Kenneth Ponce shared that he once hunted pheasant with his father in the lands *mauka* of the current project area. He commented that the area was entirely covered in sugarcane, but by utilizing existing cane haul roads they were able to reach the very base of the mountains. The pheasants were consumed and/or mounted by his father. Feathers from the pheasants were also sent to Mr. Ponce's family on Oʻahu for the creation of *humu papa*. These animals may remain in the *mauka* portions of Keālia.

7.2 Religious Practice and Burials

Traditionally, prior to any undertaking, prayers were offered to the multitude of ancestor gods and spirits, to *akua*, *ʻaumākua*, and *kupua* alike. As Mary Kawena Pukui notes, "Long before the missionaries came, Hawaiians were *haipule*, religious. Everything they did, they did with prayer" (Pukui et al. 1972:121). The offering of prayer is especially evident within a *moʻolelo* about Hiʻiaka and Wahineʻōmaʻo in Keālia (Wichman 2001). In this legend, Hiʻiaka and Wahineʻōmaʻo help a man named Kalalea cook *lūʻau* to feed his sick wife. Hiʻiaka proceeds to heal the sick wife as well. In the Wichman (2001) version of the tale, Hiʻiaka offers her chant to Kānekapolei, asking for the god to "pray enter, and heal, and let live Koʻana-wai, the ailing woman of Ke-ālia" (Wichman 2001:95). Formal prayers consisting of "composed, memorized, handed-down chants" were often associated with public ceremonies involving both the *aliʻi* and the priestly class. Those belonging to the royal and priestly classes prayed before *kuahu* (altars) and *heiau* (Pukui et al. 1972:123). According to Pukui et al. (1972:123), "these prayers were often accompanied by sacrifices to the gods, [and] embellished by ritual. . ."

It was at the *heiau*, the sacred temples, that sacrifices or offerings were made. Several *heiau* stood in Keālia Ahupuaʻa including Pahua Heiau, Kumalae Heiau, Waiehumalama Heiau, Napuupaakai Heiau, Noemakalii Heiau, Puukoa Heiau, Piouka Heiau, Una Heiau, Mano Heiau, and Makanalimu Heiau (HEN 1885:214–216). In addition to those *heiau* documented by Lahainaluna students in the late nineteenth century (HEN 1885:214–216), Thrum makes note of Kawelomamaia Heiau (Site 112) in Keālia (Bennett 1976:129; Thrum 1907:41). Bennett locates this *heiau* in the *makai* portion of Keālia Ahupuaʻa, "where the Kawelomamaia stream runs into the sea north of Keālia" (Bennett 1976:129); Thrum identifies this site as being within the Hōmaikawaʻa area. Thrum additionally notes this *heiau* is of the *poʻokanaka* class. *Heiau* classified as *poʻokanaka* (literally translated as "skull") were used ceremoniously for human sacrifices (Stokes 1991:24). Quite notably, the Kawelomamaia Heiau is described as being associated with Kawelo, and dedicated to his shark god.

In the *moʻolelo* of Kawelomahamahaia, a shark man is said to patrol the waters between Keālia and Wailua, eating any child that dares to swim out in this area. The shark man is finally caught by the Puna residents and put to death. However, Beckwith notes that this shark man, "is identified with the famous chief Kawelomahamahaia (Kawelo with fins like a fish), a grandfather of Kawelo and descended from Mano-ka-lani-po, who was believed to become a shark god (akua mano) at death" (Beckwith 1970:141).

The notion of the "man-eater" or *niuhi* is invoked within another *moʻolelo* of Keālia. Within the *moʻolelo* of ʻAʻaka the *menehune*, ʻĀhihi Point and Hōmaikawaʻa figure prominently. While swimming at ʻĀhihi Point,ʻAʻaka has a nearly fatal encounter with a man-eating shark (Wichman 1998). In the Rice (1977) version of the story, ʻAʻaka goes swimming with other *menehune* at Hōmaikawaʻa. While bathing, they are nearly caught by the shark. The *menehune* swim ashore, and continue fleeing inland toward the plain known as ʻAʻaka. Led by the *menehune* ʻAʻaka, the group devises a plan to catch the shark. The *menehune* succeed in capturing the shark, dragging it to the reef at ʻAliomanu, near Anahola.

The shark was one of the many animal forms (*kinolau*) that *ʻaumākua*, or ancestor gods, could take. However, on the Island of Kauaʻi, *ʻaumākua* did not assume the form of sharks (Pukui and Elbert 1986:32). The *ʻaumākua* was a revered intercessor, providing the "closest man-with-god relationship" (Pukui et al. 1972:123). As Pukui (1972) also notes:

> For these deities had once been living beings; they were long departed ancestors become gods. From the long corridors of time the *ʻaumākua* watched their

> descendants. And though they judged and punished, they were also special advocates and protectors. For *ʻohana* (family) loyalty continued into eternity. [Pukui 1972:123]

As a protective entity, *ʻaumākua* were believed to accompany the *huakaʻi pō* or *ʻoiʻo* as well. The *ʻaumākua* marched alongside the spirits of chiefs, chiefesses, priests, and warriors "to protect any of the living children who might be caught in the path of the march" (Taylor 1995:45). During community consultation, *kupuna* and *kumu hula* Beverly Muraoka identified a night marcher path in the vicinity of the project area. According to Kupuna Muraoka, the night marcher's path stretches from Mt. Makaleha to Keālia Beach.

It has been noted that the dimly lit, last four nights of the lunar phase, the nights of Kāne, Lono, Mauli, and Muku, were when the spirits marched. Martha Beckwith writes that marchers were seen only on the sacred nights of Kū, Lono, Kāne, and Kanaloa (Beckwith 1970:164). There were two types of spirit processions; for the processions of the gods, "the marchers move five abreast with five torches burning red between the ranks, and without music save that of the voice raised in chant" (Beckwith 1970:164). The processions of chiefs and *ʻaumākua,* however, were conducted in silence, or to the accompaniment of drum, nose-flute, and chanting (Beckwith 1970:164). According to Beckwith, to meet a procession of the former, was very dangerous.

> 'O-ia' (let him be pierced) is the cry of the leader and if no relative among the dead or none of his aumakua is present to protect him, a ghostly spearman will strike him dead. The wise thing to do is to 'remove all clothing and turn face up and feign sleep.' [Beckwith 1970:164]

Upon death, the spirit of the recently deceased was said to leave the body and then proceed toward a leaping place (Handy and Pukui 1977:146). It was in fact the *ʻaumākua* that guided the spirit to and over the *leina* (leaping place) for its leap into Pō, the world of the "unseen" (Handy and Pukui 1977:146). The body of the deceased, however, was attended to by the living. Those who attended the dead body, preparing it for burial were considered *haumia* (defiled) (Malo 1951:97). Burial was done at night,

> . . . so that by morning the burial was accomplished. Then in the early morning all who had taken part in the burial went and bathed themselves in [the ocean] water, and on their return from the bath seated themselves in a row before the house where the corpse had been. [Malo 1951:97]

A purification ceremony was then performed by the *kahuna pule heiau* (temple priest) for all those who participated in the burial (Malo 1951:97). Burials have been encountered in the coastal areas, although SIHP # -3959 was encountered in the *mauka* portion of Keālia Ahupuaʻa, approximately 575 m to the southwest of the current project area.

In a letter addressed to CSH, from Dr. Kamanaʻopono Crabbe of the OHA, comments were made regarding potential cultural deposits and *iwi kūpuna* within the project area: "OHA notes that even in heavily disturbed areas such as those parcels utilized for sugar cane cultivation, intact cultural deposits and resources, including ancestral human burials have been discovered beneath tilled areas."

During consultation with Kupuna Val Ako, CSH was informed that burials may be encountered during ground disturbance. Kupuna Ako stated that per appropriate cultural protocol, *iwi kūpuna* should not be removed from Keālia Ahupua. If *iwi kūpuna* are encountered within Keālia Ahupuaʻa, they must be reinterred within Keālia Ahupuaʻa. The determination of reinterment location and protocol must remain the *kuleana* of lineal and cultural descendants of Keālia Ahupuaʻa and the KNIBC. Kupuna Ako also stated that reinterment sites must remain inconspicuous.

Interviewees did not disclose to CSH information (i.e. location of sites or whether they currently access/care for sites) about specific man-made religious sites such as *heiau*, *ahu* (altar or shrine), *kūʻula* (stone god used to attract fish; *heiau* near the sea used for worship of fish gods), or *ilina* (grave or cemetery). Mr. Tim Reis did note, however, that they grow heliconia within their *kuleana* parcel to place at family grave sites. Additionally, interviewees did not identify any religious sites within the current project area, nor did they provide comment on any ongoing religious practices occurring within the project area.

7.3 Cultural Sites

Cultural sites, or Hawaiian *wahi pana* effectively contribute to the ways in which *kamaʻāina* remember and identify (Basso 1996; Holtorf and Williams 2006), and thus continue to manifest and perpetuate culture. It may be inferred that *wahi pana*, due to their ability "to manifest and perpetuate culture," function as cultural resources. As Cipolla (2008) makes clear,

> . . . people inherit the places that they inhabit (from the past), connections between memory, identity and landscape are usually quite strong. In this sense, space, as configured in the past (which could be the recent past) by either natural or cultural processes, ties reflexively to social relations in the present (see Bourdieu 1977; Lefevbre 1991) and, in turn, to social memories. [Cipolla 2008:199]

These social memories, in turn, work to inform world views and everyday practices. Counted among these practices, and largely subsumed under a "living contemporary culture" (Kawelu 2015:3), is the care or management of natural resources, including cultural sites.

The care of *wahi pana* is in many ways akin in nature to the care of one's *kūpuna*. *Wahi pana*, as storied places, are often connected to various *moʻolelo*. Mr. Timothy Reis pointed out that *moʻolelo* are an aspect of one's *moʻokūʻauhau*; both represent sacred linkages to the past. In this way, the *kamaʻāina* of Keālia are intimately linked to the *wahi pana* of the *ahupuaʻa*. Mr. Reis also understands Keālia Ahupuaʻa as a culturally and historically rich *wahi pana*, well suited to supporting a Hawaiian cultural education system. In denoting the *ahupuaʻa* as *wahi pana*, Mr. Reis also went on to point out that culturally significant *pōhaku* may be contained within the project area. *Wahi pana* in this instance is understood to include natural geographic locations, man-made structures, and Hawaiian land divisions such as *moku*, *ahupuaʻa* or *ʻili*.

ʻUmi, son of the great chief Līloa, is credited with instituting the division of the Hawaiian Islands into taxable districts: "The four *mokupuni* (larger islands) of Kauaʻi, Oʻahu, Maui, and Hawaiʻi were divided into *moku* (districts). . . For ease in collecting annual tribute the *moku* were subdivided into *ahupuaʻa*. . ." (Kamehameha Schools 1994:VI). Keālia Ahupuaʻa belongs to the ancient district of Puna, one of five ancient districts on Kauaʻi (King 1935:228). Puna was the second largest district on Kauaʻi, behind Kona, and extended from Kīpū, south of Līhuʻe to Kamalomaloʻo, just north of Keālia. For taxation, educational, and judicial reasons, new districts were created in the 1840s. Nearly forty years later, King Kalākaua created the new district of

Kawaihau. This new district stretched across multiple *ahupuaʻa*, from Olohena in the south to Kīlauea in the north. Subsequent alterations to district boundaries in the 1920s left Kawaihau with Olohena as its southernmost boundary and Moloaʻa as its northernmost boundary (King 1935:222).

The land division of Keālia lies between the *ahupuaʻa* of Kapaʻa, Kalihiwai, Anahola, and Kamalomaloʻo. Natural features often served as boundaries within the *moku* and *ahupuaʻa*. The *mauka* border extends from the Makaleha Mountains in the south to the Anahola Mountains in the north, and includes the prominent peaks of Makaleha, Puʻu ʻEu, and Anahola. The western border of Keālia abuts the eastern boundary of Kalihiwai Ahupuaʻa and the southeastern boundary of Anahola Ahupuaʻa. Both Keiwa Ridge and Kapaʻa Stream (Keālia River) form portions of Keālia's southern boundary, while the northern boundary generally follows the path of Kamalomaloʻo Stream. The ocean constituted the *makai* border, as it does today.

Within the above stated boundaries were several *ʻili*. The *ʻili* of Keālia, as identified within LCA claims, were Akiana (LCA 10907), Awikiwili (LCA 10907), Haleki (LCA 7966), Haulei (LCA 8060, 1980), Hawaipahea (LCA 8060, 1980), Kaʻeleʻele (LCA 10473, 1980), Kahue (LCA 8834), Kapuna (LCA 8061), Kapunakai (LCA 3413), Kauaha (also Kanaha or Kaha) (LCA 8842), Kaukuolono (LCA 10906), Kaunakakai (LCA 10628), Kealohipaa (LCA 10149, 8060), Kuaiula (LCA 10628), Kuakahi (also Kuahaki or Makuahaki) (LCA 10473), Kulehaole (also Kulehale or Kulihaele) (LCA 8833), Mahuaku (Mahuali) (LCA 7966), Makapono (Makahono) (LCA 8842), Pauahi (LCA 10473), Puhokea (LCA 10473), and Waipunaula (LCA 08833). Waipunaaula was also identified as a fishpond within Keālia. Not explicitly designated within Keālia, but identified within nearby localities were Kapuahola (Kapuaahole) possibly an *ʻili* in Hōmaikawaʻa (LCA 10689) and Naapakukui an *ʻili* in Kumukumu (LCA 10660).

LCA claims not only provided information regarding *ʻili*, they also proved to be a source for descriptions of natural features and boundaries contained within the *ahupuaʻa*. The *wahi pana* of Keahapana was identified within LCA data and by interviewees. Keahapana, was famed for its "heavy taro" (HEN: *Kuokoa*, May 1913). In an interview conducted by CSH in 2002 (Bushnell et al. 2002), Keahapana was identified as an area located up the Keālia River, where Hawaiians continue to live, and where taro was grown until the late 1990s. Mr. Kaui understood the entirety of Keahapana Valley (located approximately 1.7 km west of the project area) to be "sacred." Such sacrality is attributed to the presence of *aliʻi*, once known to traverse the lands of Keālia in ancient times. The peaceful environment in which *kamaʻāina* were allowed to live and work in, also contributed to notions of Keahapana Valley as a sacred space. Mr. Kaui shared that the practice of human sacrifice did not occur in Keahapana Valley.

There exist a myriad of cultural sites or *wahi pana* for Kawaihau District. For the *ahupuaʻa* of Keālia, however, several natural features remain significant. These include *puʻu* such as Pohakuomanu, Pukahulu, Moalepi (Moalepe), and Puʻu Kinui. Pualani, Pohakupili, and ʻŌhiʻa are the names of mountain peaks in Keālia (Hawaiʻi State Archives, Interior Department, Land, 23 June 1862). The place name Pohakupili, however, is also the name of a mountain in the larger Puna (Kawaihau) District. This peak is famed in chant as a place where clouds gather (HEN 1885:I:211–216). Pohakupili is also utilized as a landmark, "when it appears to be on the hill of Nounou," by those fishing at the fishing ground of Limawela (HEN 1885:I:211). Interviewee Tim Reis noted that a significant *puʻu* is located immediately east of the current project area. He did not disclose the name of this *puʻu* nor any *moʻolelo* associated with it. However, he did identify the *puʻu* on a map (see Figure 29). Due to the proximity of this *puʻu*, culturally significant pōhaku may be present within the project area. Culturally significant *pōhaku* are understood to represent pre-Contact lithic material (i.e. lithic scatter, tool, debitage) or isolated remnants of Pre-Contact rock alignments (i.e. walls, enclosures, upright stones). Mr. Reis recommended that GPR be utilized prior to construction-related ground disturbance. In addition to GPR, Mr. Reis recommended that construction personnel be educated on cultural sensitivity and traditional cultural material. He also recommended that a field guide be generated for archaeological monitors and construction crews.

Historic properties previously identified within the proposed project area remain above surface. These surface sites include SIHP #s -7013 and -7016. SIHP # -7013 is the defunct Kumukumu Camp. SIHP # -7016 is a railroad complex associated with historic-era sugarcane plantation operations. Although these historic properties do not represent traditional Hawaiian cultural sites, they do provide information important for research on prehistory or history (Criterion d; HAR §13-284-6).

During a 2017 field inspection (Kamai and Hammatt 2017) for the current project, five features (CSH-1 through CSH-5) were observed and documented. Kamai and Hammatt 2017 provide descriptions of these features:

> . . . CSH-1 through CSH-4 appear to have been associated with SIHP # -07013. . . The five features within the project area are associated with the plantation as seen in previous archaeological studies as well as the similar style of construction associated with water control in sugar plantation systems on Kauaʻi. . . . CSH numbers. . . will most likely be given feature numbers associated with SIHP #s -07013 and -07016. During the current inspection, SIHP # -07016 could not be reidentified. [Kamai and Hammatt 2017:58]

Mr. Reis also discussed the significance of freshwater resources within his family's *kuleana* parcel. Because *wahi pana* can include natural resources such as springs and streams, CSH understands that the *pūnāwai* contained within the Bray (Reis), Kaui, Kanehoalani, and Ornellas *kuleana* parcel constitutes a *wahi pana*, and thus a cultural site. Mr. Reis actively cares for this natural resource and *wahi pana*. During consultation, Mr. Kaui and Mr. Ponce also identified the freshwater spring.

Other significant freshwater resources for Keālia include Keālia Stream and ʻŌpae Kalaʻole, Kapaʻa Stream, Mimino Stream, Halaʻula Stream, Kapahi Stream, Makaleha Stream, Moalepe Stream, Waipahi Stream, Maiakiʻi Stream, Waiʻawaʻawa Stream, Opeka Stream, Kumukumu Stream, and Hōmaikawaʻa Stream. Of these streams, Kumukumu is situated the closest to the current project area.

Overall, however, interviewees commented that they were unaware of cultural sites or cultural resources being contained within the project area. Mr. Reis shared with CSH,

> . . . I don't think it's a bad idea or bad location. I really don't. It's on the side of the road, there's nothing but cows there, as far as cultural resources, they're not present on the property. So, I understand their choice, I understand it's probably going to be built.

Interviewee Kenneth Ponce also did not believe cultural resources or cultural sites were contained within the project area. He commented that,

> Actually, when I saw this project I had a good feeling about it. Because what they're doing is extending part of the existing subdivision. Like I said, I don't think it will impact anything. . .when I looked at it, I felt good about it, that somebody had a good idea to put a subdivision next to an existing subdivision. Right now, it's out of the *tsunami* zone, so I think it's an asset.

7.4 Hawaiian Cultural Education System

Cultural practices of late have been inspired by traditional understandings of caring for natural and cultural resources. Many organizations have adopted practices wherein the community can *mālama* cultural sites, and in turn benefit from the knowledge inherent in such sites. Cultural sites across the islands have become the focus of those dedicated to an *ʻāina*-based education or Hawaiian cultural education system. Mr. Tim Reis provided an example of one such institution employing a Hawaiian cultural education system. Kawaikini, as a "Hawaiian-medium and Hawaiian-values school" makes it its mission to create a "thoughtful, knowledgeable, and healthy community where the language, beliefs and practices of the indigenous people of Hawaiʻi are instinctive" (Kawaikini 2018).

Mr. Reis, as a *kālai pōhaku*, has worked with the students of Kawaikini, teaching them the way to shape *pohaku kuiʻai* utilizing traditional stone tools. He has observed how teaching such practices have helped to perpetuate traditional Hawaiian values. He shared,

> Working with wood and stone, there's no guarantee of what's inside. You oftentimes run into flaws, so you have to learn to adapt and work with those things. . . That's why I took it to Kawaikini, because I thought if our children would be taught in a manner exposed to these art forms, they would be unknowingly exposed to these [values]: patience, perseverance, dealing with problems, strategizing. And I thought those would all be good things for that individual or that child throughout their life if, through the education system, they were exposed to that for twelve years. That's actually kind of my goal to be able to produce a work, and great programs, and make them available to the education system. I think the Hawaiian cultural education system is in its infancy now, and in the future, there would be room for that type of inclusion or implementation of that kind program.

In addition to learning traditional Hawaiian values, *kamaʻāina* children acquire the "social and emotional learning (SEL) skills and academic mindsets to succeed in college, careers and communities locally and globally" (Department of Education 2015). Mr. Reis believes the *ahupuaʻa* of Keālia has the potential to be an essential teaching tool within a Hawaiian cultural education system. However, he cautioned with the following,

> Here in this *ahupuaʻa*, this *ahupuaʻa* has been tied up by a large landowner for a very long time yeah, and it has changed hands. It's predominately cattle. . . As far as [how cultural practices are maintained and an *ʻāina*-based learning approach] develops in this *ahupuaʻa*, it has potential.

> . . . All the *ahupua‘a* have potential, it just depends on who is driving the development and the intent, and that's kind of where we are at today. [We are] wanting to see more of the Hawaiian culture included in that.

Interviewee Richard Kaui also expressed a desire to see the passing on of traditional knowledge to *nā ‘opio*. His descriptions of historic Keālia provided a sense of place, a tacit understanding of *kīpuka*. Despite rapid change occurring on Kaua‘i, Keālia still maintains much of its "rural" feel. Within cultural *kīpuka*, the expression and transmission of native Hawaiian culture can succesfully occur. Mr. Kaui expressed the following desire during consultation,

> . . . I'm concerned about our kids today. You know, maybe we can set up something from this survey for the children. Because they're the leaders to come. That's my heavy concern.

Currently, there are no schools or learning centers within Keālia. Schools are located within neighboring Kapa‘a and Anahola. As such, a Hawaiian Cultural Education System is not currently employed within Keālia Ahupua‘a.

Section 8 Results and Analysis

CSH undertook this CIA at the request of HHF, on behalf of Keālia Properties, LLC. The research broadly covered the entire *ahupuaʻa* of Keālia, including the current project area as well as the *moku* of Kawaihau.

8.1 Results of Background Research

Background research for this study yielded the following results:

1. Keālia Ahupuaʻa belongs to the ancient district of Puna, one of five ancient districts on Kauaʻi (King 1935:228). For taxation, educational, and judicial reasons, new districts were created in the 1840s. In 1878, King Kalākaua, in an attempt to solidify the stature and influence of the Hui Kawaihau (a choral society established by Prince Leleiohoku), created the new district of Kawaihau. This new district encompassed the *ahupuaʻa* ranging from Olohena on the south to Kīlauea on the north. Subsequent alterations to district boundaries in the 1920s left Kawaihau with Olohena as its southernmost boundary and Moloaʻa as its northernmost boundary (King 1935:222).
2. Keālia translates as "salt encrustation." According to John Clark, who translates Keālia as "the salt bed" or "the salt encrusted area," this is a direct reference to the natural salt ponds that formed along the low-lying coastal portions of Keālia Ahupuaʻa. This salt or *paʻakai* satisfied a variety of domestic, medicinal, and ceremonial needs (Clark 1990:11).
3. Generally, Keālia was described as "rather dry" (Handy and Handy 1972:423). This condition may be inferred by the relative lack of traditional rain names associated with Keālia Ahupuaʻa. The Nāʻulu rain is the only known associated rain name for Keālia. Due to the lack of rainwater, freshwater resources such as streams were modified to satisy the needs of *makaʻāinana* living upon the lands.
4. Various members of the Kawelo family line are said to have spent time within Keālia and its environs. Two *moʻolelo* are associated with this legendary line of Kauaʻi kings. The first involves Kaweloleimakua and Kauahoa at the *wahi pana* known as Waipaheʻe. In the legend, the two kinsfolk, engage as young boys in a series of contests. In each of the contests, Kawelo is bested by Kauahoa. As grown men, they are finally pitted in bloody battle against each other. In order to thwart the conflict, Kawelo attempts to remind Kauahoa of their boyhood excursions; Kauahoa is not swayed and swears to fight to the death. The second legend concerns Kawelomahamahaia, the shark man of Kauaʻi. The shark man, a man-eater who hunted in the waters between Keālia and Wailua, was finally caught and stoned to death. This shark man was believed to be associated with Chief Kawelomahamahaia, a grandfather of Kawelo and descended from Manokalanipo (Beckwith 1970:141).
5. Several *heiau* stood in Keālia Ahupuaʻa including Pahua Heiau, Kumalae Heiau, Waiehumalama Heiau, Napuupaakai Heiau, Noemakalii Heiau, Puukoa Heiau, Piouka Heiau, Una Heiau, Mano Heiau, and Makanalimu Heiau (HEN 1885:214–216). Unfortunately, the exact locations of these *heiau* remain unknown. An additional significant temple was the *heiau* known as Kawelomamaia (Site 112) (Bennett 1976:129; Thrum 1907:41). Thrum identifies this *heiau* as being of the *poʻokanaka* ("skull") class. *Heiau* classified as *poʻokanaka* were used ceremoniously for human sacrifices (Stokes

1991:24). Kawelomamaia Heiau is also described as being associated with Kawelo, and dedicated to his shark god. Other important *wahi pana* include ʻĀhihi Point and Hōmaikawaʻa ("give me the canoe"); Kaea (the banana patch of Palila); Waipaheʻe ("slippery water"); Ōpae Kalaʻole (a *wailele*); and a myriad of natural and man-made features including *ʻili*, streams, mountain peaks, and ridges.

6. Early foreign accounts describe the east coast of Kauaʻi, including Keālia Ahupuaʻa, as the "most fertile and pleasant district of the island" (Vancouver 1798:221–222). Captain George Vancouver places an extensive village, located in close proximity to a king's residence, somewhere along the northeast coast, an area spanning from Keālia to Moloaʻa Bay.
7. Keālia was granted to the *aliʻi* Miriam Keʻahikuni Kekauʻonohi (LCA 11216; Royal Patent 6071). Kekauʻonohi was a granddaughter of Kamehameha, one of Liholiho's wives, and served as Kauaʻi governor from 1842 to 1844.
8. Nearly five years later, beginning in 1850, the *makaʻāinana* began receiving their land titles. According to Māhele documentation, LCAs were awarded in an area immediately southeast of the current project area, in close proximity to the Kapaʻa Stream (also identified as the Keālia River). No LCAs were found within the project area.
9. With the increase in foreign interests on Kauaʻi Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. The first large-scale agricultural enterprise in the Keālia area was begun in 1877 by the Makee Sugar Plantation (led by Captain James Makee) and the Hui Kawaihau (Dole 1916:8). Although hoping to establish a successful sugar corporation on the east side of Kauaʻi, a series of unfortunate events led to the disbandment of the Hui, and the passing on of property and leasehold rights to Makee's son-in-law and the new Makee Plantation owner, Colonel Z.S. Spalding (Dole 1916:14).
10. As part of Colonel Spalding's takeover in 1885, the Makee Plantation mill was moved from Kapaʻa to Keālia. To transport their sugar product from the Keālia mill, a railroad was constructed in the late nineteenth century. This railroad line was part of a 20-mile network of plantation railroads with some portable track, and included a portion of Keālia Valley and the *mauka* regions of the plateau lands north of Keālia (Condé and Best 1973:180).
11. The Ahukini Terminal & Railway Company was formed in 1920 to establish a railroad to connect Anahola, Keālia, Kapaʻa to Ahukini Landing, and "provide relatively cheap freight rates for the carriage of plantation sugar to a terminal outlet" (Condé and Best 1973:185).
12. In 1934, the Lihue Plantation Company absorbed the Ahukini Terminal & Railway Company and Makee Sugar Company (Condé and Best 1973:167). Besides hauling sugarcane, the railroad was also used to haul plantation freight including "fertilizer. . . [and] canned pineapple from Hawaiian Canneries to Ahukini and Nawiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd." (Hawaiian Territorial Planning Board 1940:11). Longtime *kamaʻāina* families of Keālia recall a concrete pier (SIHP # 50-30-08-789:H) just north of Kumukumu Stream, where pineapple waste was dumped into the ocean. According to *kamaʻāina*, the current would carry the waste to Kapaʻa, which would attract fish and sharks (Bushnell, Shideler, and Hammatt 2003)
13. The explosive growth of the sugar industry within Keālia inevitably led to the development of a small town comprised mainly of sugar plantation workers, many of whom were

immigrants from Portugal, Puerto Rico, the Philippines, Japan, and China (Kaua‘i Historical Society n.d.). However, the decline of sugar also marked the end of Keālia Town. The town slowly dispersed after the incorporation of the Makee Sugar Company into the Lihue Plantation in the 1930s. Many of the plantation workers bought property of their own and moved out of plantation camps. The plantation camps that bordered Kūhiō Highway were disbanded in the 1980s. In 1997, the entire *ahupua‘a* of Keālia was sold off in an effort to downsize Amfac's landholdings. Because Keālia was the most distant from the Lihue Plantation sugar mill, it was considered the least profitable (*Honolulu Advertiser*, 7 July 1997).

14. Previous archaeological studies locate two historic properties within the boundaries of the current project area; these sites are associated with sugar plantation operations (SIHP # -7013, "New Kumukumu Camp;" SIHP # -7016, railroad complex). Several historic properties are also located immediately north, west, and south of the current project area; these sites are associated with historic sugar plantation operations (SIHP # -3952, a concrete structure and historic petroglyph; SIHP # -1127, a historic terrace; SIHP # -1125, a plantation road and bridge; SIHP # -3957, culvert; SIHP # -7014, cement column pipe supports and concrete columns; SIHP # -3946, a well/cistern; SIHP # -3944, an alignment; SIHP # -3955, a bridge) (Drennan et al. 2006; Drennan and Dega 2007a; Drennan and Dega 2007b). Burial sites appear to be concentrated far south (SIHP #s -1851, -7040, -2161, -3960, -2162, -2074) and far northeast (SIHP # -1899) of the current project area.

8.2 Results of Community Consultations

CSH initiated its outreach effort in April 2017 through letters, email, telephone calls, and in-person contact. CSH completed its outreach effort in February 2018. CSH attempted to reach 34 individuals and agencies. The organizations consulted include the OHA, the KNIBC, the SHPD Burial Sites Specialist and History and Culture Branch, Queen Deborah Kapule Hawaiian Civic Club and the Kaua‘i Council of Hawaiian Civic Clubs (via the Association of Hawaiian Civic Clubs), and community members of Kawaihau District. Below is a list of individuals who shared their *mana‘o* and *‘ike* about the project area and Keālia Ahupua‘a:

1. Kenneth Ponce, *kama‘āina* of Kapa‘a and descendant of former plantation workers, Pedring and Crescencia Ponce
2. Kupuna Valentine Ako, *kama‘āina* of Kapa‘a
3. Uncle Richard Kaui, *kama‘āina* of Keālia, *mahi‘ai* within Keahapana Valley
4. Timothy Reis, *mahi‘ai* within Keahapana Valley, *kālai pōhaku*, *kālai ki‘i*

8.3 Non-Culturally Relevant Community Concerns and Recommendations

During consultation, the community may discuss non-culturally relevant concerns. As these relate to the environmental, economic, and social welfare of the community, they lay beyond the purview of the current CIA. However, these concerns should be evaluated within the FEIS. Based on information gathered from community consultation, participants voiced the following non-culturally relevant concerns:

1. A community concern expressed during consultation regarded the integrity of the Hala‘ula Reservoir located *mauka* of the current project area. Comparisons

were drawn to the Kaloko Dam catastrophe, and a request was made by Kupuna Beverly Muraoka that efforts be made to prevent a similar tragedy from occurring within Keālia. No additional recommendations were offered regarding this concern.

2. Kupuna Beverly Muraoka expressed a concern about the presence of chemical fertilizers and pesticides within the soil. As former cane lands, chemicals once utilized for this industry may be present within project area soils.

8.4 Culturally Relevant Community Concerns and Recommendations

During consultation, the community expressed concerns for cultural resources and cultural practices existing outside the current project area. Of those consulted, three community members articulated that currently there are no traditional cultural resources within the project area, nor are there any traditional cultural practices currently being exercised within the project area. However, comments provided by the community solely pertained to extant, surface cultural resources (or the lack thereof) within the project area. Although traditional Hawaiian cultural resources and cultural sites are not known to exist above surface within the current project area, the community expressed concerns that subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) may be impacted by the proposed project.

Despite the impacts of historic-era sugar plantation activities, interviewees, in general, described Keālia Ahupuaʻa as a rich cultural landscape. Although no surface sites were identified within the project area during community consultation, subsurface remains such as burials, pre-Contact rock alignments, and/or occupation scatters may exist in areas that were not extensively plowed or developed. Cultural material related to burials, pre-Contact features and/or religious structures remain significant to traditional Hawaiian religious belief and practice. Due to the cultural significance of such material, and several community comments postulating the potential for subsurface finds, CSH has made an effort to report these concerns. The following list is intended to present the *manaʻo* (concerns and mitigation recommendations) of the community, and should not be understood to represent CSH's own findings and analysis (see Section 8.5 and Section 8.6).

The following list also presents community concerns for cultural resources and practices existing outside the current project area. Based on information gathered from community consultation, participants voiced the following specific, culturally relevant concerns, and provided mitigation recommendations when applicable:

1. It is necessary to note that certain types of historic properties and cultural sites are difficult to recognize by pedestrian survey alone. It is possible subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) may yet exist, and may be encountered during ground disturbing activities. During community consultation, both Dr. Kamanaʻopono Crabbe (OHA) and Kupuna Valentine Ako articulated that *iwi kūpuna* and other cultural finds may be present within the project area. Timothy Reis, a *kālai pōhaku* residing in Keahapana Valley, indicated culturally significant *pōhaku* may be buried within the project area. Culturally significant *pōhaku*, as noted by Mr. Reis, are understood to represent pre-Contact lithic material (i.e., lithic scatter, tool, debitage) or isolated remnants of pre-Contact rock alignments (i.e., walls, enclosures, upright stones). Mr. Reis recommended that GPR be utilized prior to ground disturbance. Mr. Reis also recommended that those working on the

project must be educated on the types and varieties of traditional Hawaiian cultural material. To facilitate education, Mr. Reis recommended that a field guide be generated and utilized as a reference for on-site construction workers and archaeological monitors. This field guide should be generated in conjunction with stakeholders and/or descendants of Keālia Ahupuaʻa.

2. During community consultation with Kupuna Valentine Ako, he requested that all inadvertently discovered human remains be reinterred within the *ahupuaʻa* where they were originally encountered. Kupuna Ako additionally recommended that the selected reinterment site remain inconspicuous and landscaped in an appropriate way.
3. Current ongoing cultural practices within the *ahupuaʻa* of Keālia include the farming of plant resources. Farmed plant resources include *kalo*, *noni*, *maiʻa*, cacao, cinnamon, and heliconia. In addition to farming, pigs are also raised for consumption. The importance of *kalo* to the Keālia community has been underscored in both *moʻolelo* and *oli*. As such, the *kamaʻāina* of Keālia have remained committed to growing this culturally signifcant staple. Mr. Reis and his *ʻohana* still cultivate *loʻi* and *māla*, utilize spring water, gather flowers for burials, and raise pigs for meat. In particular, Mr. Reis expressed concern about potential impacts to a spring contained within his family's *kuleana* parcel (LCA 8061, approximately 1.64 km east of the current project area); this spring provides water to his *loʻi kalo*. Mr. Reis estimated the proposed project will draw "2 million gallons a month (10,000 gallons x 200 homes) or 24 million gallons a year" from a well site near the project area. Mr. Reis requested "proof" that the proposed project will not have negative impacts on the aquifer and ground water resources throughout Keālia Ahupuaʻa. Mr. Reis believes that should his spring be impacted, it would be too late to rectify the situation, and thus did not provide mitigation recommendations.

8.5 Analysis

Based on information gathered from the cultural and historical background, and the community consultation, no culturally significant resources were identified within the current project area. At present, there are no traditional or customary Native Hawaiian rights being exercised within the current project area. Additionally, no traditional cultural practices are known to currently occur within the project area. While no cultural resources, practices, or beliefs were identified as currently existing within the project area, Keālia Ahupuaʻa maintains a rich cultural history. Keālia Ahupuaʻa traditionally was "home to a large, settled population of farmers and fishermen, who exploited the coastal areas abundant natural resources, as well as the land that contained nutrient rich soil immediately inland and *mauka* (upland) from the coasts" (Drennen et al. 2007:12).

Evidence of pre-Contact settlement and land use, however, has most likely been obliterated by plowing and other historic-era sugar plantation activities. Large portions of the current project area have been subject to historic-era agricultural and, to a more limited extent, urban development. This has resulted in the loss of cultural resources and possible archaeological remains.

Despite this loss, a reconstruction of the traditional landscape can still be achieved through an examination of the historic record. Keālia Ahupuaʻa can be described as a stream valley, with a fairly large alluvial plain bisected by a major stream. Kapaʻa Stream is the major stream within the area, formed by the joining of the Kapahi, the Makaleha, and the Moalepe streams (Handy 1940:68). Further *makai*, the Keālia Stream intersects with the Kapaʻa Stream. Keālia's headwaters include Waipahi, Maiakiʻi, and Waiʻawaʻawa. *Mauka* portions of Keālia were also cut by the Kumukumu and Hōmaikawaʻa streams. Beginning in the twelfth century, a vast system of irrigated taro fields was constructed. This field system—an impressive engineering design—took advantage of the natural environment to provide ample fresh water to residents of the *ahupuaʻa*. Despite the fame of Keālia's "large, heavy taros," *loʻi kalo* were only one element of a complex of features that characterized Keālia during the pre-Contact (before 1778) period. Closer to the Keālia shoreline, house sites, salt beds, and fishponds once dotted the landscape. Extending out into the ocean, *kamaʻāina* of the *ahupuaʻa* availed themselves to various marine resources.

Chiefly residences were centered primarily within nearby Kapaʻa and Wailua Ahupuaʻa. Traditional sources generally do not describe Keālia Ahupuaʻa as being home to *aliʻi*. Although, Keālia was not explicitly identified as a site of chiefly residences, it is believed that *aliʻi* frequented the *ahupuaʻa*. One may better understand Kealia's association with royalty by looking to the *manaʻo* of Keālia's *kamaʻāina*. During community consultation, it was noted that a night marcher path sits in close proximity to the project area. Spirits participating in the *huakaʻi po* were generally understood to belong to the chiefly class. It was additionally noted that *aliʻi* once traversed the *mauka* portions of the *ahupuaʻa*.

More so, Keālia was the home of farmers and fisherman. Devoted to farming and fishing, residents of the *ahupuaʻa* enjoyed a kind of "harmony." A stable population soon developed amidst this Hawaiian-engineered abundance. Captain George Vancouver (1798), sailing off the east coast of Kauaʻi during his third voyage to the Hawaiian Islands in 1793, captured something of this profusion in his journals. He writes, "This portion of Attowai, [is] the most fertile and pleasant district of the island. . ." (Vancouver 1798:221–222).

Keālia Ahupuaʻa has also been enlivened by stories of goddesses, *kupua*, *aliʻi*, and *menehune*. *Wahi pana* within Keālia are reflective of these traditional *moʻolelo*, directly tied to figures such as Hiʻiaka, Kaweloleimakua, and Kauahoa. For the *hoaʻāina* of Keālia, these *moʻolelo* are also understood to be tied to one's *moʻokūauhau*. Several *wahi pana* or *wahi kapu* were located in the lands Keālia, outside the current project area. These *wahi pana* currently function as markers of cultural identity and cultural beliefs. Quite significantly, ten *heiau* were identified within Keālia Ahupuaʻa (HEN 1885:214–216). The presence of such a large number of religious sites suggests Keālia may have possibly been more politically significant in ancient times. Early archaeological studies, however, failed to confirm these *heiau*. Recent archaeological studies within and around the current project area also did not identify any traditional Hawaiian historic properties. Historic properties previously identified within the project area are associated with post-Contact sugar plantation infrastructure.

The post-Contact period brought numerous changes throughout the Hawaiian Islands. The socio-economic and socio-political changes of the nineteenth century were most visible within the landscape of Keālia. By the early twentieth century, the entire *makai* half of Keālia Ahupuaʻa was covered in sugarcane. Plantation infrastructure dominated the *makai* portion of the *ahupuaʻa*; traditional sites and resources were most likely altered or removed entirely to make way for this new industry. Coupled with these landscape changes, were changes to Keālia's racial and ethnic demographics.

The growth of sugar within Keālia required the sponsorship of immigrant workers. Many of these workers were immigrants from Portugal, Puerto Rico, the Philippines, Japan, and China

(Kauaʻi Historical Society n.d.). The influx of immigrants transformed Keālia, leading to the development of a small, diverse town. These new residents brought along their food, religion, and unique way of life. The genesis of Hawaiʻi's own "*kamaʻāina*" or "local" culture can be traced back to these populations of multi-ethnic working class people drawn together by the plantation experience. These workers played a pivotal part in shaping Hawaiʻi's history, and were responsible for the "changes that saw Big Five control over Hawaii give way to multi-ethnic participation in a more democratic society"(Taniguchi in Nishimoto et al. 1984:Foreword).

Although traditional Hawaiian cultural sites are not known to exist above surface within the project area, historic properties related to sugarcane plantation operations are known to exist within the project area. Previous archaeological studies have indicated the presence of two historic properties (SIHP # 50-30-08-7013, the "New Kumukumu Camp" and SIHP # -7016, a railroad complex associated with historic-era sugarcane plantation operations) within the current project area. Background research on sugarcane plantation operations indicates the project area was heavily plowed in the historic era. Typically, soils were plowed to a depth of 18 to 24 inches. Due to this disturbance, the likelihood of encountering subsurface cultural deposits (i.e., *iwi kūpuna*, *imu*, *pōhaku*) remains low.

However, the community also indicated cultural material may exist below these plow zones, and thus may be impacted by the proposed project. Previous archaeological studies conducted in the vicinity of the project area have largely resulted in the identification of historic properties associated with sugarcane plantation operations. No burials or traditional cultural material have yet been encountered within the project area. In general, burials have been encountered along the *makai* portion of the *ahupuaʻa*. Only one burial, SIHP # -3959, was encountered in the *mauka* portion of Keālia Ahupuaʻa. This burial is located approximately 575 m southwest of the current project area.

A concern was also expressed about potential impacts to cultural practices occurring within greater Keālia Ahupuaʻa. *Mahiʻai* Timothy Reis shared concerns about potential impacts to ground water resources and the aquifer. He currently cultivates *kalo* within Keahapana Valley, utilizing a natural spring to water his crops. Although the farming of *kalo* represents a traditional cultural practice, this practice occurs well outside the current project area. Mr. Reis requested that CSH provide evidence that the proposed action would not impact his cultural practices within Keahapana Valley. Per HHF Planners,

> The Proposed Action has estimated water demand of 118,000 gallons per day (gpd), with maximum daily demand of 17,250 gpd. [The] existing water service agreement with Kealia Water Company allows for drawing up to 300,000 gpd. Two existing wells will be used. The existing and proposed pumpage is well within the pump capacity approved by the DLNR Commission on Water Resource Management.

8.6 Recommendations

Based on the above analysis, the following preliminary recommendations are made:

1. The proposed project may have an adverse effect on SIHP #s -07013 and -07016, historic properties related to sugarcane plantation operations. Consultation with the SHPD is recommended to determine if additional archaeological work is required.

2. Although the likelihood of finds remains low, project construction workers and all other personnel involved in the construction and related activities of the project must be informed of the possibility of inadvertent cultural finds, including human remains during a preconstruction meeting. As part of this preconstruction meeting, project construction workers and all other personnel involved in the construction and related activities of the project should be educated on the types of cultural material that may be encountered during the course of ground disturbance.
3. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan in compliance with HAR §13-300 and HRS §6E-43 is recommended.
4. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and/or preservation plan. Proposed reinterment sites must be located within Keālia Ahupua‘a.
5. Although, the above analysis places water draw well within the pump capacity approved by the DLNR Commission on Water Resource Management, it is recommended that a hydrologeologist investigate this situation. The results of this investigation and mitigative measures, if necessary, must be included in the FEIS. Should stakeholders (i.e., *mahi‘ai* and/or cultural descendants) observe changes or impacts to water resources, the landowner and/or developer should remain amenable to engaging in *ho‘oponopono* (conflict resolution).

8.7 Ka Pa‘akai Analysis

In Ka Pa‘akai v. Land Use Commission, 94 Hawai‘i 31, 74, 7 P.3d 1068, 1084 (2000), the Court held the following analysis also be conducted:

1. The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;
2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and
3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist.

The CIA found there are no known traditional and customary Native Hawaiian rights exercised in the petition area. Under the Ka Pa‘akai Case, the required analysis therefore ends after the determination that there are no known traditional and customary Native Hawaiian rights exercised in the 53.361-acre petition area.

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Appendix A Letter Response from the Office of Hawaiian Affairs (OHA)

PHONE (808) 594-1888

FAX (808) 594-1938

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
560 N. NIMITZ HWY., SUITE 200
HONOLULU, HAWAI'I 96817

HRD17-8175

May 10, 2017

Brittany Beauchan
Cultural Researcher
Cultural Surveys Hawai'i, Inc.
P.O. Box 1114
Kailua, HI 96734

Re: Cultural Impact Assessment Consultation
Kealia Subdivision
Kealia Ahupua'a, Kawaihau District, Kaua'i Island
Tax Map Key: (4) 4-7-009:001, (4) 4-7-009:002

Aloha e Brittany Beauchan:

The Office of Hawaiian Affairs (OHA) is in receipt of your letter dated April 2017 letter, initiating consultation and seeking comments ahead of a cultural impact assessment (CIA) for the proposed Kealia Subdivision project located in Kealia, what looks to be old sugarcane fields.

OHA notes that even in heavily disturbed areas such as those parcels utilized for sugar cane cultivation, intact cultural deposits and resources, including ancestral human burials have been discovered beneath the tilled areas.

OHA recommends consultation be initiated with Liberta Albao - president of the Queen Deborah Kapule Hawaiian Civic Club, Jerry Nakasone - kama'aina from the Kealia plantation camp area, and Puanani Rogers - Ho'okipa Network-Kaua'i.

Thank you for the opportunity to comment. Should you have any questions, please contact Kathryn Keala at (808) 594-0272 or kathyk@oha.org.

'O wau iho nō me ka 'oia 'i'o,

Kamana'opono M. Crabbe, Ph.D.
Ka Pouhana, Chief Executive Officer

KC:kk

C: Kaliko Santos, OHA Kaua'i Community Outreach Coordinator (via email)

Appendix B Keālia Reminisce provided by the Kaua‘i Historical Society

{ Pg. 1-7 }

Kealia means:{salt marsh or salt pan} Makee Plantation was a community of races from different places! Makee Plantation like other Plantations segregated each race into groups;having them living in a camp with their own race. Plantations thought each race wouldn't get along with each other;but they did!The Japanese lived near Kealia river having their church & hall in the same area;along with their Bon Dance celebrations. Community also participated in the celebrations.Next to the Japanese were the Filipinos.They had a hall for their celebrations also.Looking mauka towards cane fields were the Chinese (Pakes).After the Chinese retired,they planted peanuts in the sandy soil & sold the boiled & roasted peanuts in the community.There was a Spanish camp too!It stood on a hill among the sugar cane & roasted peanuts in the community.There was a Spanish camp too.It stood on a hill among the sugar cane fields & the train tracks;which had empty cane cars parked there!Close to Keapana!I think it was called mimino { meaning:to wrinkle, curl up or wither}.

Kumukumu means {roots or stumps;or to cut short} camp. Grandparents Maria & Antonio Louis {Fagota} lived with their children in Kumukumu camp.Many Portuguese also lived there!The Portuguese had their celebrations such as Holy Ghost celebrations such as Holy Ghost Feasts, with Azorean & Madeiran dances in Kealia park;with an all Portuguese band, marching with their flags, where they came from. Services were held at St.Catherine's Catholic church in Kealia;'cause the mail were picked up at Kealia Post Office.Then address was changed to Kapa'a.Kapa'a boundary starts on the east side of Kealia bridge {river}.

Another camp was Halaula.There were a mixture of races:Portuguese, PortoRicans, Japanese, Filipinos & Spanish!All homes were painted white wash in & out;green tar paper roof;T& G floor boards, 1x12 rough lumber for the walls.No ceilings. Up & down windows.Had a kitchen,where we washed our faces & brushed our teeth.Took a bath in the washhouse in a shower! It's where mom did her laundry! It had 1 window!The homes were comfortable enough to live in.Had enough ventilation;kept rain, wind & sun away!Sometimes our home had rats, mice, scorpions & centipedes crawling about!.First outhouse {lua} was over an irrgation ditch;where sewage went into the ocean:where we fished, swam, surfed, picked opihis & pipipis. It had 2 {pukas} holes in them:1 for big butts & the other for small butts.Later years, Board of Health made Kealia Plantation take away the luas across the ditch and put it into each lot.Only Bosses {lunas} had beautiful homes with inside bathrooms! Employee's homes had runny water in kitchen & washhouse.We used lanterns!No electricity!About the 1930's electricity was installed. It had a long electric cord with a globe and switch (knob) to turn on & off.Homes had no ceilings!Our home had 3 bedrooms, parlor,kitchen, & dinningroom.Had a kerosene stove:where mom cooks her meals & baked Portuguese white & sweet breads.Boiled her clothes before washing the clothes. Mom planted Kale (Portuguese cabbage) head cabbage, stringbeans-either bush or pole.Looked around community for poles. Found & used poles from koa trees! It served it's purpose! Also planted Irish potatoes, green onion, parsley, watercress, pipinela(squash), some kind of herbs & kabasa.Mom also raised ducks, laying chickens & also hatched chicks.Sometimes she sold eggs. Sometime the laying chickens peck on the eggs & broke them; so mom & some of us went to Kealia beach to pickup seashells. She mixed the chicken feed with the seashells & that did the trick! No more cracked eggs!

When LihuePlantation took over Makee Plantation in 1934 many people moved from Kealia to Lihue!As Lihue Plantation needed these workers; Kealia's homes became empty. Lihue Plantation moved people from the Spaulding Monument, Halaula or Kumukumu areas to live in these empty homes.

My parents:Joe F. Barretto& family lived across the dirt road from Makee Sugar Mill and the trainhouse: where trains parked for the night. Themill's wastewater flowed into a ditch that comes directly back of our home. At first outhouses {luas} were across the ditch for each home. Sewage from this ditch flowed directly to Kealia beach where people swam, fished, surfed & picked opihis & pipipis Board of Health contacted Lihue Plantation regarding the outhouses{luas}that was over the ditch to remove them!The Plantation at this time put it in each home lots!Was done after I was born!Practically all these homes were occupied by relatives: 1st..home-William Victorino's sister Bella & hubby.When they moved; cousins Cynthia & Manuel Machado & sons moved into that home; 2nd HomeAuntie Cynthia & Louis Rodrigues & family;after they moved to Lihue, their daughter Emily &William Victorino & family moved into that home; 3rd Home:my parents-Lorinda & Joe Barretto & children; after we moved from that home, it was torn down;4th Home: cousins Frank & Nevis Machado with 3 girls; 5 Home:First it was auntie Augusta & Manuel Soares & family;-after they moved to Lihue, another auntie Minnie & Manuel Machado & family moved into that home;6 Kila & Mary Mckeague & children;7Home was auntie Ida & uncle John Barretto & children;after they moved mauka in the valley-Rose & Cipiano Pacada & children moved intothat home 8 Home:Grandparents Frank & Frances Freitas Barretto.When they passed away, cousin Bernice & Manuel Ornellas & family moved into that home!There was a train track between this home & the home of Daniel Vasques. Next home was Joe,Amelia Vasques & family. Between these 2 last homes were a Water Pump Station.In another section in Kealia, was a 2 story hotel,where Mr.Bagget or Baggard lived.He worked for Makee Sugar Co. also!At this home we lived in near Makee sugar mill & trainhouse was getting rotten;dad asked the plantation to fixed it;but they never did! When the Shiraki's { the Plantation's carpenter}moved to Lihue,parents moved into that home, which had 5 bedrooms, parlor,kitchen,bathroom facilities, front & back porches & a washhouse.We lived in that home for 5 yrs. The home where we once lived by the Makee Sugar Mill & trainhouse, was torn down.About 23 yrs. we lived in this particular home! Wemissed that home& visited the site every so often! 7 of my brothers & 3 of my sisters & myself all were born in that home; which we loved! From this home we could see all the trains when they come in for the night! We counted how many! My younger brothers & I climbed the roof of our home to get a better view of the trains coming in! In 1946 we moved from the 2nd. home in Kealia to our own home in Kapa'a Heights-Hauaala Rd. overlooking Kealia & the blue Pacific Ocean! Everywhere we are in our property at Hauaala Road we could see Kealia. We missed Kealia alot & on Sunday afternoons we footmobiled down Mailehune Rd. then Kuhio Hwy. to Kealia theatre to see a movie!Theatre was owned & operated by Fernandes family:owners of Roxy theatre at that time! Ruth Kano, her dad King Kano worked in the theatre.This area of homes were 1st my auntie Frances & Carl Bandman & family;when they moved mauka in the valley,Tony Silva,wife & children moved into

{ Pg. 2-7 }

that home; across the hotel was Mr.&Mrs. Eddie Ebinger & sons;the Rapozo's; when they moved to Lihue with their children, the Hoshino's moved into that home.across the hotel;next was Joe Gomes & family & across the dirt road:opposite from Joe Barretto's home was Mabel & John Reis & family, the next home was once occupied by Mr.&Mrs. John Bandman & sons: when they moved from that home; Mary Ornellas Arruda & family moved into that home;next home was Mr.& Mrs. Benjamin Lizama & family, whenLizama's passed away:Mary Ornellas Arruda & family moved into that home;across the dirt road from once the Lizama's & Mary Ornellas Arruda & family home;was the home of John B.Sousa & family; then a Chinese widow Mrs.Liu & son Percy:mauka in the valley was auntie Frances & uncle Carl Bandman & family.Directly in the back of my parents home was another Souza's home Joaquin & Wilamina Souza & family; across their home & Kealia Rd. was a home occupied by the Edwards;a Plantation boss {luna}. There was a stream in the front of Edwards & other homes on the side of Kealia store were occupied by Fred Mendes, wife & family. Fred Mendes was one of the Sales clerks at Kealia store.He sold fishing supplies,nails,screws & etc.After Mendes's died;Ceasar Agos-to, Mary & family moved into Mendes's home from Halaula camp. 2nd home was Louis Alemeda,wife & family lived.Mr.Alemeda was a boss {luna} in the Plantation fields. 3rd home Antone,Mathilda Machado & family & directly back of Kealia store were the:Alapai's/ Lopes. Gas station was next to Kealia store. It was owned & operated by Makee Plantation: sold gas, kerosene & an airhose for car tires! Air hose was put inside by closing time! Kerosene was free of charge for all Kealia families! Joseph Sugai was the proprietor of the gas station. Kealia store was a long building:section of it was set aside for the U.S.Post Office;inside store had an office where Raymond Souza,Harry Yamaguchi & a clerk dealt with the store business each day! Grocery department-Sales Clerks:Alfred Rodrigues, Lillian Tanigawa, King Kano, Joe Teves Sr. & Fred Mendes took care of the hardware department! Grocery department sold produce & fruit also!Store had an upstairs department;where clothing were sewed & hemmed by a Japanese man; don't remem-ber his name! I'm not sure whether or not the clothing this Japanese man sewed or hemmed were items that people bought from Kealia store! The meat market sold fish, meat & pork.The only person that I recall was Ramos who worked in Kealia Meat Market. No vegetables or fruits were sold there!Each family planted their own veggies!Fruits were sold at the produce section. Next to the Meat Market was an Office Building where the bosses {lunas } get their orders for the work day!This office was used also for paying the workers.Was paid in cash!Had to say or present the worker's bango no. to the man in the window before giving you cash inside a small envelope.I did pickup my dad's & brothers pay sometimes when mom took take care of the baby. My brothers & dad each had a separate envelope with cash inside!Present store now was this office!In the park I played with my younger brother& sisters, cousins & the McKeague's children:played soft ball & hide & seek! We never had any disagreements. Had community celebrations there also! Other games played were: yoyo's, 1 & 5 holes with agates {marbles}, tops, ka rope: single & double, Jacks, kite flying! Yoyos were made by each child from empty spool thread containers: strings were from the rice bags.Used cooked rice for glue!Tops also was made by the boys who played with it-strings were from rice bags also.On the dirt road in front of our home:the boys made a circle on the road& put at least 1 top in the middle:the object wasto knock out the top in the middle of the circle. Sometimes they would spin the top to see if any boy could put it in the palm of their hand.My dad was a train engineer & the train passes between the golf links, he pickup a golf ball for our Jacks. Picked up 6 similar sizes stones for our jacks from our dirt road in front of our home. Played in our veranda which we called it then.The golf ball made a lot of noise & kept the baby awake!Dad told me that their is another ball inside.Got an old knife & cut the golf ball & walla another ball which was quieter then the golf ball.The agats {marbles} sometimes my younger brothers didn't have any agates to play with; so one cousin loaned a kini {agate} so that my brothers would be able to compete in the games!Kini{king} was a loner!When my brothers wins; he would return the kini to his cousin.We played tarzan,Jane & cheeta in the tall koa trees during our school vacations! Made our own slingshots! We shot at birds in the trees; but not at each oth er or at homes!We would get it with the belt.We couldn't get away with it!Our cousins & my brother Mack,sister Hilda & I swam in the mill's waste waterstream.The,girls swam in panties & the boys swam nude!We didn't have no evil thoughts! We're cousins playing together!Halaula camp had mixed races living there!On Kealia Rd. & a dirt road lived the Ito's, Watanabe's, Wa-kuta's, Manuel Arruda's, JoeGoveia's & others which I don't remember!About ½ mile there were other homes:Salsedo's, Balbino's, Ceasar Agusto's, William &Lucy Freitas & family, Celestino Augusto & family, Antonio & Anglica Augosto's, Manuel Ornellas's, Balbino's, wife Mariana & family, the Martins's family & last was the Duarte's family! Eventually all the people from Halaula were moving to Kealia flats; my sister Lucy & William Freitas & family including all the rest of the families living in Halaula later moved toKealia!My sister Lucy,William Freitas & family,Lived in Halaula but later moved to Kealia!Some others that lived in Kealia:Ibia's, Pascua's, Aringorayan's, Dela Cruz's, Deligdig's,Takashiro's, Kubo's, Baldonado's, Soma's, Migia's,Furumoto's,Yamaguchi's, Yamane's, Arinaga's, Wada's, Hashimoto's & Asunsion.Mrs.Yamane was a semstress and a barber.She sewed my communion dress & trimmed my hair to a dutch cut!Restaurant owned & operated by Chong family, near Kealia theatre & Kuhio Hwy.We did have a Camp Police-Can't recall his name! By the way each home had averanda {porch}.We had a kerosene stove.Kerosene were free of charge the Plantation gave to the people!One day mom brought a 5 gal can to be filled with kerosene.Her younger children including myself accompanied her to the gas station.Since it closes about 6 pm:mom told Joe Sugai to leave it outside,that she'll pick it up later! We all went to Kealia beach;where we walked along chasing crabs into a hole that we made!Later we poleho the big crabs over a fire! After staying for several hours,we took some sea water & threw it over the fire;then we covered it with sand. Believe it or not:the 5 gals.kerosene can was still outside Kealia gas station!No one stoled it,because we all knew each other in the community & visa versa. Mom told me on a Sunday afternoon she took her sons: Joe, John & Frank to see a movie at Makee Sugar Mill. Don't know whether it was free or not! I think it must have been in the middle of the 1920's.Kealia hospital was a U-Shape brown building. Cousin Mary Rodrigues & Bert Aqui worked there! Dr. Bill Belfor was the physician in charge at Kealia hospital! Arinaga's home now was once Dr. Belfor's home!Bert Aqui's home was at Kealia bluff. Whenever a lady in the community gives birth;a member of the family takes the information to Kealia Hospital:giving parents' names, ages, where they work, name of child, birthdate &birth-place, male or female, roughly the weight & length & whether child were born alive or dead!These are some of the questions answer-ed at that time!When anyone in Kealia passed away; Makee & Lihue Plantations madea wooden (coffin) for the poor people to be

{Pg. 3-7}

buried in. Also dug hole{puka} & covering it, was done by plantation workers.People couldn't afford it!This is one of the things Makee& Lihue Plantations did for their workers & families! Andrew Gross & family lived on Kumukumu & Keallia roads.Worked at Makee's Plantation office.Later Gross's moved to Lihue. My sister Mabel,brothers Manuel & Tony & a few cousins & I went roller skating at the tennis court which was made especially for the Barnes family,Moller family& other families living at upper Kealia near the hospital! Manuel & Mary Arruda & family moved from Halaula camp to live in upper Kealia.We used a trail by footmobile to get to the tennis court. We did ask permission! Roller skates came from Kapa'a rubbish pile.We put them together.We used tire tubing;cutting it into strips & using them to hold our shoes in place on the roller skates! It did the trick! We were poor!Couldn't afford it!On Kealia bluff there was a dam {reservoir} in that area!Some people that lived there:Antone & Carrie Arruda, Joe Teves Jr.wife & family, King Kano & family,Joe Rapozo& wife & family;Joe Souza & family,Bert Aqui,wife-Frances & family,Herman Chong-wifeThelma & family,Harry Yamaguchi,wife Dora & daughter, Alisna & family & others!

I was told that the distance from Kealia store to Kapa'a school was 1 ½ miles.

1st. Apr. 1946 Tsunami{tidal wave}:water came as far as Kealia park, the machine shop & under the homes alongside Kuhio Hwy. By footmobile went to church that morning.Didn't see anything unusual; was concerned to get to church on time!After mass heard sirens blowing from Kealia.It was about that time the plantation picked up people from Kealia & took them to higher ground! Saw some people from Kealia on St.Catherine's property:Mrs Lai a retired teacher & later Principal at Koolau,Anahola & Kapa'a told me to check it out!I did & to my astonishment,I witnessed the waves coming in Kealia river&Kealia's low lying area-s as far as Keapana.The waves sucked out back to the ocean; pigs & chickens in their pens. Saw the bottom of Kealia landing! No one there knew what it was!Asked Mrs.Lai about it! She said it's a tidal wave{tsunami}. I've never seen a tsunami {tidal wave} in my life! Mom told me they had a tidal wave alert years ago.Kealia's people went up to the hospital to wait it out!Mom didn't say when they had this tsunami alert. I think it must have been between the 1920's or 1930's! It was a false alarm! But it's better to be safe than sorry.

King {Kawika} Kalakaua & others owned ½ of Makee Sugar Plantation.Capt.James Makee was the 1st Manager of Makee Sugar Co. On June 9th 1947 my senior class of Kapa'a Hi.School had our banquet at Valley House restaurant:beautiful grounds with a swimming pool, tennis court & etc.I sang at the banquet! In 1950 this beautiful restaurant was burned down.Many people were sad to see it go! By the way,I was told that by Col. Spaulding Monument there were homes! Eventually Plantation torn down the homes & it's people were moved to Kealia flats!Col. Spaulding Monument were made by Kealia Japanese community.

During World War 1 & 2 many of Kealia's young men were drafted into U.S Armed Forces! My dad Joe Barretto,my uncle Marion Louis, Antone Arruda & others were drafted forWorld War 1.They were sent to Schofield Barracks on Oahu. We were inoculated, had food & gas rations; everyone were distributed a gas mask!Everywhere we took it with us!Had curfew! Blackened our windows, so the light will not be seen from the outside! There was no movies & any other celebrations at night! Each section in Kealia had a Warden!My dad Joe F.Barretto was our Warden for our section! Wardens walked along Kealia beach looking for any lights coming from the ocean from anywhere in the beach; for sabateus & any lights coming from any homes! They consulted families regarding lights from their home.This was World War 2.My older brothers were never drafted because they were essential workers for Lihue Plantation Co. My brothers Joe, John & Frank joined the All Kauai Volunteers! They were in the Cavalry{horses}division. Many people watch them marching on their horses:went by two's,then 3's, then by 4's & so forth!Many men were from Kealia!While they were doing that,I sang intoa mike few war songs for them.Families of John Reis, Mary O.Arruda's & Joe Barretto's build a secluded air raid shelter under the hugh koa trees about 30 ft. away from our homes!Families asked the Plantation permission to build it! It was an ideal place!Had benches,a radio & some canned goods!While there, we all prayed,talked & children played games.

Before having the air raid shelter we left our homes & went under the hugh koa trees, where later our air raid shelter was built! We stayed there until the all clear signal was sounded! One day after school I dropped in at Kealia store & spoked to some of the clerks:who knew me well & visa versa.They asked me if I sing in the store, they would give me a soda pop;so I did! Everyone stopped what they were doing & listened!They all applauded! Had my soda pop & it was ono katoots:delicious! Parents couldn't afford to buy any of it!Money was mostly used for food!

My paternal grandparents:Francisco & Francisca Barretto & family raised wild pigs!Some of their sons were pig hunters!By doing so, it put more food on the table! Raised hunting dogs!They fished at Kealia landing & at the beach house!Also picked opiis & pipipis.We ate eel,o'opu & puntat, opae too! During the year they went to the beach house for a picnic & fishing! Beach House is in the outskirts of Kealia.Lihue Plantation; year's ago built a beach home there for the bosses! By the time grandparents & families fished, swam there the home was gone!There was no sight of a home!It was a nice place to fish & a picnic! In Kealia our yards were fenced! My dad & brothers were also pig hunters.My brothers was the second generation of pig hunters! Raised several hunting dogs! They hunted from early morning until sometime in the evening!At first they were not allowed to carry a rifle; later as the years went by they bought rifles.While dogs corned the pig 1 of my brothers would killed it with a knife! Had a model T or a Model A truck for hunting & fishing.We raised wild pigs at our home in Kealia! Whoever went with my dad & brothers got a piece of meat. We didn't have no refrigerator or freezer; so we improvised: the cut pieces of meat after it was cleaned & put Hawaiian salt from the ocean; were put into a cleaned hugh pan.Mom put a damp cloth over the meat.We were told not to lift the cloth up! We listened and and obey! Every now and then mom checked the cloth:if it's dry,she wetted it again & put it over the meat! Do you know the meat never got spoiled with semenela! It brought extra food on the table for us! Sometimes,they brought the piglets home & raised them also for food!My brothers also went bird hunting! Meat & pork were too expensive to buy.Dad fished at Kealia landing as well as beach house.Altho' he didn't have a driver's license, he drove the Model T or Model A for fishing.Later upon retirement dad fished for o'opu & catfish (pantat}. We also had a Pontiac car for holoholo. It was used sparingly!Used it for only important places to go! Few of my nephews still go for pig hunting!This is the 3rd. generation of pig hunters in the Joe Barretto's family! In the home,back of the hotel, parents leased leased land to raise milking cows.Made a shack where my mom & dad milked the cows! We had fresh milk to drink.Don't know how much the lease of the land was!Our mom was our nurse.She gave us her tender loving care when we

{Pg. 4-7}

were sick; along with many prayers. The only time we went to the hospital was when I had a broken leg & my sister Hilda had a broken arm.Dad was our dentist! He pulled our teeth with tying one end of the string to the tooth & the other end on the door knob. He slammed the door shut & out came the tooth. Sometime he pulls the loose tooth with his fingers. At times we dare not tell him we have a loose tooth!We had free medical but not free dentist! Couldn't afford it! There were no sweets in our home when I was growing up!We had no toys!Any toys that we had,we made ourselves!We were poor so couldn't afford many things! Malasadas {donuts}were eaten before lent; on Easter & Christmas Portuguese {poa duce} sweet bread were eaten also! Only 3 x a yr. we had sweets! Mr.Oda came to Kealia to sell his ice cream! Mom bought sometimes ice cream from him for her children! Many times she had no money; so she bartered eggs for ice cream! It did work! I think he lived in Kapa'a. He drove a station wagon! When the Chinesemen came to our side of the community to sell their boiled & dried peanuts; mom also bartered with them! It's the best way to go: either eggs or a duck was bartered at that time!Mom had no spare money to buy the peanuts! We liked the boiled ones!
At Waipahee,my parents & the rest of the family had a picnics there;where we swam in the pool. A very nice place for a picnic! We celebrated New Year's, Easter, Thanksgiving & Christmas by attending church services.These 4 holidays we had roast beef & potatoes; along with chicken stew! We didn't have any Christmas trees in our Kealia homes but we had a shelf of Jesus,Mary, Joseph, & other Statues of the saints! Mom put a plate of food on the shelve for Jesus & the Saints! Mom told us not to touch or eat it. It's for them! We listened & obey! We never exchanged gifts or cards while we we living in Kealia! No money!Our home at Hauaala road had a Norfolk Christmas tree & exchanged gifts & cards!Our daily dinners in Kealia was of different types of Portuguese soups!We never complained!At our home by the mill & trainhouse, Makee Plantation made a brick oven for my parents.Later it fell apart. Dad asked the Plantation to repair it;but they never did.Dad & brothers didn't have time to fix it, so it fell apart!
It was cleared for our garage!Dad told thePlantation;home needed of repairing! Plantation never sent the carpenters to repair it! it! Home had holes that we could see outside!Mom had a kerosene stove & an oven to bake the Portuguese white & sweet breads.On Holidays mom gave sweet breads to our Priest. The catholic church was a part of our daily lives & still is!
By the way, we had a Health nurse that came to family homes in Kealia to check them out! Her name was Miss Kyer.Don't know the spelling of her name, but it sounds like it!She would come to check each family who had small children!She checks each families' children every time she comes!She took a liking to me! She gave me a miniture glass doll with some clothing!That doll I treasured it! I've never had a doll. To me, it was like it was made of gold! I think she came once a month for a visit & to check the families up.
Now I remember more families that were living in Kealia: the Dodo's, Hashimoto's , Tanigawa 's, Tamagawa's & Sugai's!
My maternal grandparents:Antone & Maria Louis {Fagota} & family lived in Kumukumu. My grandfather,2 older daughters & 3 sons all worked for Makee plantation; when daughters & sons were through with school.Usually up to the 7th grade! My grandparents leased a piece of land in Kumukumu to start their dairy business! They bought a few milking cows for the milk business! All their children of school age walked behind the wagon that grandma Maria drove; delivering the milk, picking up the empties And putting them in the back of the wagon. This was done before they went to school! Milk was delivered in Kumukumu & Kealia. How many people bought the milk,I really don't know! I don't know either how much was each milk bottle costs! After school was out, my aunties& later my mom to pickup the empties & brought them home with them!After supper themilk bottles were washed to make ready for the morning delivery!The family got up at 5 am & began filling up mild into the bottles! Making ready for delivey to each customer!My mom was the last child! When she was of age, she also help in her parents milk business.
I'm not so sure whether any of my aunties & uncles attended the first Kapa'a School on Kaahiahi Point.I know that mom & dad attended Kapa'a Grammar school on Mailehune & Hundley Roads! It went up to the 7th grade! Mom told me that many a time she had to stay home to take care of her grandma. She stayed home too many days; so the school sent a policeman with a wagon to pick all the students who stayed home too many times!The police went to each child's home to pick them up!He tied each child's hands together & tied it to the wagon.They all walked in the back of the wagon to Kapa'a grammar school!At that time she lived in Kumukumu-Kealia! She said that her hands were sorry by the time she got to school!
Kealia had a baseball team; which competed with other plantations' teams. Had their games at Kealia park! Dad was the pitcher for the baseball team! Don't really remember who else played in the team!
Used hand me down clothing! About 2 x a yr. auntie Mary Louis Downie sent to us rummage clothing.Mom kept all the clothes that fits us & the rest were used to wipe our hands, feet & our butts. Sometimes there were nothing to wipe our butts with;so we used pages from the National BelaHess catalog!The old clothes with buttons & snaps, mom cut them out & used them for the clothing she made fromthe rice bags.In those days the 100 lb. rice bags were of cotton material! The bags had the words:California with a pictured rose in the center of the bag than had the word rice on it!After it's empty, mom bleached it outside for several days.Then she boiled & washes it. We were told not to let the fire (peo) burn out! We would put some wood into the fire & watch it until it was ready for mom to take clothes out! Had them dry on the line!Then she would sew a sleeveless blouse & a short pants for us to wear out of the rice bags; that's when she used her buttons or snaps. She didn't have a sewing machine; only a scissors, black & white spool threads & a few sewing needles.Mom sewed our clothes all by hand.Very few clothing was bought. Most of the clothing were bought for my dad & older brothers who were working for Makee &Lihue Plantations! My brothers:Joe,John & Frank first worked out in the fields:doing odds & ends jobs! Later when the trains were introduced;all 3 of them applied!All 3 were chosen,to be breakmen for the trains!Their job was to regulate the cane cars with sugar cane inside!Each cane cars had a break on it! Each train had 2 breakmen, firemen & driver.The fireman checks the gages if it has enough steam & sometimes his job was to put sand on the tracks because of wetness that causes the train to slip on the tracks! After the trains were gone, brothers worked out in the fields as caterpillar drivers!
During vacations,mom & some of us kids went around looking for ripe guavas on the side of Kealia's dirt roads.The guavas were washed & cut & later boiled to make jelly to put on our Portuguese white bread that mom baked! In our home by the train house & Makee mill we had no phone, no refrigerator/freezer;but we only had 1 radio;which was used only in the evening after supper! We children had to only listen but not talk.The moment we spoke we were sent to our room! By the way mom would change cash

{Pg.5-7}

at Kealia store office for a book or two in coupons. It had $1.00 ,$5.00, $10.00 & $20.00 in coupons! With that she knows how much she has used each time she goes to the store to shop!

I think it was in 1945 when a water spout (or a tornado)came from the ocean straight for Kealia. The Mariane Ornellas home was lifted from it foundation but put it back on the same place. In the Pake's (Chinese) section of Kealia, their {luas}out houses were tossed into the canefields across from their homes! The sugarcane was all flattened down by this tornado or water spout! No one got hurt or any big damage to Kealia homes!

Oh by the way, I think it was in 1945 or early 1946 that the ILWU union came to speak to the men & women who worked for Lihue Plantation in Kealia at the theatre.Many workers joined the union. From that time the workers were paid more than the plantation ever paid for each worker!Then the people in Kealia received a better way of life for them & their families! Slowly but surely Kealia people moved to Lihue, Hanamaulu, Kapa'a Heights & Kapahi to their own homes! Now Kealia is used for sandmining! Before I started attendingKapa'a elementary school in 1934; in Aug. 1934 the Health Dept. opened a clinic in Kealia theatre; where all the children of school age were taken by their parents to be inoculated. Dad took my brother Manuel & I to be inoculated too.! Many children cried;including my brother & I. There were many nurses & doctors to inoculate all the children of school age! Without this inoculations the children wouldn't be able to attend Kapa'a elementary school in Sep.1934. It was this way for awhile;until many years later; when the Health Dept. started to give inoculations to all babies who were a month old!

7 brothers, 3 sisters & I were all born in Kealia in the same home by a midwife,usually by relatives! When one of us had (hule) stomache},mom would take us to one of our aunties who knew how to do it! Usually the stomach is rubbed by some kind of oil that was heated & rubbing the hule stomach with saying some prayers! It was done for 9 days! Usually by the 9th day the baby was cured! Practically everywhere we went, it was by footmobile! {New word for walking}.We only wore shoes when we went to church on Sundays! Sometimes people give us the bad eye; somom would take us to a healing person;usually a relative who had the know how of the healing power.In Portuguese the word is: curadeira meaning practitioner.Some Portuguese used their knicknames:like Barretto's! To me, Makee & Lihue Plantations was inconsiderate by not notifying the people about burning cane fields back of our home. When we saw & smelled the smoke;mom would close all the windows & doors from having the smoke enter our home! It made us cough & tears came from our eyes! It filled our home with smoke!

Some of the names of the trains I remembered:Kealia, Makee,Col. S. Spaulding, Lihue, Kilohana, Hanalei, Wainiha, Kalalau & etc. When both grandparents's came as contract workers from Madeira Is. & Azore Is.to Hawaii! Lived in Kealia until they died!Makee Sugar gave them wood for their wooden stoves, fish, meat, Hawaiian salt & some other items! Free home rent, runny water & when electricity was installed! Grandfather Francisco Freitas Barretto's last job at Makee Sugar Mill was a night watchman. My other grandfather Antonio Louis {Fagota} last job at Makee Sugar Plantation was a custodium in Kealia's store!

Since my younger brother's & cousins enjoyed trains; they made their own trains out of odds & ends around our home!Found a piece of board 2" x 4" x 12" for the base of the train.The body of the train was an empty milk can & the back portion was the large side of the cornbeef can. They were nailed down on the board.On top of the milk can they made a hole, placing the empty sardine can cover & placed it into the hole on top of the milk can for the smoke stack!The cane cars were the empty, either the large or small sardine cans. They made holes on both sides of the cans;then they tied each can with string which they got from the rice bags. The first sardine can with string were tied on a nail that was nailed to the back portion of the train!They also made a crane, again with odds & end around our home! 2"x 4" x 12" board; with 2 lads nailed on either side of the board;on top of the 2 lads they nailed it together.On the board of the crane we nailed 2 nails. Had 2 strings that we tied on each nail;the other end of the strings were tied to the vienna sausage can; which we made 2 holes on either side of the can.Vienna sausage was the crane's bucket, using it to pick up the dirt!I played with them under our home by the trainhouse & Makee Sugar mill! We put some pieces of paper in the smoke stack & lighted; it sure worked! Mom smelled the smoke & scolded & told us not to do it again.We listened & obeyed! Never more did we light up the train again!We played hopscotch on the dirt road in the front of our yard!Made our own stilts with boards that lay around our home! We would walk & run with it in a race! Sometimes we would fall;but that didn't stop us from doing it again! Made another type of stilts with 2 cans of the same size with holes in the middle of the cans with strings tied to it! It didn't work that good;but learn to master it! When our homes in Kealia was installed with electricity, the men left the empty container where the electricity roll of coils once was. We played with it! Put our bodies in the middle section & using our hands to move the sort of wheels forwards & backwards! We also stood up in the middle section of this container:going back & forth! We didn't get hurt from doing so!We took turns & had fun with it! Bro.Gil. & I caught opae's for Mr. Freitas who works at Makee Mill. He used it for fishing bait! The ditch was back of our home!We also played with our hands! Jung kina po, potato game: the players are all in a circular with both hands are all in fists, the leader goes around the circular touching each handfists say the word1 potato ,2 potatos,3 potatos & so forth until the leader come to a certain number, then that person gets out of the circular & so forth & so on! Jun kin a po played with our hands!{scissors, paper or stone} Played another game with our hands! To me it was in Japanese! It goes like this: Say Say Say, I Ota Mai Ka Sho Ka Te, I O ta,May Shama Su, she ri ta,A may shama su, she Ri Ta, rooo po, ro po!

*Beginning: hold partner's hands with yours, shaking while saying the words, then hands goes left & then right crossing, then partner & you, put both hands together clapping then put hands on lap, then you & partner clap again;then both you & your partner rolled our hands in a circle & say the words: row po!Hope you'll understand my explanation for this hand game! The spelling of this Japanese hand game it's not spelt that way; but wrote it according to the soud system!These are some of the Hawaiian words Kealia 's people used at play or at work when we lived in Kealia! We knew the meaning but not the English words for them;until later when the children went to school! kini -king, pulapula-sugar cane cuttings{seedlings},pipi-cattle, holoholo-pleasure riding, walking, kakio - sore, hapuku-crane,ka-to turn rope to jump; opae-shrimp,Kalai-to cut, to carve;hoe hana-to work,pilau-stink; moelepo-dirty, minamina-selfish & etc!My cousins Douglas & Bernard Machado & my brothers Manuel & Tony, me & other relatives made our own canoes.It was made with iron roof & some odd & ends wood around our home! Made also the oars! It did work for awhile but eventurally it sank with some of us in side!We didn't get hurt but only wet! It was tested in the stream alongside our

{Pg.6-7}

homes! Had fun making it!When the Filipinos had their wedding or birthday parties; they invited the whole community to celebrate with them.I sang at these celebrations! While I was singing they threw money on the stage where I was singing! Someone collected the money & gave it tome!At weddings, while the groom & bride were dancing, someone put a dollar or more in the brides mouth & the groom tried to get it from her lips & he did at that time they kissed! Kealia was a close community. Knew each family well! and the groom tried to get it from her mouth and he did it at that time they kissed! Kealia was a close community! Knew each family well! Kealia's people learned each other's language:including Hawaiian! Take my dad:Joseph Freitas Barretto Sr. spoked fluently these languages:Portuguese, Japanese,Hawaiian,German, Filopino,Chinese & English! Altho' Kealia workers came from distant lands, they learned other races languages, ate each othe kinds of food. By doing so they got along well working together!

HISTORY OF KEALIA TOWN

One of the earliest commercial developments on the eastside.of Kauai was a cattle ranch owned by Ernest Krull. Located in the Waipahee area,the ranch was noted for its dairy and beef products. The ranch supplied beef products for both visiting whaling ships and Honolulu stores; as well as firewood for ships that anchored off Anahola bay. Krull, married to a Hawaiian woman, entertained many notable persons, including King Kawika {David} Kalakaua, at his ranch house at Kalualihilihi.

In October 1876,Krull sold his ranch house to Colonel Z.S.Spaulding and his father-in-law,Captain James Makee, for $30,000. The purchasers of the ranch intended to start a Sugar Plantation, later to be known as Makee Sugar Company.

In 1878, Colonel Spaulding, together with members of the Hui Kawaihau, started sugar production at Kealia and Kapa'a, establishing Kealia Plantation. King Kalakaua, himself had a 25% interest in this early Plantation. Spaulding built a fine residence, called,Valley House, in a sheltered valley near the Krull ranch house.

After the death of Capt. James Makee, the ownership of the Kapa'a mill passed on to Col. Spaulding and both Plantations were combined into One Company: The Makee Sugar Co. The Kapa'a Mill was closed in 1884, and all Sugar processing was done at Kealia, greatly expanding the scope and productivity of his operations. Cane was cultivated from Anahola to Wailua, from the shore to the mountains. { from makai to mauka}, on lands privately owned ot leased from the government. Because Spaulding was always looking for the latest developments in sugar productions, Makee Sugar Co. was considered by many to be the Most Modern and Productive in Hawaii!

Sugar was first shipped from Kapa'a Wharf. Before 1900, the Anahola wharf was built and used until 1910, when the Kealia landing became the port for sugar shipments. In 1924,sugar was taken by rail to Ahukini landing for shipment!

In 1916, Colonel Spaulding sold a majority share of his holdings to Lihue Plantation. In 1924, he left Kauai to live with his son in California, where he died in 1927. Gaylord Wilcox was one of Kealia's Makee Plantation Managers!

Lihue Plantation continued to operate the Makee Sugar Mill until 1934, at which time the mill was dismantled and sent by rail to Lihue, where it was set up to form Mill B,still in operation today. {Operations ended in the 1960's}.

From 1934, the Plantation community of Kealia continued to decline,as Plantation operations were phased out and workers moved to other neighborhoods.

In 1986, the last resident of Kealia's main camp moved out from the area. The passing of Kealia Camp marks the end of an Era that began when Makee Sugar Company first erected the homes near the turn of the century;thus ending the prosperous Plantation town of Kealia. The last resident was: Joaquin Freitas- my brother-in-law William Freitas brother!

At one time in history, the community of Kealia boasted over 1,200 residents. Lihue Plantation Company <LPCO> has no Immediate plans for the site, other than to continue mining of sand.

These paragraphs taken from "RAILROADS OF HAWAII" BY GERALD M. BEST!

As the Plantations Era expand in Hawaii after 1876, the transportation picture changed too.Animal power already in use on small railroad lines was being replaced with Steam Locomotives. On many of the Plantations the finished raw sugar was hauled by rail from the mill to landings where the sugar could be lightered on a barge out to anchored vessels in the bay or loaded directly aboard the ships if the harbor was protected from the weather and was deep enough. The locomotives of the early plantation railroads were largely of British or German Manufacture. Most were 3-foot gauge as in the case of the British Engines built by John Fowler and Ransomes & Rapier. The lines built for the German owned Plantations on Kauai were 30-inch gauge except for the 2-foot gauge Kilauea Plantation. Kauai railroads remained 30-inches to the end of rail operations.

AHUKINI TERMINAL & RAILWAY CO.

30-Inch Gauge

1	0-6-0	Porter	6608	1/1921	36-12x18-48000	To Lihue 1934; named Kalalau #2nd 8. Retired 1947.
2	0-6-0	Porter	7029	10/1926	36-12x18-48000	To Lihue 1934; named Hanalei #2nd 9.
--	0-4-0	Ford Motor Co.				4 tons. Rebuilt from Tractor. To Lihue Plantation 1934.

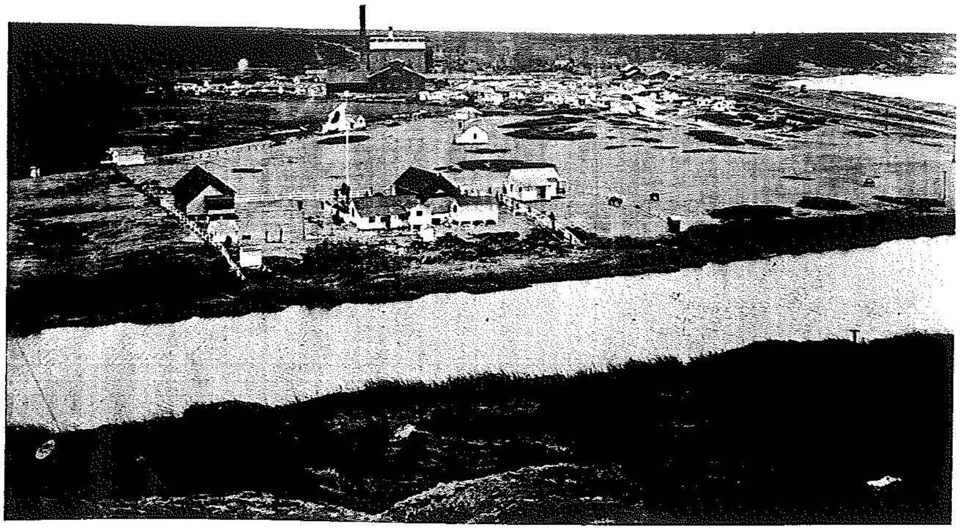
KAUAI RAILWAY

30-Inch Gauge

1	0-6-2T	Baldwin	38311	9/1912	33-12x16-45000	New Bir.XO-2057-1924. To Lihue Plant. 4th X3 named Wainiha.1932
2	04-2T	Baldwin	17686	4/1900	37-9x16-	ExMcBryde Sugar Co. Wahiawa. Acq.1907 Renamed Port Allen,1909 Renamed Ono,1921; to McBryde Sugar Co.; renamed Hanapepe
2	0-6-2T	Baldwin	54719	4/1921	33-12x16-46000	Named Port Allen. To McBryde Sugar #4,Wahiawa;to Grove Farm #5 9/1947.In service until 1957. Preserved.
-	0-4-0	Whitcomb	60001	1/1936		Diesel-electric, 10 tons. To Lihue Plant. #18,then #618.
-	0-4-0	Whitcomb	60003	3/1937		Diesel-electric, 10 tons. To Lihue Plant. #20, then #620
-	0-4-0	Fordson Gasoline Mech.				No Information.

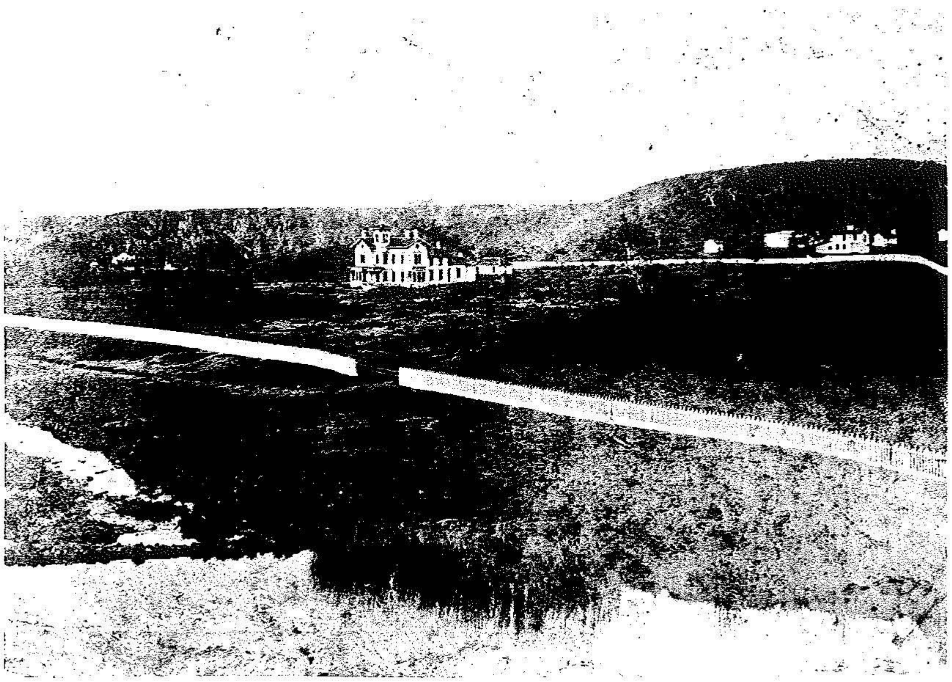
(Pg. 7-7)

KEALIA, KAUAI: Early 1890's : Makee Sugar Mill In Background



TOWN OF KEALIA: On the Eastern side of Kauai in the 1900's-Makee Sugar Co. A Bursting Community

KEALIA VALLEY HOUSE – IN THE 1900'S (Pg. 7-8)



THE VALLEY HOUSE. . .home of Z.S. Spalding, owner of Makee Sugar Co. . built in 1880 and it was destroyed by fire in 1950. Colonel Spalding invited the students and teachers of Kapa'a School to his home, The Valley House, following the first Armistice Day in 1918, to present a Christmas program.What a treat it was for the students and teachers of Kapa'a School to go by train through the Kealia fields and Keapana, a quaint Hawaiian Village. Col. Spalding was a very gracious host. Both students and teachers enjoyed the Christmas celebration that Colonel Spalding hosted at his Valley House estate. They were all overwhelmed by their host generosity. They all will never forget the wonderful time they had on Dec.1918; at the Colonel's Valley House estate.

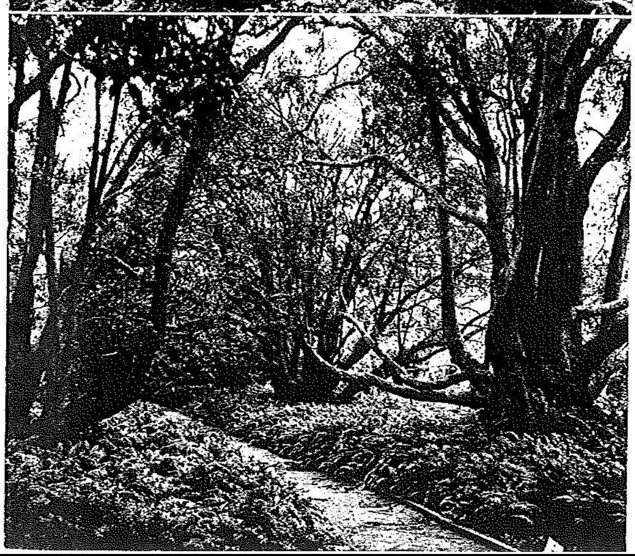
70 YEARS AGO

From the Aug. 1, 1916 issue of The Garden Island

Negotiations have been under way for sometime between representatives of the Lihue Plantation Co., Ltd. and Col. Z.S. Spalding for the purchase by the former of a majority interest in the plantation property known as the Makee Sugar Company. It was reported in Honolulu last week that the deal was about to be closed, but the statement was premature. Vice President Rodeik, of Hackfeld & Company, spent the weekend on Kauai and during his visit the matter was further discussed.

It is understood that the deal is more promising now than ever before but nothing of an absolutely definite character has been settled.

The Makee Sugar Company is one of the oldest and most successful sugar properties in the Islands. Its taxation value is about a million and a quarter dollars. Just what figure is being considered in present negotiations has not been divulged.



Kauai's Valley House

Symbol of a Vanished Era

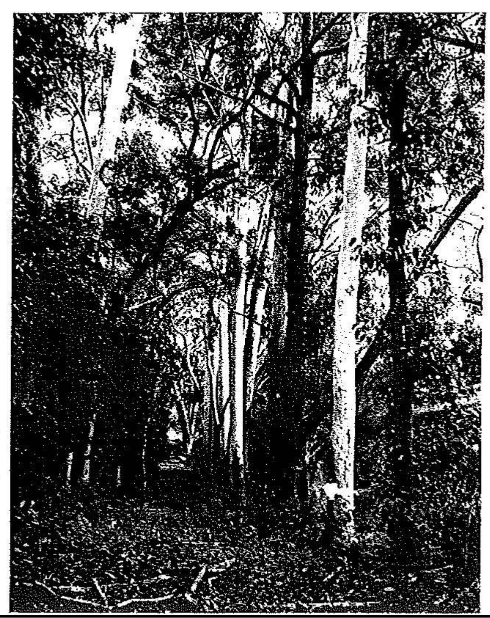
By Francis Lee

THE EASE and graciousness of living which characterized the last century does still linger on in some of the by-ways of the world. Despite the bustle of present day, a whimsical bit of the elegance of *la derniere siecle* still hovers about some of the Italian isles; some of the spirit of classical Japan still lingers in Kyoto, and in Hawaii, on Kauai, there is still the graciousness and quietude of the old Spalding estate.

The Valley House, as Colonel Zephaniah Smith Spalding named his estate, during the past century was known as a gorgeous Pacific refuge among fashionable circles in both America and Europe. The colonel's three daughters married Italian noblemen, while the colonel himself represented Hawaii at Brussels in 1896 and at the Paris Exposition in 1889. From his trips abroad he brought back guests and many possessions to contribute to the elegance of the establishment. The King of Sweden sent trees to be planted on the estate. Besides such special trees from Europe, the estate abounds in camphor trees, brought from Formosa, eucalyptus trees and the trees of the islands, such as pikake, ohai and ginger. King Kalakaua was particularly fond of the shaded walks of the eucalyptus and the camphor trees. He visited on many occasions the ninety acre estate, which is situated near the town of Kapaa, on Kauai.

It was the custom at the Valley House in the afternoons for the Spalding family and their guests to drive

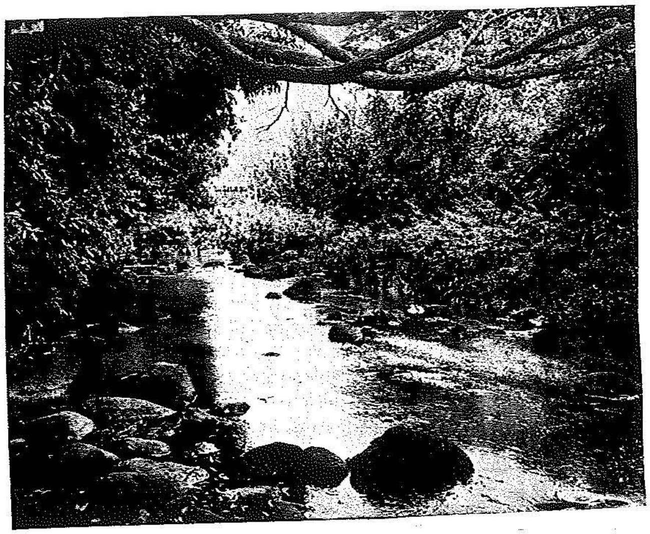
The camphor trees, below, left, were the first brought to Hawaii, coming from Formosa. Below, the eucalyptus trees.



in surreys to the waterfalls on the property where they took tea while Mrs. Julia Makee Spalding played the harp. To swim in the ocean they rode to nearby Hanalei beach. The fabulous parties given at Valley House have become almost legendary.

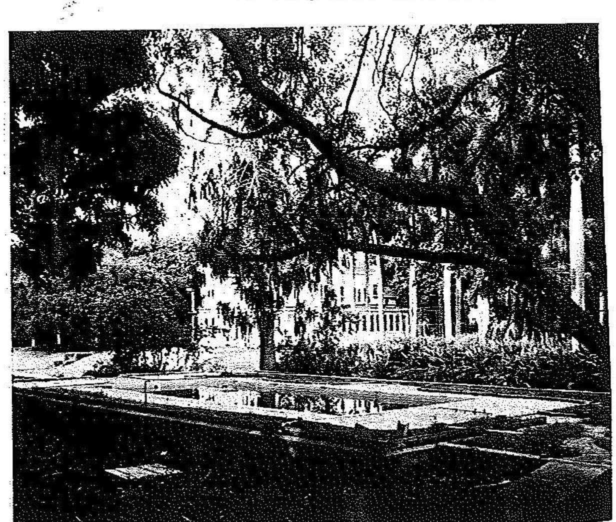
The Kealia River surrounds the estate, and the approach to the house is over a bridge which crosses this

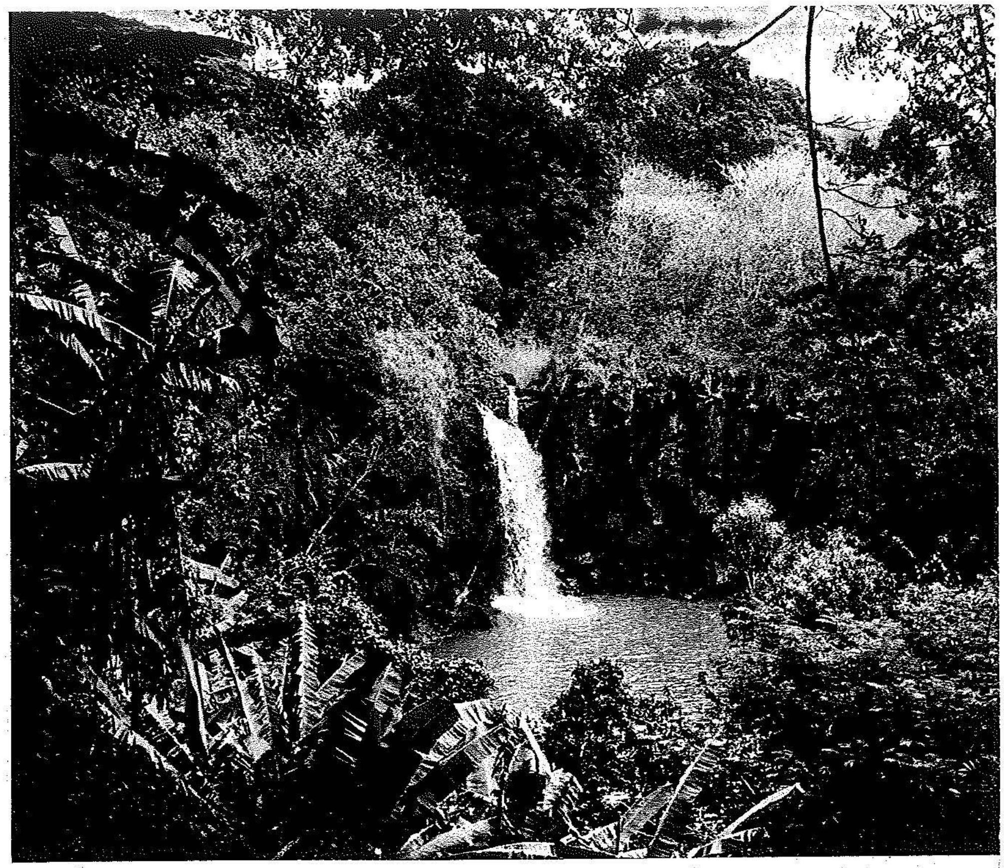
The Kealia River surrounds the entire Valley House estate, and abounds with fish.



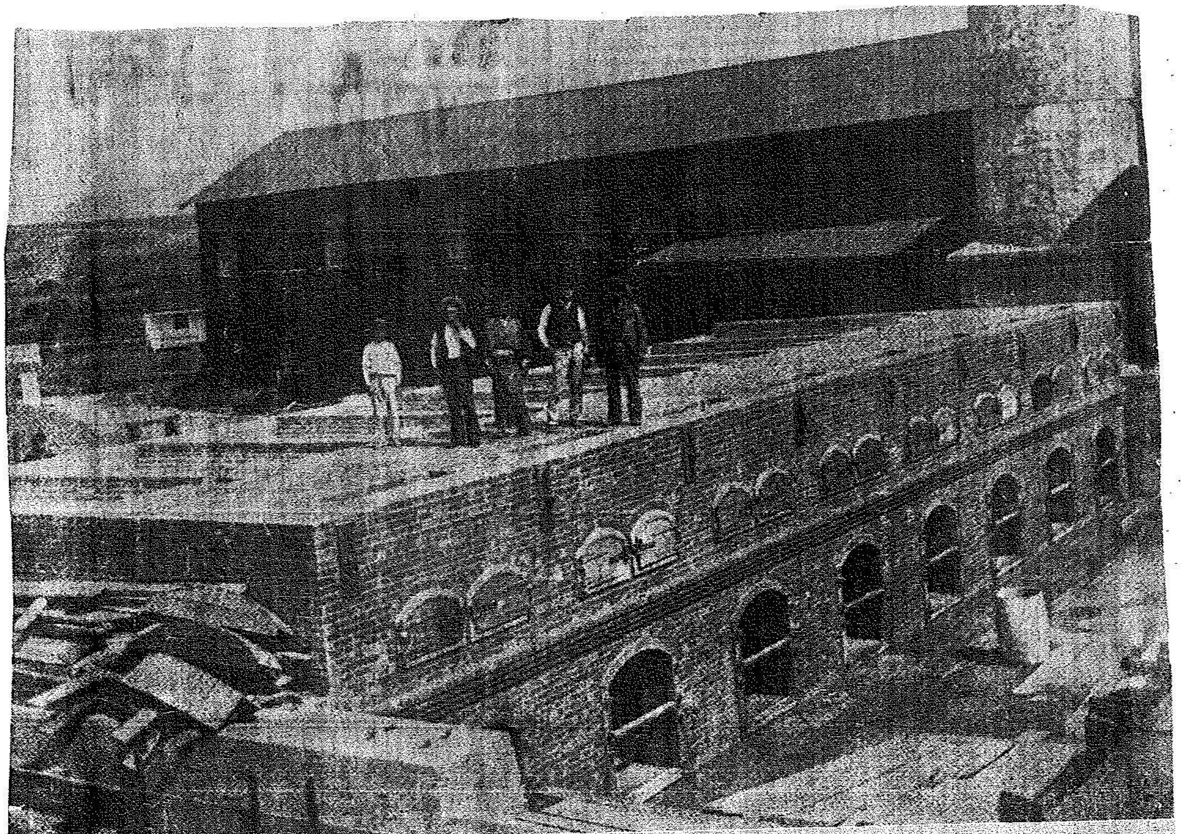
stream. The Valley House is a simple but stately two story structure in an almost idyllic setting. About it are guest houses, a tennis court, a spacious lawn leading down from the house to a lily pond. From the gardens extend the camphor tree and the eucalyptus tree walks. The swimming pool is surrounded by exotic tropical plants and a splendid array of orchids.

The Valley House, Isle of Kauai.





The waterfalls were a favorite gathering place of the Spalding family guests.



The boiler room under construction at Makee Mill, Kealia, Kaua'i, ca. 1900. Steam was produced in the boiler room to generate power to run the hill. Horizontal return tubular boilers (HRT) which sit atop the fire boxes are missing; only the ash pits and fire boxes with fuel entrances are shown here.—***Photo courtesy Hawai'i State Archives.***

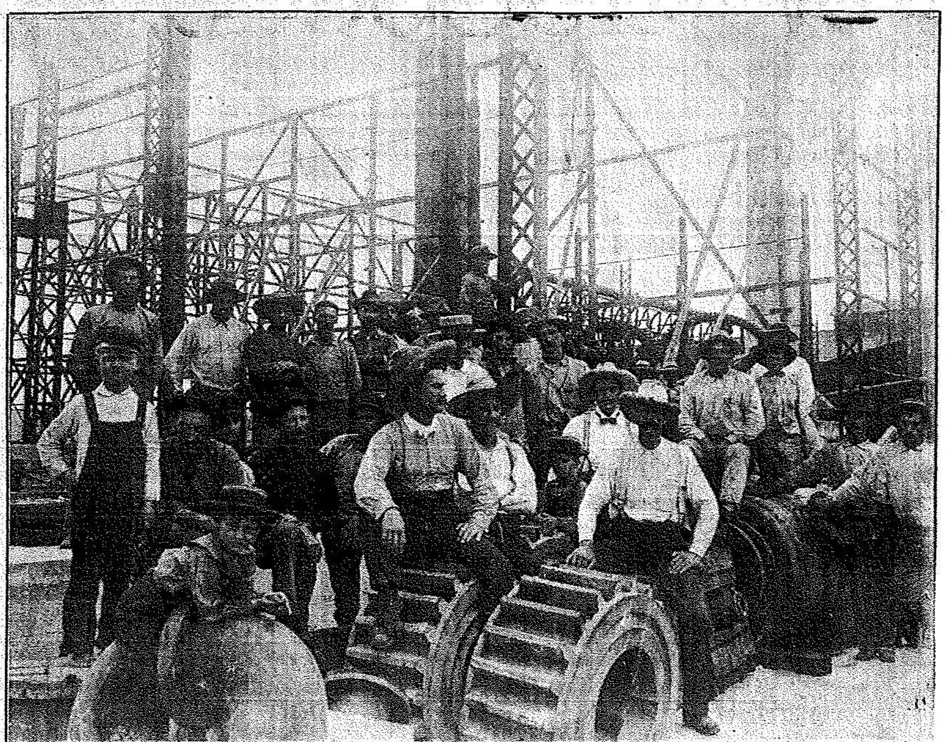
Photos from the past bring alive bygone days

A new series of photographs taken on Kaua'i between 1900-1904 by amateur photographer Henry Funk are now on display at Kaua'i Museum.

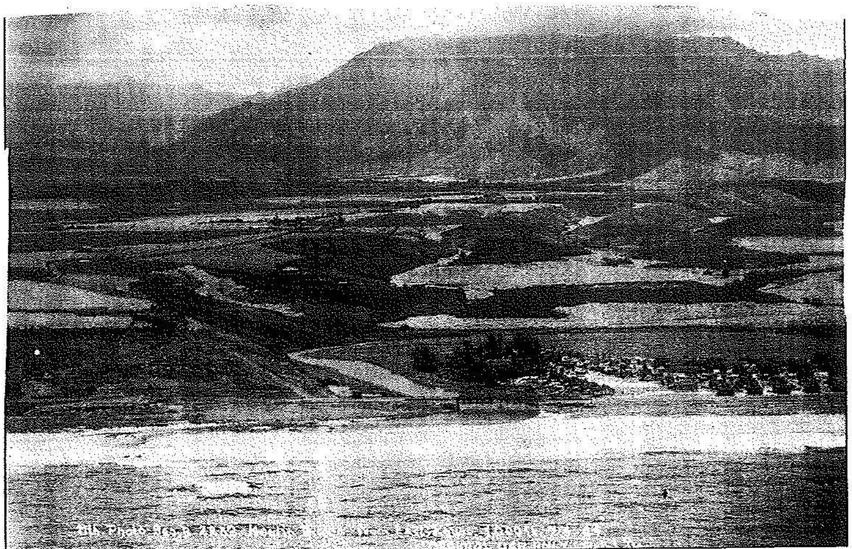
As part of the continuing series, Photography on Kaua'i, these rare glimpses into Kaua'i's past were printed by R.F. Wichman Photography from the original glass plate negatives.

Funk, a machinist for Makee Sugar Company at Kealia in the early 1900's, documented the building of the mill where he was employed, the various ethnic groups at the plantation, native Hawaiian families and leisure activities. This period represents a time of rapid economic, political and social transition.

The work of other Kaua'i photographers is also on exhibit at Kaua'i Museum including samples of various types of photographic processes and a general history of photography.



BACK IN TIME Machinery and gears surround these workmen at the Makee Mill yard in the early 1900s. This is one of the photos by Henry Funk on display at Kaua'i Museum. The photographs were reproduced from glass plate negatives by R.F. Wichman Photography.



Kaua'i Historical Society / Contributed photo

The Kealia coastline *(check out the plateau at left where today exists Kapa'a High School and hundreds of homes) as it looked in the early 20th century shows a neat row of homes along what is now Kaumuali'i Highway across the highway from Kealia Beach.*

MAKEE SUGAR CO.

View of old sugar mill and railroad at Kapaa Original site of Makee Sugar Company about 1890. *Kauai Museum.*

34 SUGAR TRAINS PICTORIAL

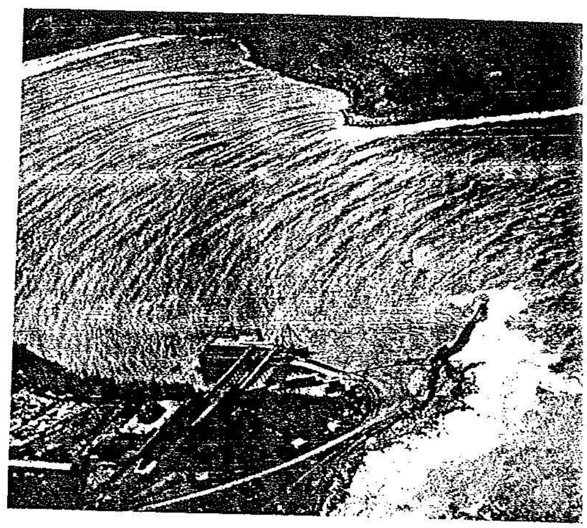
Ahukini Terminal & Railway Company
30-inch gauge—Island of Kauai

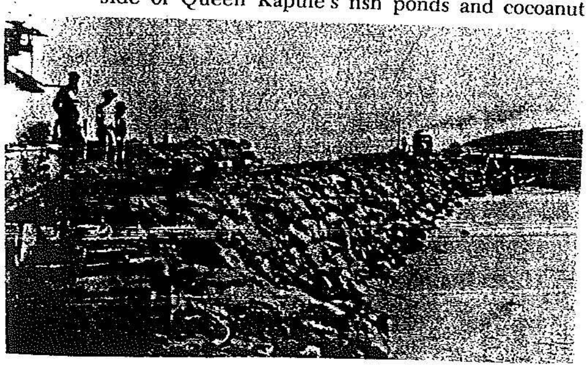
The Ahukini Terminal & Railway Company was a short-lived freight carrier organized in 1920 by Amfac (American Factors), the agents of Lihue Plantation and the Makee Sugar Company, to provide the latter with a connection to Lihue Plantation's dock at Ahukini Landing in Hanamaulu Bay. Before its construction, Makee Sugar had to use small landings at Anahola, Kealia, and Kapaa, and send the raw sugar out to ships on lighters—a most unsatisfactory method in the presence of strong winds and heavy seas.

The new railroad was built during 1920 and 1921 from a starting point one-half mile from Ahukini Landing. Construction of the first two miles north of the landing was extremely expensive. A 900-foot fill, 30 feet high, had to be built across the Hanamaulu Valley, and a 175-foot concrete bridge across the Hanamaulu River erected in the center of the fill. To keep the grades reasonably low, a cut 1,800 feet long was dug through a rise north of the river to a depth of 40 feet in the center.

The next four miles represented fairly easy going along the coast—until the Waialua River was reached. There a 390-foot through-girder concrete bridge was built, at a cost of $151,000. This crossing is the spot from which ferry boats today carry tourists on the popular trip up the river to the Fern Grotto.

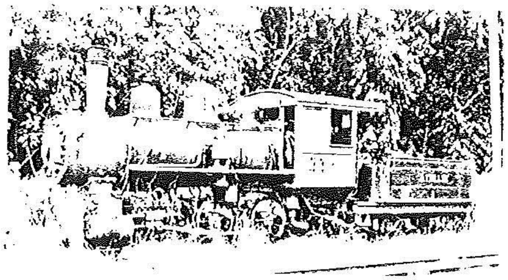
A few hundred yards north of the Waialua River bridge, the railroad passed on the ocean side of Queen Kapule's fish ponds and cocoanut grove, where the Queen's subjects were wont to pay tribute to her by stocking the ponds with fish, and where the Coco Palms Hotel stands today. Continuing along the shore, the road ran through the towns of Kapaa and Kealia, and ended at the old wharf on Anahola Bay. The tracklayers reached Kealia in May 1921, and service from there to Ahukini Wharf began then. By the end of the year, the line had been extended to Anahola. The improvements at Ahukini Wharf, however, were not completed until February 1, 1922.



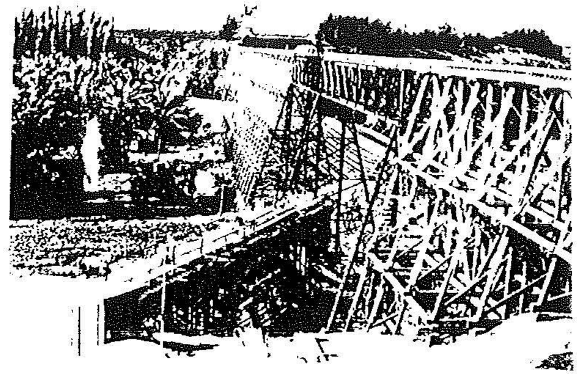


Hanamaulu Bay, showing the Ahukini Terminal. The effect of the breakwater on the Pacific Ocean swells is plainly visible. (LEFT) Building the breakwater at Ahukini Landing in 1921. — BOTH AMFAC

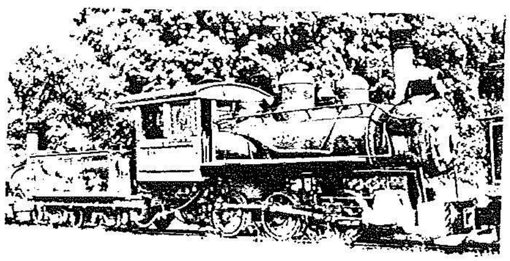
163



Ahukini Terminal Company Limited No. 1, the *Kalalau*, abandoned at Lihue Plantation in 1946.
– FRED A. STINDT

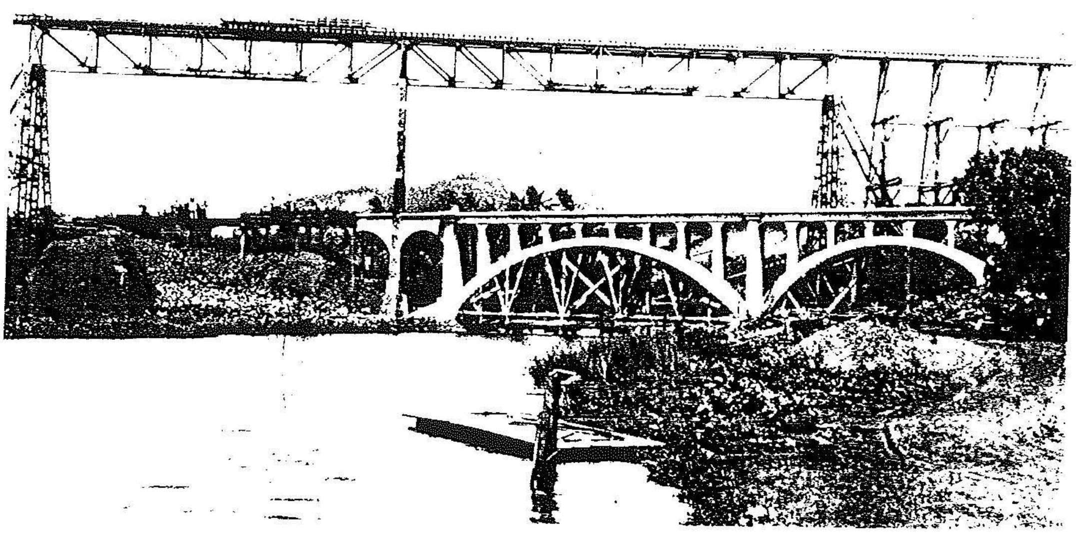


The Ahukini Terminal & Railway Co. bridge under construction as shown in the foreground. The trestle above the railroad is a sugar cane flume for Lihue Plantation. AMFAC



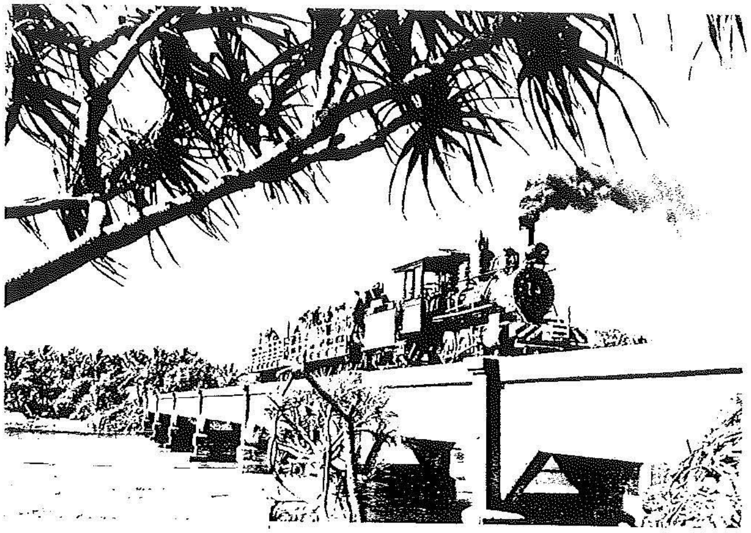
The former Ahukini Terminal & Railway Co. No. 2 became Lihue Plantation *Hanalei* No. 9. It is shown here on the scrap line at Lihue in 1946.
— FRED A. STINDT

The finished concrete arch bridge across the Wailua River. At the left, the temporary trestle is being filled in to meet the end of the bridge. – AMFAC



164

Indeed, such places exist throughout the islands, but it

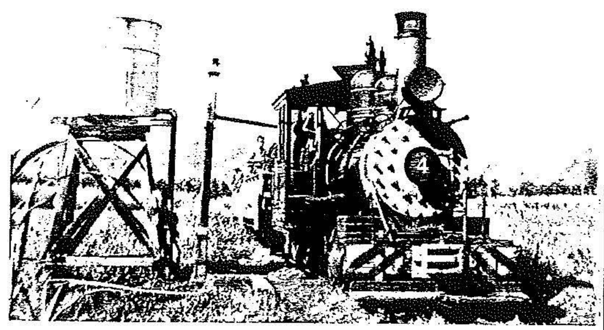


Lihue Plantation No. 4 with two flat cars loaded with rail enthusiasts pauses on the Wailua River bridge for a record photograph. — ROBERT A. RAMSAY

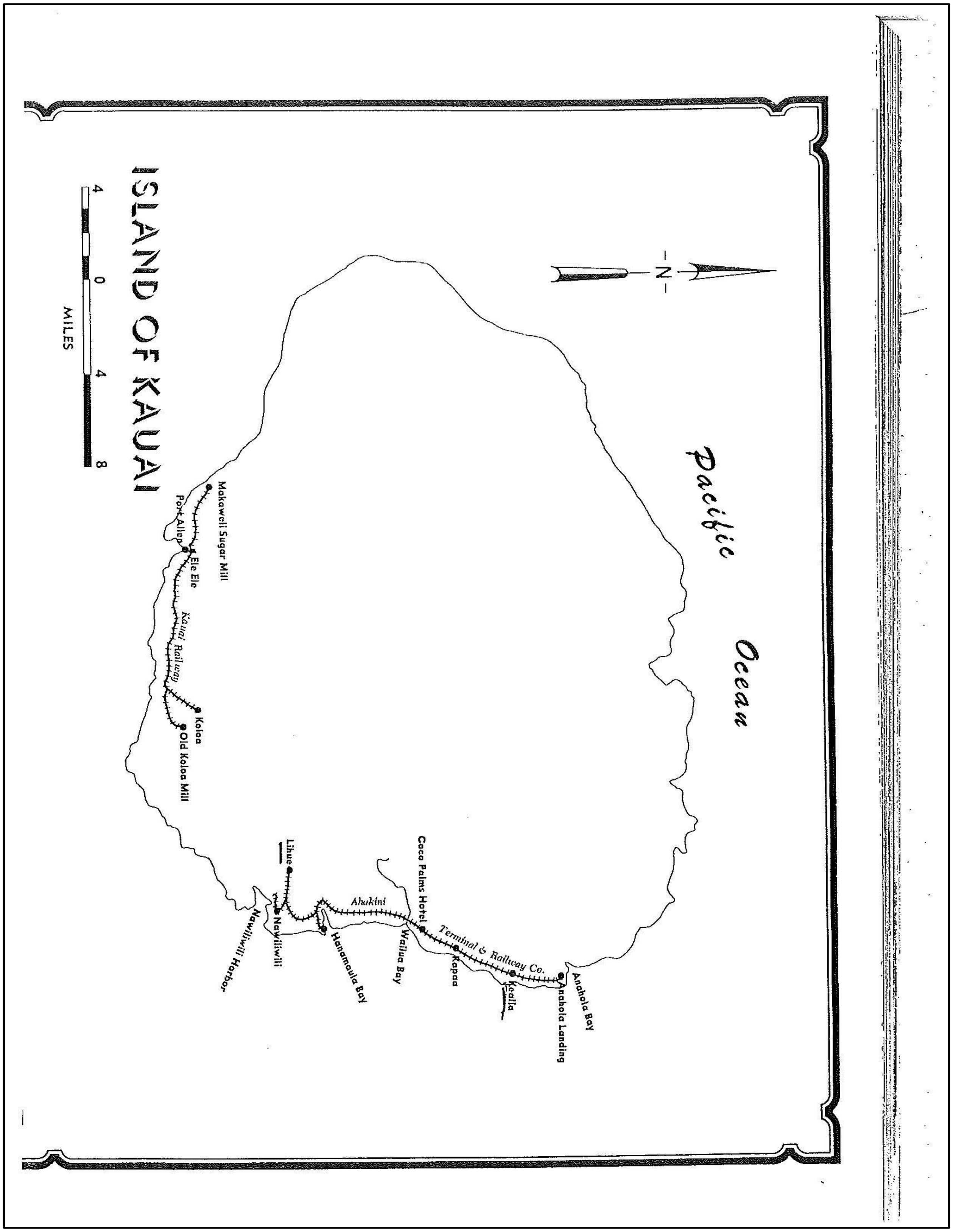
One 24-ton 0-6-0 with tender was built by Porter for the Ahukini Terminal & Railway Company in 1921. By the time the line was opened in 1922, 20 box cars and two flat cars were in service. By renting flat cars from the plantations, the railroad increased the latter figure to 22. An identical Porter 0-6-0 was purchased in 1926, in addition to a 4-ton Ford tractor equipped to operate on rails.

In 1931, in conjunction with Lihue Plantation, a branch was built to the port of Nawiliwili. This extension was seldom used and in 1934, the Makee Sugar Company merged with Lihue Plantation, taking the Ahukini Terminal & Railway Company with it. The two Ahukini locomotives, as well as Makee's motive power, became part of Lihue's fleet. One engine was relettered to conform with Lihue's numbering system; but Ahukini No. 1 retained its original lettering to the end of railroad operations.

During its brief 12-year life span, the railroad carried a considerable amount of freight, thus serving its purpose; but it was certainly no big money maker for its owners. In all probability, administration and equipment costs were lower under Lihue management. Although the Ahukini Terminal & Railway Company was never listed in *Poors* or *Moodys*, it deserves a place in railroad history as a 30-inch gauge common carrier. One can drive today over this very scenic route to Anahola and see traces of the right-of-way, for Lihue Plantation continued to use the line for 25 years, and the last rails were not pulled up until 1959.



Lihue Plantation No. 4 taking water near Wailua bridge. This is on the old Ahukini Terminal Company's main line. — ROBERT A. RAMSAY


ISLAND OF KAUAI
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MILES
N
Pacific Ocean
Makaweli Sugar Mill
Port Allen
Ele Ele
Kauai Railway
Koloa
Old Koloa Mill
Lihue
Nawiliwili
Nawiliwili Harbor
Hanamaula Bay
Ahukini
Wailua Bay
Coco Palms Hotel
Kapaa
Terminal & Railway Co.
Kealia
Anahola Landing
Anahola Bay

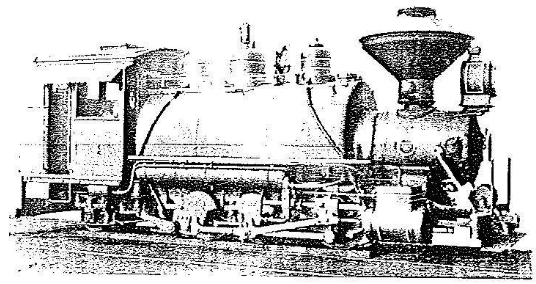
Kauai Railway Company—30-inch gauge—Island of Kauai

Like the Ahukini Terminal & Railway Company, the Kauai Railway was a common carrier serving three plantations but neither hauling cane to the mills nor providing passenger service, except during World War I (when makeshift cars were used).

The McBryde Sugar Company at Eleele on the island of Kauai was a combination of the Eleele Plantation, the Wahiawa Ranch, and the Koloa Agricultural Company, brought together in 1899 by none other than Benjamin F. Dillingham, with Theo. H. Davies Ltd. as agents. In 1906, Davies decided that raw sugar hauling from the mill to Eleele Landing should be handled separately from cane hauling by rail, and to this end organized the Kauai Railway Company. H. M. Van Holt held a franchise to build a railroad on Kauai which he had never used, and he traded the rights for 100 shares of stock in the Kauai Railway Company, roughly 10 percent of its valuation. Improvements to the harbor and docks at Eleele constituted the Kauai Railway's initial activity. These were followed by a connection with the town of Koloa at the nine mile point and construction on to the Koloa Mill, 11 rail miles from Eleele Landing. Two spectacular horseshoe curves marked the line to Koloa, for crossings of Lawai Stream, a half mile north of Lawai Bay, and Wahiawa Stream, a mile north of Wahiawa Bay.

Koloa Sugar Company had a rail network of its own, and all that was left to do was to connect McBryde Mill near the village of Numila with the Koloa Sugar Company's rails near Koloa. This connection was made in 1912, when Koloa Sugar built a new mill and abandoned the old railroad that had carried its raw sugar to market via Koloa Landing at the mouth of Waikomo Stream.

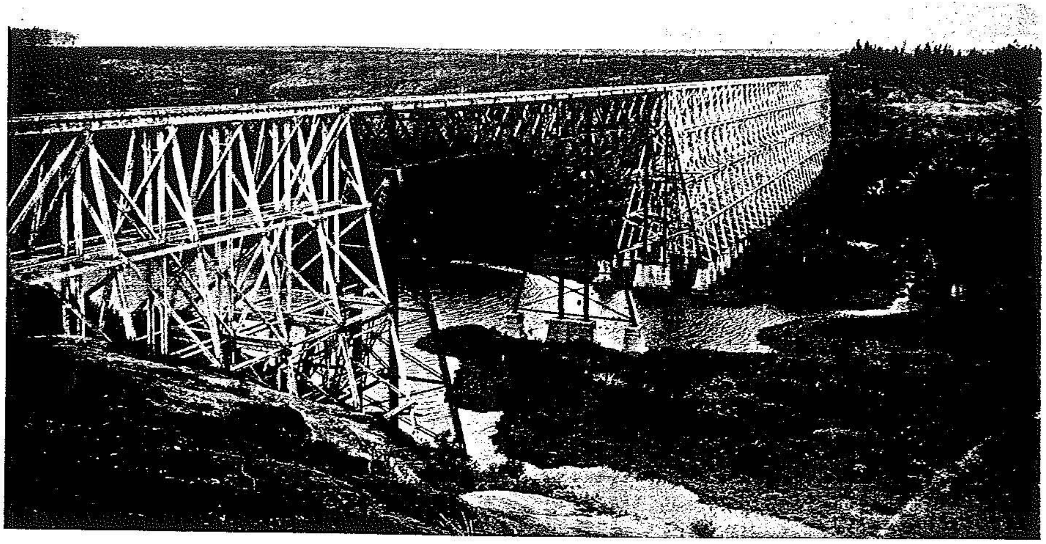
In 1909, Eleele Landing was renamed Port Allen, in honor of the late Samuel Cresson Allen, prominent merchant of Honolulu and probably one of the McBryde stockholders. That year, too, the one locomotive that had been turned over to the Kauai Railway for its exclusive use by McBryde Sugar, the *Wahiawa*, was renamed the *Port Allen*. This engine had been built by the Baldwin Locomotive Works in 1900 as a 2-4-2T; but by the time the Kauai Railway received it, McBryde had removed the pony truck and converted the locomotive into an 0-4-2T. A new engine, a Baldwin 0-6-2T No. 1, was purchased in 1912 and remained nameless until 1932, when it was sold to Lihue Plantation.



Kauai Railway No. 1, later named *Wainiha* No. 3, on the Lihue Plantation's railroad. — BROADBELT COLLECTION

In addition to operating trains under trackage rights on the McBryde rails, the Kauai Railway made a connection with the Hawaiian Sugar Company, which covered a large area northwest of Port Allen along the coast and extending inland as far as seven miles. Hawaiian Sugar built a large trestle and bridge across the Hanapepe River a half mile west of Port Allen, and the Kauai Railway built connecting tracks to the bridge and 1.5 miles beyond, where it connected with the Hawaiian Sugar Company rails. It was just four miles from the Hawaiian Sugar Company's mill at Makaweli to Port Allen.

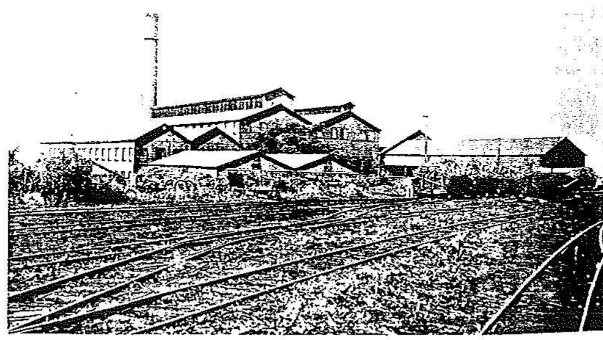
In 1922, a territorial report listed 19.22 miles of track for the Kauai Railway. If the line is measured on the map from the mill at Makaweli through Port Allen to Koloa Sugar's mill, main line trackage appears to be about 15 miles. When a four-mile branch built by the railway from a junction a short distance west of McBryde Mill to Kalaheo Homesteads (at an elevation of 700 feet) is added, the railroad's length agrees with the published figures. The branch was intended to transport building materials and supplies to the rapidly-growing town.



Lihue Railway's high trestle across the Hanapepe River above Port Allen. — BISHOP MUSEUM

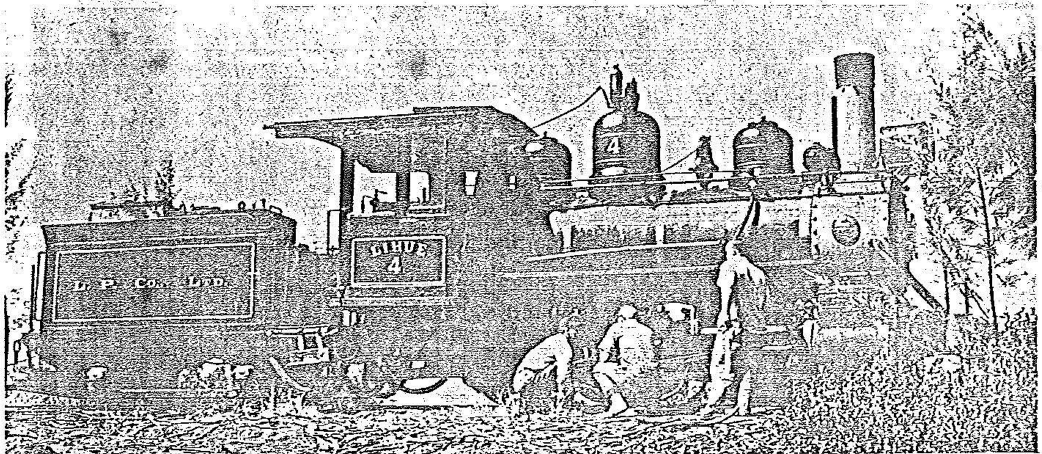
The Kauai Railway purchased another new Baldwin 0-6-2T in 1921, and this became the second *Port Allen*, road No. 2. The first *Port Allen* was apparently renamed the *Ono*—which might suggest to the facetiously inclined that each time another engine was named *Port Allen*, the employees cried, "Oh, NO!!". Actually, *ono* is the Hawaiian word for a large mackerel, by its preferred definition; although when pronounced differently it means "tastes good."

In 1930, the published mileage for the Kauai Railway was down to 7.06, the balance probably having been absorbed by the plantations. In 1932 and 1933, a portion of the rolling stock was sold to McBryde Sugar. Then in 1936 and 1937, two new Whitcomb diesels were purchased. In 1938, McBryde bought back its old *Wahiawa*, later *Port Allen*, even later *Ono*, and renamed it *Hanapepe* No. 5. Some time after 1938—no doubt in 1947 when McBryde's rail operations were replaced by trucks—the two diesels which had been switching at Port Allen were sold to Lihue Plantation. Several references indicate that the Kauai Railway was disincorporated in 1933 and ceased to exist. So how does one explain the factory record of orders received for Whitcomb diesels in 1936 and 1937 and the sale of the *Wahiawa* back to McBryde in 1938? It's part of the fun of chasing down railroad history.

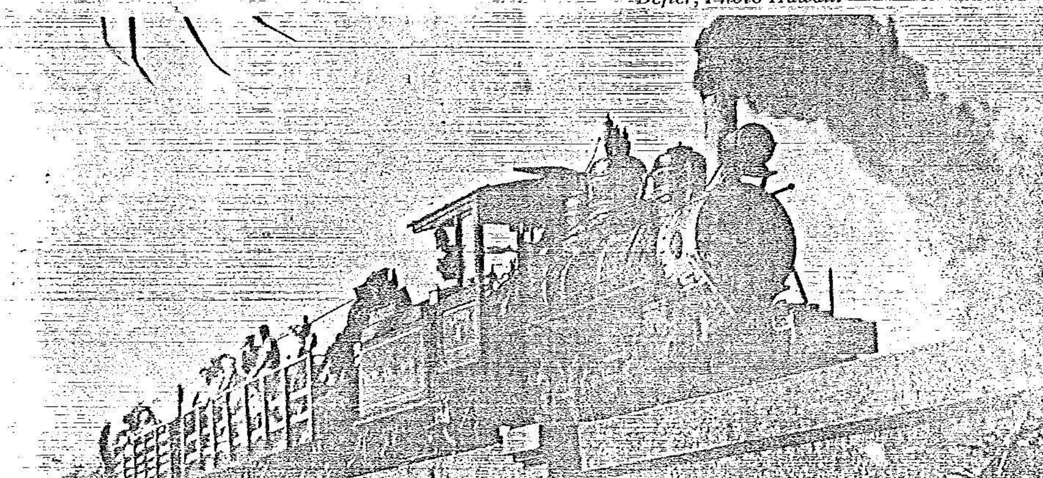


The Hawaiian Sugar Company mill at Makaweli, located at the western end of the Kauai Railway. — KAUAI MUSEUM - JAY CONDE COLLECTION

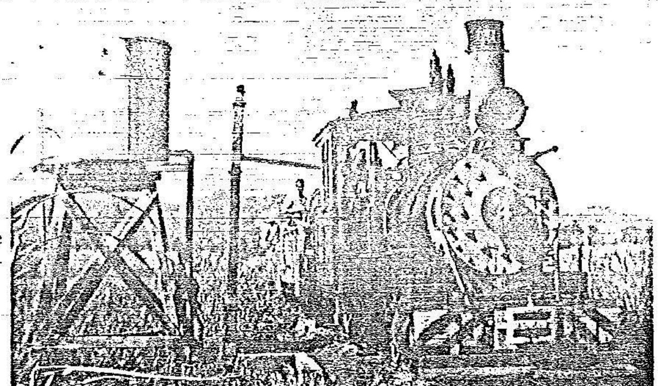
LIHUE PLANTATION CO.



Hibiscus and Heliconia Rail Club, of Honolulu, on fan trip to Lihue 1959. Locomotive #4 was later renumbered to #604 and finally sold to a mainland buyer. *Murray Befler, Photo Hawaii.*

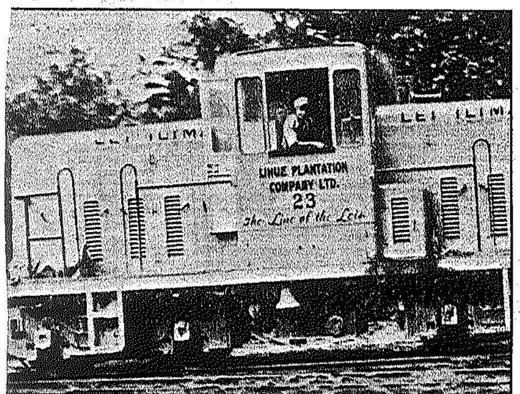


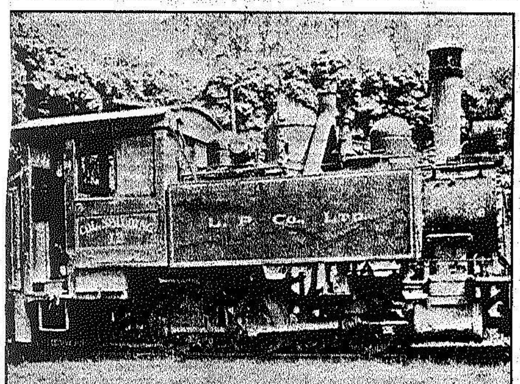
H & H fan trip crosses the Wailua bridge near Lihue 1959. *Robert Ramsay.*



Lihue #4 under engine servicing at Lihue in September of 1959 during H&H club railfan trip. *Robert Ramsay.*

38 SUGAR TRAINS PICTORIAL





PHOTOS COURTESY Rick Burrell

John F. Barretto (seen in top photo) used to drive sugar trains.

Sugar trains link Kaua‘i history, family roots

Local man researches island railroads

BY LESTER CHANG
TGI Staff Writer

When Wailua resident Rick Burrell runs over train track or sees a bridge which a train once crossed to bring cane to a mill, Kauai's history and his own family history rush over him.

Burrell is quickly reminded of:

● His grandfather, John F. Barretto, who either worked, in different capacities, on locomotives for the Makee Sugar Company or Lihu'e Plantation Company, between the 1920s and 1959.

● The history of Kaua'i's once-thriving sugar industry.

● His Portuguese heritage. In the mid-1880s, his great-grandfather and great-grandmother were part of a continuing wave of Portuguese immigrants who came to Hawai'i for work in the sugar plantation industry.

The information Burrell has so far collected has helped him gain a better perspective of the sugar industry, which has dominated Hawai'i for more than 150 years and of his own roots.

Burrell, 42, said his interest in the research project was sparked a year ago after he rode his dirt bike over tracks in east Kaua'i and in Anahola.

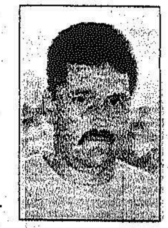
In those areas, Makee Sugar, now defunct, and Lihu'e Plantation, among Kaua'i's most productive and largest plantations, used trains to bring cane to mills before sugar products were sent to markets abroad.

As part of his research, Burrell was invited for a short ride on one of three trains owned by Grove Farm Company on Kaua'i.

Burrell wants to share the information he has accumulated with the Kaua'i Historical Society, as a way to help educate people about the history of the island, its people and culture. He wants to get in touch with people who might have maps of the location of his grandfather's old homes in Kealia and Kapahi or photographs of trains he drove.

"It is almost like a treasure hunt. It is a challenge," Burrell said.

Barretto, the son of Francisco De Freitas and Francisca Barretto, was born in Kealia Camp in 1901 and died in 1987. His interest in trains was sparked when he was in his 20s, first working as a breakman, a fireman and then as an engineer, Burrell said.



BURRELL

An employee of MaKee Sugar Company between 1920 and 1934, Barretto drove trains through thousands of acres of canefields in Anahola, Kealia and Wailua.

Burrell said his grandfather very likely drove trains through Wailua Homesteads. It is the same area where Burrell, a painting contractor, now lives with his wife and two children.

MaKee Company, in which King Kalakaua had an interest, was incorporated in 1877 and owned by George A. Macfarlane and Capt. James MaKee. The company operated until 1934, when it was acquired by Lihu'e Plantation Company, and the MaKee mill was disassembled and was transported to Lihu'e.

Burrell's grandfather continued driv-

See TRAINS, Page 7-A

TRAINS

Kaua‘i was once criss-crossed by tracks

Continued from 1-A

ing trains and transporting cane to the Lihu‘e mill until 1959.

During his employment with Makee and LIhu'e Plantation, Barretto operated numerous locomotives, including the Kilohana, Number 13, in the 1920s and 1930s and the Col. Spalding, both fitted with steam-powered engines, and the Lei Ilima, a diesel-powered train, in the late 1940s.

One of Burrell's prized photos is that of his grandfather driving the Lei Ilima.

He said his grandfather loved driving trains and always wore his engineer's hat.

Like many employees of the sugar industry in those days, his grandfather worked five days a week, ten hours a day, Burrell said.

The first train to operate on Kaua‘i was the Fowler, brought to the island from England in 1881 for Kilauea Plantation Company.

Over the next 80 years, some of the island's largest and most productive sugar companies operated train systems.

PHOTO COURTESY Rick Burrell

The late John F. Barretto (featured here with his wife, Ida), operated sugar trains on the island. His grandson is researching the history of sugar trains.

They included Koloa Plantation, Grove Farm Company, Makaweli Hawaiian Sugar Company, Kekaha Sugar company, Koloa Sugar Company, McBryde Sugar Company, ‘Ele'ele Plantation and Waimea Sugar Company.

Railways systems also were operated by Ahukini Terminal and Railway Company and the Kaua'i Railway Company.

After the cane was transported to mills for processing, it was shipped out from ports on Kaua‘i to markets in Honolulu and abroad.

Trains operated on O‘ahu from 1840 to 1947, shutting down to make away for more efficient cane-hauling trucks, according to Jana Kahale, administrator for the Hawaiian Railway Society, formed in 1971 to preserve the history of trains.

Today, only tourist-oriented trains operate on a 16-mile route on O‘ahu and in Lahaina, Maui, Kahale said.

The use of all trains on Kaua'i for hauling cane came to an end in 1959. Some west-side sugar companies shut down their systems as early as 1941. Larger companies, such as Lihu'e Plantation, ended the use of trains at a later date because they had invested large amounts of capital in the systems.

After the Lihu'e Plantation trains shut down, Barretto was offered a job to drive trucks, but refused because he loved driving trains, Burrell said.

Burrell said his grandfather lived for his work and his family. Barretto lived with his wife, Ida, who is now in her 90s, and his six children, including John Barretto Jr., a former member of the Kaua‘i County Council, in Kealia and then in Kapahi in the mid-1950s.

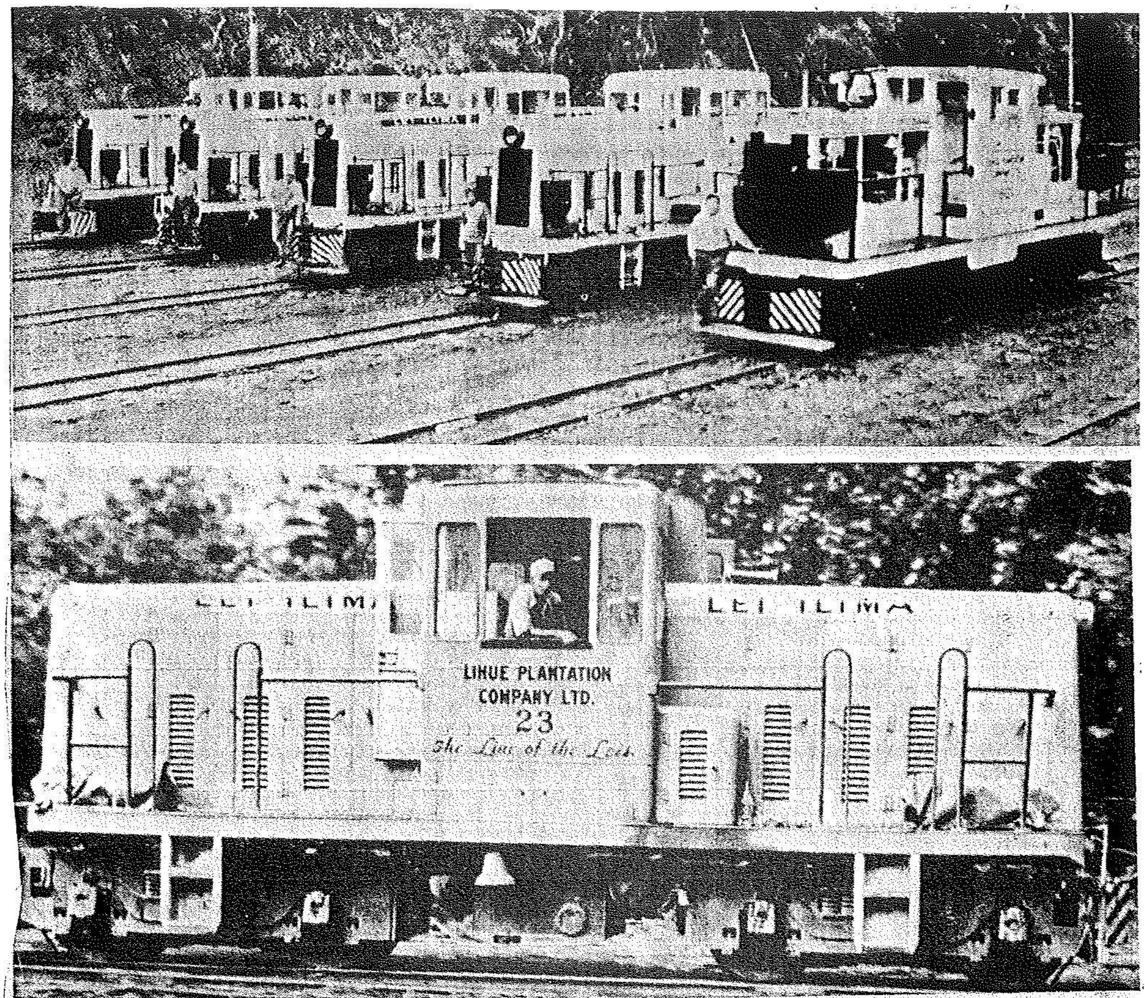
While at work, Barretto thought of his wife often. At stops along his route, he used to pick up hibiscus plants and flowers to be planted in her garden, Burrell said.

His grandfather, who had an eight-grade education, was always "up on the news and politics of the day," Burrell said.

During World War II, Barretto had a victory garden, and gave his produce to neighbors and friends. He once spotted what he thought was a Japanese submarine off Kaua‘i's coastline and reported the sighting to the U.S. military, Burrell said.

Barretto also loved baseball, and even though games were broadcast on television, he would rather listen to radio broadcasts.

"He wasn't one of the leaders of the sugar industry," Burrell said. "He was a working man who drove trains for a living so he could put food on the table for his family. I am really proud of who he was."



END OF THE LOCOMOTIVE ERA—A typical diesel electric lineup at Lihu'e Plantation about 1957 (top). These locomotives carried the banner "Line of the Leis" on the side of the diesel cabs. The names originated from the Hawaiian names of the most popular flower of each major Island.
Above, a typical diesel locomotive, "Lei Ilima," about 1945. The last serviceable diesels were sold to Cuba.—*Photos courtesy Amfac Inc.*

30 YEARS AGO

From the May 23, 1956 issue of The Garden Island

Lihue Plantation Co. Ltd. will change its cane transport system from rail to truck hauling as soon as possible, manager Keith B. Tester announced Thursday. The conversion will cost about $3,200,000. The first truck hauling is expected to take place in 1958.

Lihue is the last of Hawaii's sugar plantations to make the change from railroad transportation of cane to trucking. Grove Farm Co. still operates a railroad, and has the only steam locomotive in use on the island, but has been trucking cane to Koloa for several years.

that "Nani Kauai" or "Beautiful Kauai" be selected as the slogan.

However the directors felt that the island's name should come first and suggested that the committee consider "Kauai ka Nani."

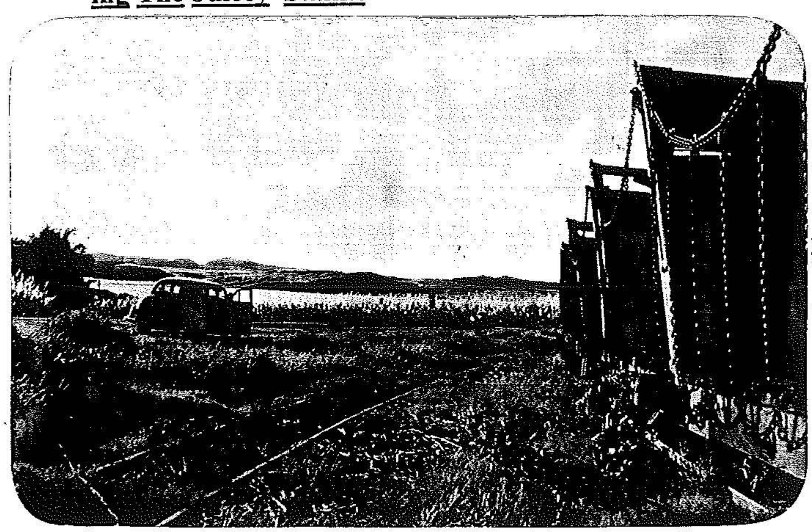
The slogan decided upon will replace "Kauai Mua-Hope-Mau," which the chamber feels has not won general acceptance.

SUGAR CANE FIRE

Harvesting Sugar Cane By Burning Leaves Before Cutt-ing The Juicey Stalks.

HARVESTING SUGAR CANE

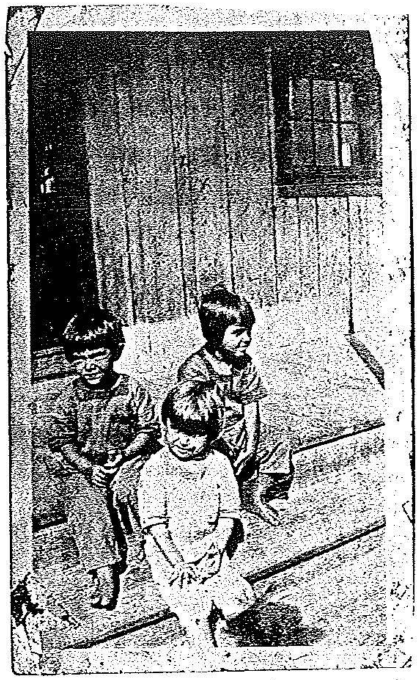
Started Loading Sugarcane By Trucks In The 1950's.



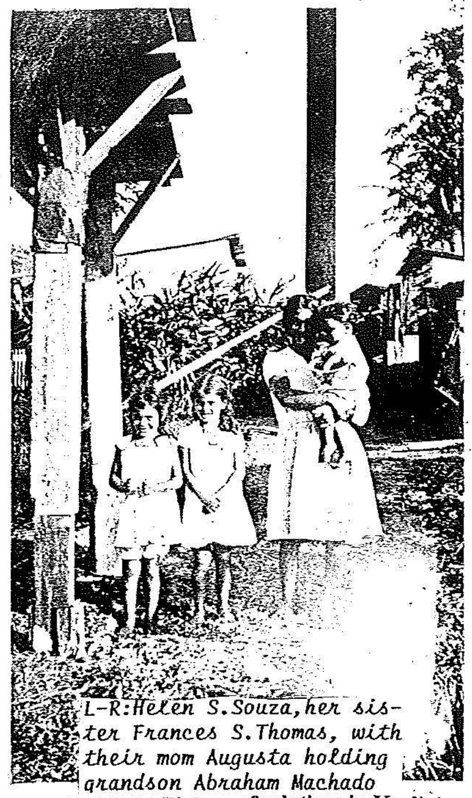
SUGAR PLANTATION "HAWAII"

In The Beginning Sugar Cane Were Transported From The Fields To The Mill On Small Gauge Rail Roads.

SOME RELATIVES HOMES IN KEALIA : SHOWING WHAT HOMES LOOKED LIKE THEN!



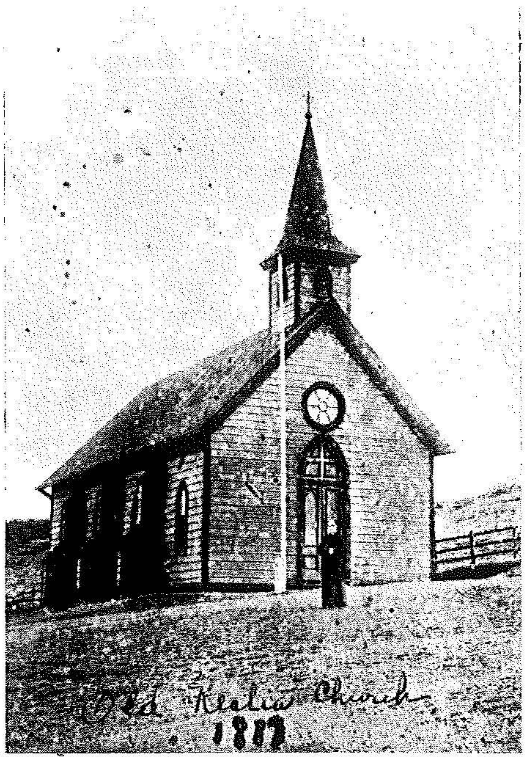
Picture shows:Cousins sitting on veranda in their Kealia camp home!



Top Right:Picture of relatives in Kealia! Background Makee Sugar Mill!

Picture showing front portion of Grandparents Barretto's Kealia home!

Cousin:Standing on railroad track in Kealia!
Background-Makee Sugar Mill!



ST. CATHERINE'S CHURCH.....at the dedication in 1887.
The priest in the photograph is FATHER EMMERAN SCHULTE, SS. CC. who was in charge of building this church.

CATHOLIC CHURCHES GREW
FOR PORTUGUESE NEEDS

One of the major effects of the Portuguese immigration to Hawaii was the growth of the Catholic religion. As Plantations developed with neverending demands for more workers, and with Portuguese filling these positions, many churches were founded to fulfill their religious needs.

Long before St. Catherine's of Kealia became the parish church of northeastern Kauai, chronologically St. Stephen at Moloaa, St. Maxim's at Hanalei and St. Sylvester at Kilauea were established. The church at Moloaa was abandoned after being destroyed by successive tidal waves [tsunami]. St. Maxim's located at the bend of the Hanalei River was abandoned and a new church, St. William's was built on Kuhio Highway in Hanalei. St. Sylvester's still remains today and its existence is due mainly to the sugar and agricultural industries in that area.

A brief history on one of these churches, Saint Catherine's is presented because it best exemplifies the development of the Portuguese influence in a Plantation community.

With the increase of Portuguese workers a school was established on a bluff between Kapaa and Kealia in 1883. Four years later in 1887, the Honolulu Catholic Mission acquired 2 acres of land for the purpose of erecting a large frame church to serve the many Portuguese now living in that area. Father Emmeran Schult, SS.CC. was in charge of constructing the Gothic style church. It was dedicated to St. Catherine and blessed by Bishop Koecken on the second day of September, 1887.

As the years passed and the parishioners increased, more land was acquired making a total of seven acres.

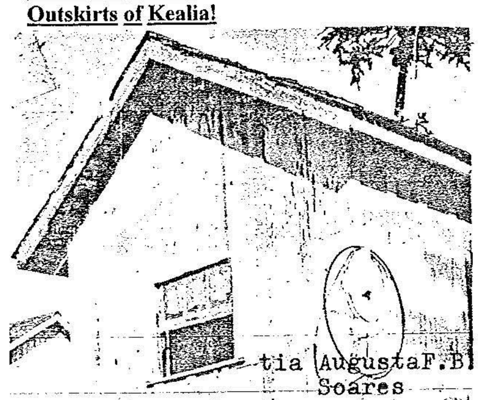
Father Victoninus Claesen, SS.CC. [1912 - 1915] added a practical and spacious sacristy to the church. During 1918 - 1924 Father Hubert Nijes, SS.CC. enlarged the church and built a large parish hall to promote church organizations and youth activities. Later the structure was destroyed by a hurricane. Father Maurice Coopman, SS.CC. [1930] enlarged the church for the third time, erecting a new rectory and improving the church's cemetery by adding a hugh bronze Calvary embedded in elaborate and solid masonry.

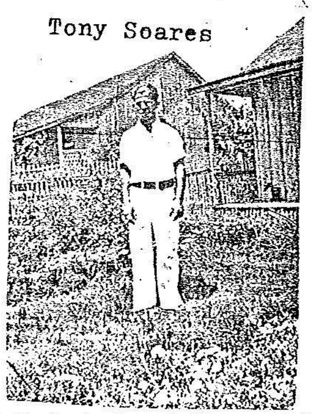
In the spring of 1958, a new, modern church containing many outstanding paintings by Hawaii's most gifted artists was completed. The old wooden church was eventually torn down with the site of the church being used today as a cemetery.

l-r:Bill Amorin, Manny Soares & Joe Barretto Sr. <pig caught in mountain>

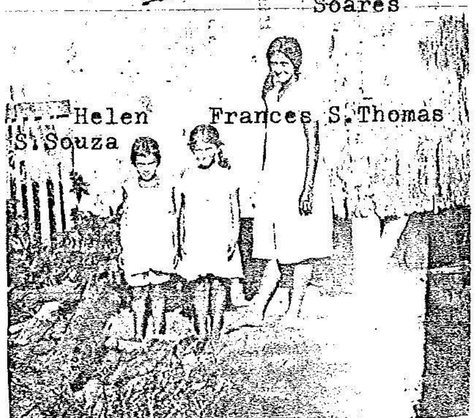
Coming home from the pig hunt! {relatives will have extra food on the table!

Beach House:Relative's special picnic place! Outskirts of Kealia!

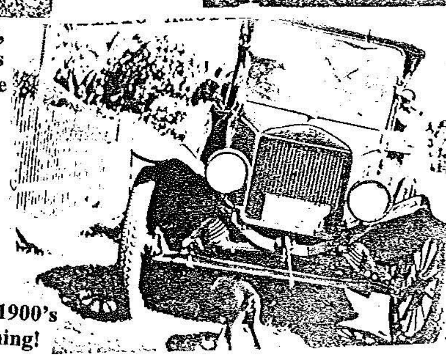




In the back of cousin Tony, picture showsKealia homes what they looked like in the 1900's!



Picture shows side portion of relative's Kealia home!



Ford A Model A or a Model T 1900's car was used for hunting & fishing!

Appendix C Letter Response from Beverly Muraoka

BEVERLY H. S. L. A. MURAOKA
[redacted]
Kapaa, Kauai, Hawaii 96746

May 15, 2017

Brittany Beauchan
Cultural Researcher
Cultural Surveys Hawaii, Inc.
P. O. Box 1114
Kailua, Hawaii 96734

Re. Job Code: KEALIA 3

Dear Ms. Beauchan:

Thank you for your letter dated April 2017 regarding Kealia Properties, LLC, CSH and Helber Hastert and Fee(HHF) Planners for a CIA for a proposed Subdivision, TMK: 4-4-7-9-001 and 002.

I confess that my background and/or knowledge of this subject discussed herein are limited to the following:

a. the proposed site may have been used for sugar cane and, therefore, may include irrigational ditches, 'auwais, and other used water systems by the early settlers;

b. the site may also possess high content of chemicals used for fertilizer, rodent control and mosquito sprays.

c. gathering of plants, leaves for medicine, and the like, may have been used by the old-timers but may not be available as was then thus, a botanist or horticulturist should be consulted if these still can be found e.g. popolo, laukahi, 'uhaloa, etc.

d. the site may also be in line of the "night marchers" from Mt. Makaleha to Kealia Beach.

e. most of the kupuna and/or elders of the Kealia I grew up with are now deceased; however, I give the following names for your contact. They are the Ho'opii family, Herman Chong family, and the only person(in her 90's) would be former Realtor, Dimples Kano.

As always, I would be pleased if any future comments for this project be allowed that may be impacted upon it, it may be granted to me.

Brittany Beauchan
Page 2
May 15, 2017

Re. Job Code: KEALIA 3

I noticed via the maps submitted the Halaula Reservoir is in direct path to the project. Please ensure no other project like the KaLoKo Dam ever occurs. This includes the Kumukumu Stream.

Again, I offer this limited knowledge in hope that ALL aspects are discussed thoroughly that the people may benefit therefrom.

Sincerely,

Beverly H.S.L.A. Muraoka

Beverly H. S. L. A. Muraoka
Kumu Hula, Retired
HEALANI'S HULA HALAU & MUSIC ACADEMY
Kapaa, Kauai, Hawaii

Appendix D Letter Response #1 from Kamealoha Hanohano Smith, on behalf of Kaiaulu Papaloa representing members of the Keālia Community

Brittany Beauchan

Cultural Surveys Hawaii

PO Box 1114

Kailua, HI 96734

Aloha Ms. Beauchan: 7 June 2017

This is a follow up to your letter sent to our kupuna. They advised that we respond as a Hui rather than having them isolated as individuals and have their mana'o gathered and used to your end.

Our Hui is a group of native Hawaiians, including the kupuna, with ties and interests in Kealia. Kai'ulu is a nonprofit organization which has been selected by the Hui to communicate their interests on this matter. They have chosen this vehicle because they fear reprisal from the land manager and its contractors.

The Hui has little interest in the issues identified in your initial letter. We are primarily concerned with traditional and customary access rights. As you may know, real property titles in Hawaii come with encumbrances. The land in Kealia is part of an award to Kekauonohi in 1848. The title to this land, like all those awarded under the mahele, is "ua koe ke kuleana o na kanaka" or "subject to the rights of native tenants". What this means is that Hawaiian people have the right to access these lands to gather what we need physically, spiritually, and culturally.

These access rights tied to land titles are also articulated in the Hawaii State Constitution, Hawaii Revised Statutes, and have been adjudicated and supported in the Hawaii Supreme Court. The Courts have been very consistent that these rights apply to all open, private lands, but cannot be exercised when land is developed, with infrastructure and homes.

What this means is that we currently have, and our descendants will retain, rights to access the area proposed for development. However, if you complete your development, then our constitutionally protected rights to access that area will be forever extinguished. Because these rights were gifted to us by our King, and because we do not know what resources our descendants may need from this area in the future, we believe that it is our responsibility to oppose a forced condemnation of these rights.

Again, our primary concern is preserving access to the land and resources in Kealia that our descendants will need. Most of these resources may occur outside the area proposed to develop. If we could assure unimpeded access to the resources elsewhere on the rest of the property, into perpetuity, then a voluntary release of our rights in the area proposed for development could be contemplated.

We strongly suggest that this issue be resolved immediately, as part of the ongoing cultural impact assessment. Because this is a highly sensitive issue dealing with our families' needs, the discussion would require the following conditions:

1. To protect the remaining resources, we request a temporary stasis of activities and tenants on the larger Kealia property. No thing and no one changes during the course of this discussion, beginning the date of this communication. Any actions or changes on the larger property will be construed as retaliation on Hui members who may be participating in this study and this discussion. Any actions will be documented and used as examples of cultural resource degradation and access condemnation as part of the permitting process for this project.
2. Written confirmation of Condition 1.
3. To protect our Hui members, the current land manager will not participate nor be privy to the discussions, other than to implement Condition 1.
4. To assure Condition 2, we will initially communicate only with you, as the chosen consultant, and you will communicate directly with the landowner and counsel.

We want to be very clear.

a. We, the hoa'aina of Kealia, have identified for you, the only significant Hawaiian cultural issue associated with the proposed development. Our constitutionally protected access rights to this area will be forever extinguished by the proposed action. It is an understatement to identify this as an adverse cultural impact. But please do so for the record and consistency with State laws.
b. When this is acknowledged, we will entertain discussion for preserving resource access on the rest of the property as mitigation.
c. As our kupuna have always done, we communicate with, and put our trust in individuals, not institutions. You were sent to us, and we embrace you and your commitment to delivering our concerns. We have given you the burden to bear our concerns first to the land owner as the priority issue, and not as part of the completed CIA.
d. If you do not convey our information to the landowner we view it as a breach of your professional duties and a violation of this process under State and County laws.

We are sure you will see the merits of helping the landowner quiet this issue before moving any further with the development plans. We suggest you contact the landowner and our Hui as soon as possible.

Kamealoha Hanohano Smith

Board President

Kaiaulu Papaloa

Box 510015

Kealia, Hawaii 96751

808-212-4356

kamealohahanohanosmith@gmail.com

References:

http://thegardenisland.com/news/local/crime-and-courts/villages-at-poipu-phase-i-at-center-of-decades-long/article_53d94c74-d6f3-5022-a704-94ba3852322e.html

http://lrbhawaii.org/con/constitution/CONST%200012-0007.html

http://www.kamehamehapublishing.org/nativehawaiianlaw/

https://apps.americanbar.org/buslaw/blt/2008-11-12/sproat.shtml

Public Access Shoreline Hawaii v. Hawaii County Planning Commission: The Affirmative Duty to Consider the Effect of Development on Native Hawaiian Gathering Rights. 16 UH L. Rev. 303

The Reassertion of Native Hawaiian Gathering Rights Within the Context of Hawai`i's Western System of Land Tenure. 17 UH L. Rev. 165.

Appendix E Letter Response #2 from Kamealoha Hanohano Smith, on behalf of Kaiaulu Papaloa representing members of the Keālia Community

Brittany Beauchan

Cultural Surveys Hawaii

PO Box 1114

Kailua, HI 96734

Aloha Ms. Beauchan: 16 June 2017

This is a follow up to our letter of 7 June 2017.

As a reminder, our Hui is a group of native Hawaiians, including the kupuna, with ties and interests in Kealia. Kai'ulu is a nonprofit organization which has been selected by the Hui to communicate their interests on this matter. They have chosen this vehicle because they fear reprisal from the land manager and its contractors.

Kai'ulu will remain the buffer between the hoa'aina and the landowner at this point, but the direct point of contact will now be Timothy Reis. You can contact him by phone at 651-4448 and by email at timreiskauai@gmail.com. Written correspondence can go to the Kai'ulu address below.

On another note, it is our understanding that you, and/or, the landowner have been in contact with State DLNR-SHPO on Kauai regarding this issue. This is of great concern because the current land manager for the Kealia property and development has familial relationships within this department, This is an obvious conflict of interest, compromises good faith discussions, and jeopardizes the process' compliance with State law.

Can you please confirm who you have spoken with regarding this issue so that we understand who is now involved in what we had hoped could be a private discussion.

Kamealoha Hanohano Smith

Board President

Kaiaulu Papaloa

Box 510015

Kealia, Hawaii 96751

Timothy Reis

Kealia Hui contact

[redacted]

Appendix F Letter Response from Dr. Hallett Hammatt

CULTURAL SURVEYS HAWAIʻI

ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES - SINCE 1982

Oʻahu Island
P.O. Box 1114
Kailua, Hawaiʻi 96734
Ph: (808) 262-9972
Fax: (808) 262-4950

Maui Island
1860 Main Street
Wailuku, Hawaiʻi 96793
Ph: (808) 242-9882
Fax: (808) 244-1994

Branch Offices:
Hilo, Hawaiʻi
Kona, Hawaiʻi
Lāwai, Kauaʻi

June 29, 2017

Kamealoha Hanohano Smith
Board President of Kaiaulu Papaloa
[redacted]

CSH Job Code---- KEALIA 3

Subject: **Response to Letter Dated June 7, 2017**

Aloha Kamealoha,

We would like to explain the role of Cultural Surveys Hawaii (CSH). The proposed Keālia Subdivision project is subject to State environment law that requires assessing impacts to the natural environment and cultural practices. To meet this requirement, project proponents must hire neutral third party consultants to conduct studies related to this compliance process. CSH has been hired to prepare a Cultural Impact Assessment (CIA) and a Literature Review and Field Inspection (LRFI) for the subject parcel. It is CSH's responsibility to conduct an objective study, to gather information from concerned community members, and to compile the information gathered into a report that becomes part of the public record. Through the consultation process, as well as the public's review of completed studies, the public has an opportunity to speak to this project.

As part of our CIA it is standard practice for us to contact people in the community, as well as key stakeholders (including the government and its appropriate agencies). As part of this process, we also reach out to the Office of Hawaiian Affairs (OHA), the Kauaʻi and Niʻihau Island Burial Council, and the State Historic Preservation Division (SHPD) (Burial Sites Specialist and History and Culture Branch). The purpose of our outreach efforts is twofold: to inform the community of the proposed project, and to identify, through consultation with knowledgeable individuals in the community, ongoing or past cultural practices occurring or that have occurred within the project area. Through community consultation, CSH can evaluate potential adverse effects on the cultural practices and cultural resources of the community and State. This is in compliance with Act 50 of State law. As outlined in Act 50, CSH is limited to only "identify[ing] and address[ing] effects on Hawaii's culture, and traditional and customary rights" (State of Hawaiʻi Act 50 2000). CSH can

WWW.CULTURALSURVEYS.COM - INFO@CULTURALSURVEYS.COM

Subj: Response to Letter Dated June 7, 2017 **Page 2**

Date: June 29, 2017

only go so far as to identifying "significant effects," and recommending mitigating actions based directly on stakeholder comments.

In order for us to remain neutral third parties, we cannot directly advocate for, or represent the hui or represent the landowner in any way. CSH cannot act as a mediator between the Keālia Hui and the landowner, nor can we actively participate in mitigation.

Thank you,

Hallett H. Hammatt, Ph.D.
President

Appendix G Authorization and Release Forms

G.1 Kenneth Ponce

22 May 2017

Cultural Surveys Hawaiʻi, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawaiʻi 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KEALIA 03 bbeauchan@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Keālia Subdivision, Keālia Ahupuaʻa, Kawaihau District, Kauaʻi Island, TMKs: [4] 4-7-009:001 and 002.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, KENNETH PONCE, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

(Signature)

5/22/17
(Date)

G.2 Richard Kaui

23 May 2017

Cultural Surveys Hawaiʻi, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawaiʻi 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KEALIA 03 bbeauchan@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Kealia Subdivision, Keālia Ahupuaʻa, Kawaihau District, Kauaʻi Island, TMKs: [4] 4-7-009:001 and 002.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, RICHARD C KAUI SR, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Richard C Kaui Sr.
(Signature)

5-23-2017
(Date)

G.3 Kupuna Valentine Ako

25 May 2017

Cultural Surveys Hawaiʻi, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawaiʻi 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KEALIA 03 bbeauchan@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kamaʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Keālia Subdivision, Keālia Ahupuaʻa, Kawaihau District, Kauaʻi Island, TMKs: [4] 4-7-009:001 and 002.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, VALENTINE AKO, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

Valentine C. Ako
(Signature)

05-25-2017
(Date)

G.4 Timothy Reis

21 December 2017

Cultural Surveys Hawaiʻi, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawaiʻi 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KEALIA 03 bbeauchan@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawaiʻi (CSH) appreciates the generosity of the *kūpuna* and *kama ʻāina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed Kealia Subdivision, Kealia Ahupuaʻa, Kawaihau District, Kauaʻi Island, TMKs: [4] 4-7-009:001 and 002.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, Timothy Reis, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

(Signature)

12-21-17
(Date)

Appendix F

Market and Econometric Studies
CBRE

2017

MARKET AND ECONOMETRIC STUDIES

PROPOSED KEALIA MAUKA HOMESITES DEVELOPMENT
Kealia, Kauai, Hawaii 96751
CBRE, Inc. File No. 17-251LA-0900

Scott Ezer, Principal in Charge
Vice President
HELBER, HASTERT & FEE, PLANNERS, INC.
733 Bishop Street, Suite 2590
Pacific Guardian Center, Makai Tower
Honolulu, Hawaii 96813

www.cbre.com/valuation

CBRE

CBRE

1003 Bishop Street, Suite 1800
Honolulu, HI 96813

T 808-521-1200
F 808-541-5155

www.cbre.com

September 20, 2017

Scott Ezer, Principal-in-Charge
Vice President
HELBER, HASTERT & FEE, PLANNERS, Inc.
Pacific Guardian Center, Makai Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

RE: Market and Econometric Studies of the Proposed Kealia Mauka Homesites Development Kealia, Kauai, Hawaii 96751 CBRE, Inc. File No. 17-251LA-0900

Dear Mr. Ezer:

At your request, we have completed a series of market and econometric analyses associated with the proposed Kealia Mauka Homesites (KMH) subdivision, a 236-lot master planned single family residential community to be located on some 53.4 acres fronting the mauka (west) side of Kuhio Highway, adjacent to the Kealia Town subdivision, inland from Kealia Beach, on the northerly outskirts of Kapaa Town, Kauai, Hawaii.

The project will offer finished house lots ranging in size from 6,000 square feet to 7,652 square feet, and include 5.86 acres of open space/parks and detention basins. The irregular-shaped site is generally level to slightly sloping, at street-grade, offers distant mountain views and is identified on State of Hawaii Tax Maps as Fourth Division Tax Map Key 4-7-9, Parcels 1 & 2 (portions). The holding is in the East Kauai Development Plan area, towards the northerly end of the "Coconut Coast" corridor, which stretches along the easterly shoreline of the island, it has favorable access characteristics, desirable climate, is proximate to employment and services, and is a natural expansion of the existing greater Kapaa community.

The development will be oriented towards full-time Kauai resident household buyers. Finished house lot prices will be consistent with comparable product elsewhere in the Lihue/East Kauai region with a portion designated for meeting workforce/affordable pricing guidelines established by the County. It is anticipated finished home values will range from "affordable" for low-moderate income households to market-pricing levels. The project will provide new, needed inventory in one of Kauai's primary residential and commercial regions; as a project having an unrestricted market-priced component there will be some non-resident second home/vacation purchasers.

The master developer plans to offer all subject inventory as vacant building lots. The subdivision's houses would be built by individual lot purchasers ("custom" homes) or in blocks by third-party contractors ("spec/tract" homes). Lot/home owners may elect to build an Accessory Dwelling Unit (ADU) on their property as then-permitted by County ordinance, but we have not considered such potentials in our analyses or modeling. Homes will not be permitted to operate as Transient Vacation Rentals (TVRs). There will be a community association with a minimal monthly fee per lot.

The KMH site is currently within the State Land Use Agriculture District, is zoned "Agriculture" by the County of Kauai, and identified for "Residential Community" use on the County Kawaihau/East Kauai Planning District Land Use Map.

Our study is primarily comprised of three elements:

1. **Market Study.** To ascertain whether there will exist sufficient demand in the Lihue/East Kauai study area (referred to as the "Lihue to Moloaa Corridor") single family residential real estate market sector to successfully absorb the finished KMH vacant house lot inventory in a timely manner given its characteristics and those of competing in-place and proposed regional development.

2. **Economic Impact Analysis.** To estimate the general and specific effects on the local economy which will result from the development of KMH, including capital investment, construction and on-going maintenance employment, worker wages and household income, contractor/supplier profits, the de facto population at build-out (resident and second home users) and their expenditures, and other regional monetary and employment effects.

3. **Public Cost/Benefit Assessment.** To quantify the impact on the public purse arising from the subject project in new tax/fee revenues received versus new on-going costs associated with the population which will be borne by the State of Hawaii and Kauai County due to the project's actualization.

The pertinent results from our studies are presented in the following report, which opens with an Executive Summary describing our salient conclusions. The remainder of the report is comprised of a series of brief discussion and introduction of addenda exhibits containing the tabular presentation of our data, analysis, and modeling for each aspect of the assignment.

The purpose of study was to provide current market data, subject product absorption estimates, economic and fiscal modeling, and an analysis of probable impacts on the Kauai community resulting from the build-out of the proposed KMH community for inclusion in submittals in the on-going entitlement process of the project.

As part of our investigation and analysis we have:

- inspected the subject property and its environs;
- researched the Lihue and East Kauai residential real property market sectors;
- interviewed knowledgeable parties active in the regional economy and property development;
- reviewed federal, state and county materials, statistics, policies and publications;

- accessed on-line databases; and
- compiled materials from published and private sources, and our files.

There were no extraordinary or hypothetical assumptions made for our analysis beyond the assumption the KMH was entitled and subdivided as proposed.

All conclusions presented herein are subject to the identified limiting conditions, assumptions, and certification of The Hallstrom Team | CBRE, Inc., in addition to any others specifically set forth in the text.

We appreciate the opportunity to be of service to HHF Planners and Kealia Properties LLC, regarding this prominent holding and needed project.

Please contact us if further discussion or detail is required. It has been a pleasure to assist you in this assignment. If you have any questions concerning the analysis, or if CBRE can be of further service, please contact us.

Respectfully submitted,

CBRE - VALUATION & ADVISORY SERVICES

Tom W. Holliday

Tom Holliday, CRE, FRICS
Director

Phone: (808) 541-5120
Fax: (808) 541-5155
Email: Tom.Holliday@cbre.com

Certification

I certify to the best of my knowledge and belief:

1. The statements of fact contained in this report are true and correct.
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions and are my personal, impartial and unbiased professional analyses, opinions, and conclusions.
3. I have no present or prospective interest in or bias with respect to the property that is the subject of this report and have no personal interest in or bias with respect to the parties involved with this assignment.
4. My engagement in this assignment was not contingent upon developing or reporting predetermined results.
5. My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
6. This assignment is not an appraisal nor is it intended to convey any form of valuation opinion regarding the subject property or its proposed development. Any monetary-based data/figures are allocations for economic and public fiscal modeling only.
7. Members of The Hallstrom Team/CBRE have made personal inspections of the property that is the subject of this report.

8. Tom Holliday as a member of The Hallstrom Group, Inc., and now The Hallstrom Team/CBRE has not completed any studies or appraisals of the subject property within the past three years.

Tom w. Holliday

Tom Holliday, CRE, FRICS
Director
Phone: 808.541.5120
Email: Tom.Holliday@cbre.com

Table of Contents

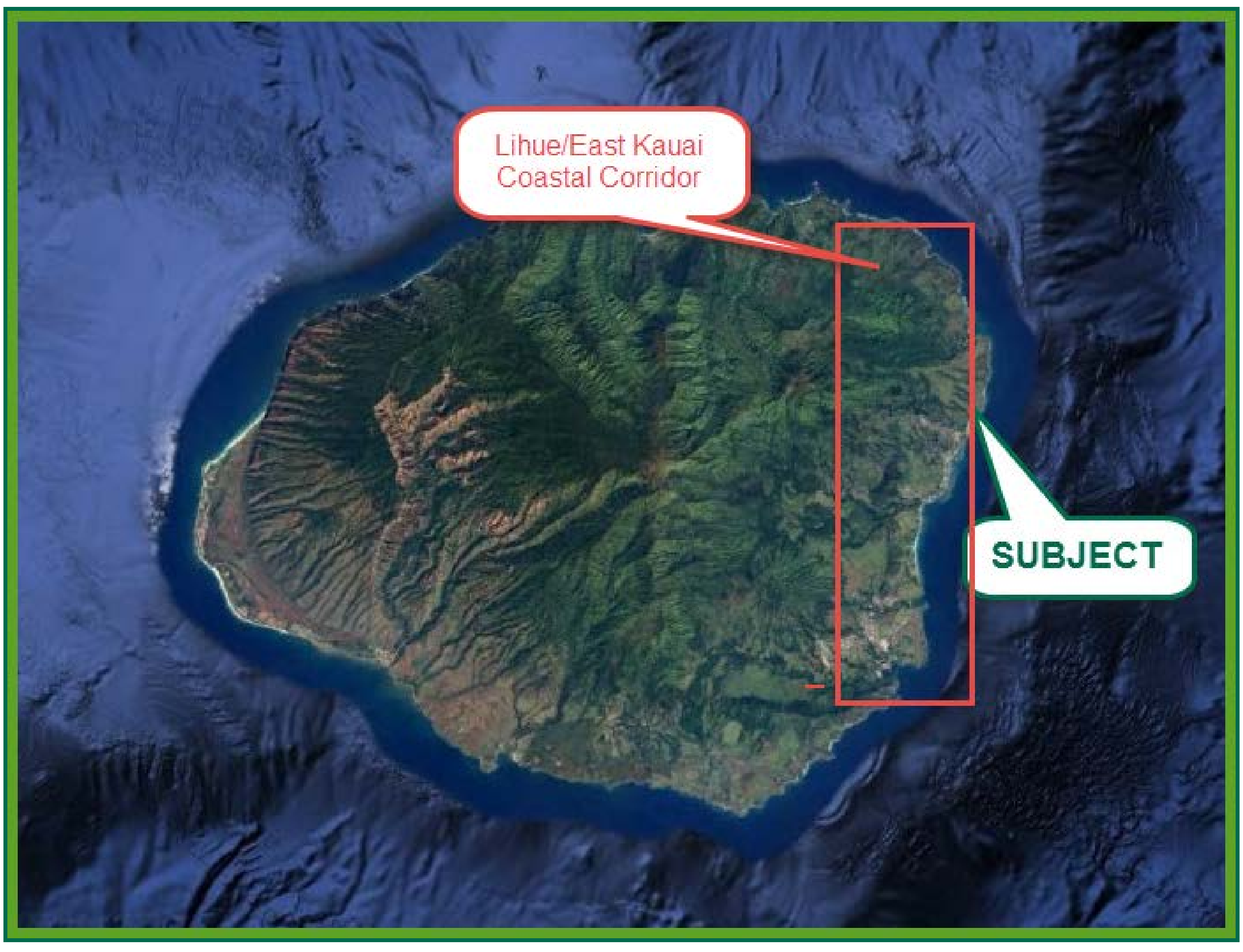
Executive Summary

INTRODUCTION

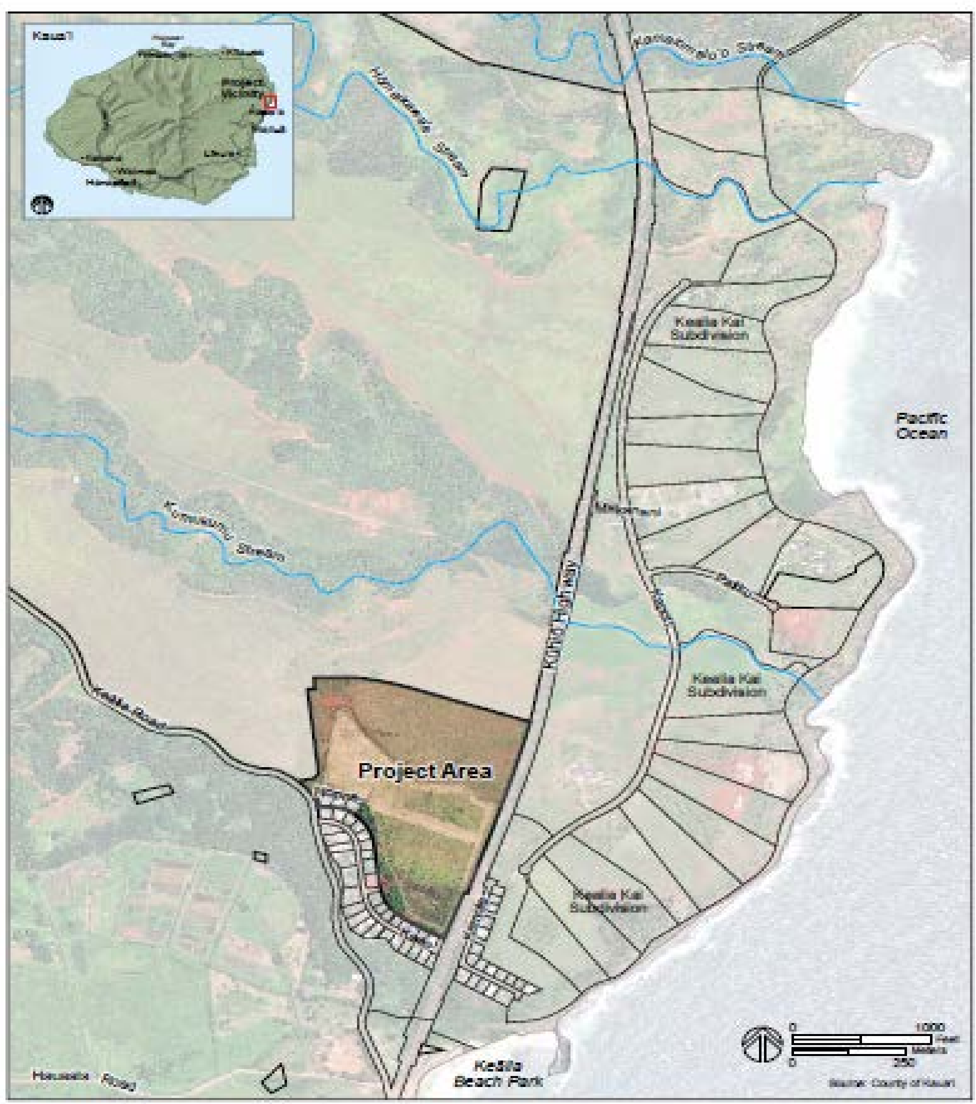
The proposed Kealia Mauka Homesites (KMH) project is described by the HHF Planners as follows:

> *Kealia Properties, LLC proposes to develop a residential subdivision at Kealia, Kaua'i consisting of approximately 236 lots ranging in area from about 5,000 square feet (SF) to 7,300 SF. The Project Area is comprised of approximately 53.4 acres of land adjacent to the north of an existing residential community in Kealia. The project includes installation of utility infrastructure (e.g., potable water, drainage, wastewater, electrical power, and telecommunications systems) and transportation improvements to serve the new community.*

KMH will be located towards the northerly-end of the urbanized coastal corridor running for some 15 miles on the East Coast of Kauai from Lihue to Moloaa, commonly referred to as "East Kauai" and encompassing the "Coconut Coast" visitor destination area, as shown on the aerial below. The site is approximately two and twelve miles north, respectively, of Kapaa Town (the largest on the island) and the Lihue Airport via Kuhio Highway which forms the makai (seaward or westerly) boundary of the holding. The subdivision will have approximately 2,600 linear feet of frontage on the Highway and stretch inland some 2,200 feet.



Apart from the southerly adjacent 38-lot Kealia Town Tract subdivision, the KMH property is surrounded by feral sugar cane fields and forested areas mauka of the Highway. To makai is the 18-lot Kealia Ocean View Tract subdivision and several large lots of the Kealia Makai subdivision, most having some form of active agricultural use. The Kealia Post Office is about 1,200 feet south of the southernmost boundary of the KMH parcel.



Project Vicinity Map
Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice
Kealia Properties, LLC

(Approximate KMH Subdivision Boundaries)

The proposed community will include 236 single family house lots which will be sold as vacant, serviced building parcels forecast with prices ranging from workforce/affordable as quantified by the Kauai County Housing Agency/Kauai Ordinance 860 to market levels. The developers will meet identified State and Kauai affordability obligations.

The finished homes, built by individual lot purchasers or by third-party contractors buying blocks of parcels, are likely to have prices/values ranging from affordable for low-moderate income households to mid-market level prices. Lot/home owners may elect to build Accessory Dwelling Units (ADUs) on their properties in accordance with County ordinances, but we have not considered such in our analysis. Homes may not be used for Transient Vacation Rental (TVR) purposes.

Although the KMH development is focused towards meeting the housing needs of working-class Kauai resident families, the open-market component of the project (apart from any lots specifically set-aside to fulfill workforce housing obligations) will be available for purchase by non-resident, second home buyers at market prices with no ownership constraints. Such buyers can be found in every single or multifamily project on the island which does not impose purchaser restrictions (which is only possible for dedicated affordable units). As noted in the report, about 19 percent of all Kauai housing inventory (non-resort or TVR), and from 8 to 33 percent of the housing units in the East Kauai corridor, are owned by non-resident/second home parties.

The KMH property is currently classified as:

- State Land Use (SLU) - "Agricultural District";
- Kawaihau (East Kauai) Planning District (Kauai Island General Plan) – "Residential Community"; and
- County of Kauai zoning – "Agricultural".

Capitalizing on a level to slightly sloping, scenic, near-shoreline site having favorable climate and mauka view potentials, the subject development is intended to be a community offering a selection of single family lots (and eventual finished homes) at prices ranging from "affordable" for Kauai households with incomes below 80% of the median household income for the island to 140% of the median and above.

Assuming sufficient market demand, KMH will transform a vacant bulk acreage holding having limited agricultural use potentials and currently offering nominal regional economic benefit, into an asset providing needed affordable/workforce and low to moderate market priced housing, producing more than a thousand "worker years" of employment and wages during build-out, attracting significant new capital investment, stimulating regional business activity, and meeting currently under-serviced community needs. This activity will in turn create employment and business opportunities for Kauai residents and an expanded tax base for the state and county.

The Hallstrom Team | CBRE, Inc., assignment was to analyze the proposed KMH community from a real estate perspective and to identify and quantify probable market, economic, and fiscal impacts associated with the master plan within its regional context and forecast trends to answer four basic study questions:

1. Is there sufficient demand to absorb the 236 finished, vacant house lots of the subject project during a reasonable exposure period given islandwide/regional population, economic and market trends, and proposed competing Kauai developments?
2. Is the subdivision an appropriate highest and best use of the underlying site relative to market needs, standard land planning objectives, accepted master plan design characteristics, and the area environs?

3. What will be the general/specific and direct/indirect economic impacts on Kauai resulting from the undertaking of the subject development via employment, wages, community operations, population, household income and spending, property values and other economic activity related to the real property asset?

4. What will be the net, new benefit to the state and county "public purse" from the project regarding "new" increased tax/fee receipts versus "new" operating cost obligations?

These issues were addressed through a comprehensive research and inquiry process utilizing data from market investigation, governmental agencies, various Hawaii-based media, industry spokespersons/sources, on-line databases, published public and private documents, and our files.

The pertinent results of our study are highlighted in the following summary report which contains brief narrative, tabular data and other materials contributing to our conclusions. The presentation is divided into six sections:

1. **Primary Study Conclusions**

2. **The Subject Property and Proposed Project**

3. **Market Study of the Lihue to Moloaa (East Kauai) Corridor Residential Market**

4. **Appropriateness of the Subject for Single Family Residential Use and Absorption Estimates**

5. **Analysis of the Economic Impacts of the Proposed Development**

6. **Assessment of the Net, New Public Fiscal Benefits and Costs Associated with the Project**

The primary source information regarding the subject used in our study were:

- Maps, master plans, unit counts, density and infrastructure cost estimates and background materials provided by HHF Planners., and other members of the planning team;

- Resident population and housing projections, proposed development and other maps, General plan materials, and other data from the County of Kauai Housing Agency, County of Kauai Planning Department and State of Hawaii Office of Planning;

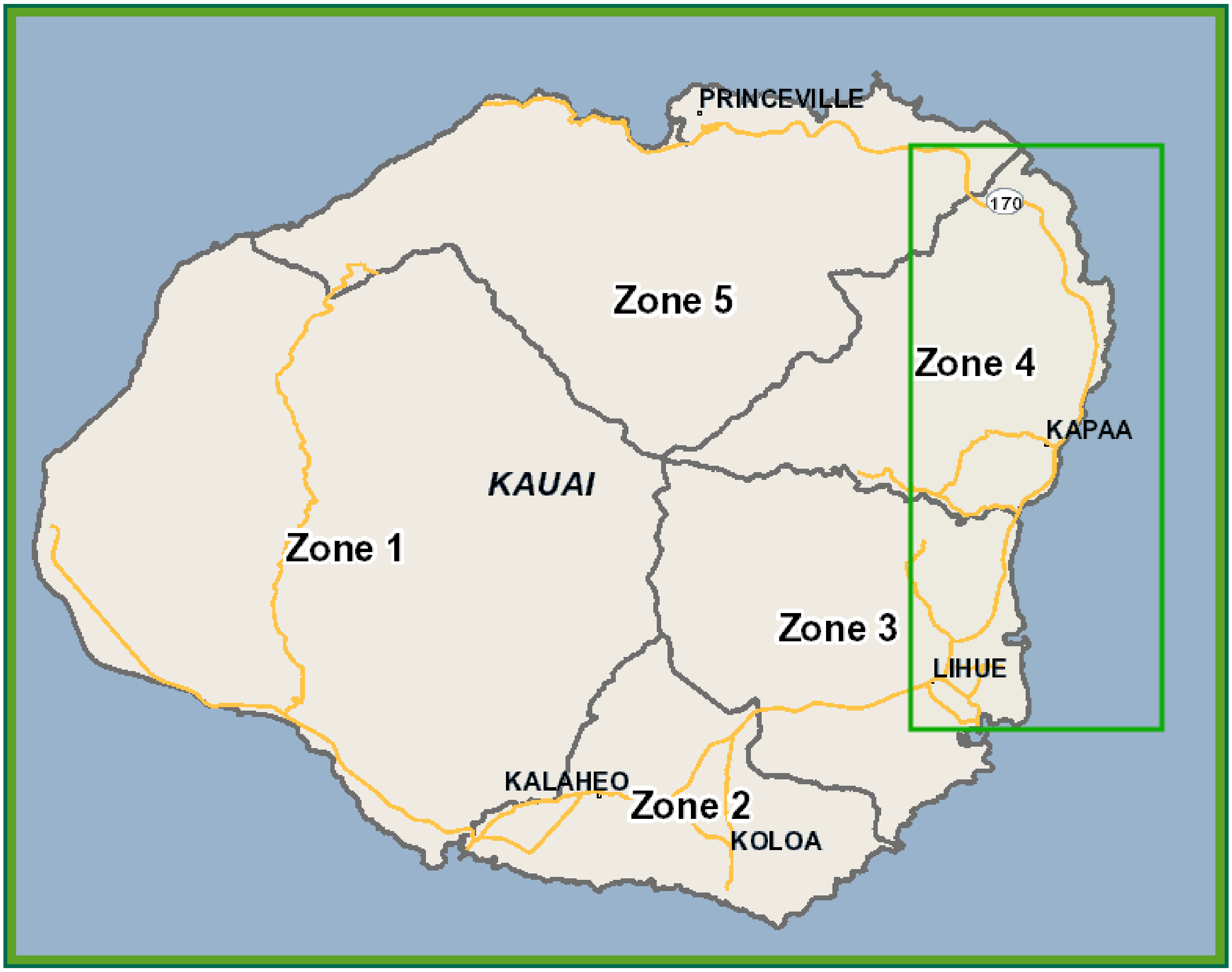
- The United States 2010 Census and subsequent 2011-2015 updates;

- Sales and listing data from the Kauai Island Board of Realtors and Hawaii Information Service: and

- Data from published and on-line sources and from our files.

The KMH site and environs have been viewed by our firm on many occasions.

We note that the locational terms "East Kauai" and the "Lihue to Moloaa (or Anahola) Corridor" are used interchangeably throughout the report to describe our focal study region on the island. This primary study area is shown outlined in green on the following map of Kauai.



Our *Market Study* time-frame which serves as a basis for subject absorption projections extends approximately 23 years to 2040, although it is anticipated the 236 subject lots will be absorbed by the market in a much shorter period. General demand for residential product in Lihue/East Kauai is quantified during this period, existing, planned competitive supply is identified, the appropriateness of the site for the proposed subdivision is analyzed, and absorption is estimated using several market-based methods.

Our *Economic Impact Analysis* and *Public Fiscal Assessment* modeling period extends from presumed commencement of site work and infrastructure emplacement in late-2018, with full-absorption/sell-out of the finished lots by 2024, equating to a seven-year project life-span.

The build-out of the homes by the lot purchasers, which is outside the purview of the KMH developers, would begin in about 2021 and continue for years thereafter (for analysis purposes-only we have assumed through 2030). This time frame effectively depicts the life-span of the project from ground-breaking, through build-out, and its eventual functional "stabilization". Primary and direct secondary capital/economic outcomes from the development of KMH are summarized within three periods (2017-2020, 2021-2025 and 2026-2030), with the de facto population and spending in the community quantified and the resultant new taxes and costs to the County and State estimated.

We have also compared our econometric outcomes with those resulting from application of the Hawaii State Input-Output Study model.

As the master developer will be selling finished lots to others, they will have no control over the timing of finished home construction. For modeling purposes, we have forecast the 236 homes would be completed by 2030, or at a rate of about 21 houses annually. This assumes some of the lots will be purchased in blocks and spec-developed by contractors. The more lots bought by individual purchasers the longer the build-out is likely to take.

The build-out timing allocation has limited relevancy from a modeling perspective which is not specifically time-sensitive. It is expressed in constant 2017 dollars and should the project timeline move several years in either direction from our estimate we would not anticipate major changes to our conclusions.

PRIMARY STUDY CONCLUSIONS

Based on our analysis of the subject property, its environs, and envisioned development we have reached the following conclusions as of the Third Quarter of 2017 regarding the probable market standing and economic impacts of the proposed KMH community.

It is noted, the larger tables formatted into the report narrative are presented in full-page size (for easier viewing) in the Addenda Exhibits attached to the report body.

The purpose of our assignment was to provide current market data and context to:

- Quantify the demand for single family house lots units in the effective market area (Lihue to Moloaa);
- Identify existing and proposed competitive supply in the region;
- Estimate the absorption period required to sell the finished lots.
- Quantify the various economic impacts to Kauai and the State from the development and "use" of the KMH lots/homes over time; and,
- Quantify the net new fiscal impacts to the County and State coffers (new tax dollars and new public expenses) resulting from the project.

The pertinent results from our studies are presented in the following summary report describing our salient conclusions. The addendum contains the tabular presentation of our data, analysis and modeling for each aspect of the assignment.

As part of our investigation program, we have: visited the subject property and its environs; researched the Lihue-Moloaa residential real property sector; interviewed knowledgeable participants in the regional economy; reviewed government statistics, policies and publications; accessed on-line databases; and compiled materials from our files and published and private sources.

Based on our investigation and analysis of the proposed KMH subdivision and regional residential housing market, our primary conclusions are:

- We project demand for 7,447 additional housing units (mid-point) in the Lihue-Moloaa/East Kauai study area between 2017 and 2040, of which about two-thirds will be for single family households (4,928 homes), the product sector in which the KMH inventory will compete. Approximately 72 percent of single family demand (or 3,458 homes) will need to be affordably priced for households making 140 percent or less of the Kauai median income. A reasonable portion of the regional single-family housing demand would consider Kealia as a viable housing location.

- Excluding KMH, there are a maximum of 5,197 additional units proposed for the study region including single family and multifamily, and standard residential and resort-residential units. Even if all were built in a timely manner and offered only as non-resort product the supply would be insufficient meet standard residential demand by some 2,250 units. However, some 30 percent of the total proposed regional units will be in developments specifically oriented towards visitors and vacation/second-home buyers (not local resident households); many will not be built within the projection period, and others will have inventory at such high price points as to be unaffordable to virtually all Kauai resident households. We forecast a shortfall of more than 3,500 standard residential units in the study corridor through 2040, with the regional single-family sector being underserviced by more than 2,000 homes/lots.

- The subject property is an appropriate location a single family residential project and has the physical and locational attributes necessary to support the development. The master plan is representative of a highest and best use of the site and will provide competitive residential inventory within the regional market. We forecast the 236-finished house lots will achieve full absorption within some 4.5 years from initial closings.

- KMH will bring some $121 million in direct capital investment into East Kauai (constant 2017 dollars) creating some 1,048 worker-years of on and off-site construction and secondary employment during build-out. The full-time resident population will be about 658 persons with an effective de facto population (including non-resident homeowners and guests) of 700 persons. Total resident household income is projected to be $20 million per year on a stabilized basis, and discretionary expenditures of the de facto population into the island's economy is forecast to reach $12.1 million annually. The "base economic impact" on Kauai will total $225 million during build-out and stabilize at $13.7 million per year.

- The project will generate some $12.7 million in tax receipts for the State of Hawaii during build-out and some $276,000 annually after completion, with $7.5 million and $1 million, respectively, for the County of Kauai.

The intended use and user of our report are specifically identified in our report as agreed upon in our contract for services and/or reliance language found in the report. No other use or user of the report is permitted by any other party for any other purpose. Dissemination of this report by any party to any non-intended users does not extend reliance to any such party, and CBRE will not be responsible for any unauthorized use of or reliance upon the report, its conclusions or contents (or any portion thereof).

We appreciate the opportunity to be of service to the Kealia Mauka Homesites development team.

Market Study

- The State of Hawaii has steadily rebounded from the 2008-09 recession and associated down-cycle in the real estate market and is now within an extended-term favorable economic period featuring gradually and consistently strengthening property sectors. Sales activity, volume, and prices have all shown meaningful recovery throughout Kauai and in the Lihue-

Moloaa Corridor (East Kauai); in many cases showing near to full recovery to the levels achieved during the 2004-07 peak market years. Expectations are for continuing economic expansion within the current up-cycle during 2017-18 (and into the mid-term) resulting in increasing demand for real estate inventory and continuing barriers to increased new development.

- Among the favorable economic indicators and trends on Kauai the unemployment rate has dropped to a current level of about 2.4 percent (approaching effective full employment) from a high of some nine percent during the depths of the recession; median household income has grown at a rate approaching four percent compounded annually since 2014; there has been major positive absorption of retail and industrial space since the beginning of 2016 (with some 200,000 square feet absorbed in the first half of 2017), increasing velocity of commercial space development; and, tourism is continually achieving all-time records year-after-year with total visitor days and spending growing at compounded annual rates above five percent and eight percent respectively since 2009.

- Although showing some trending instability in the first quarter of 2017, The Kauai residential real estate market has also shown post-recession recovery and growth. Island-wide the single family residential, condominium and vacant lot sectors are experiencing the highest level of sales activity since 2004-07, and median prices are at their highest since 2007-08, with average prices during full-year 2016 for single family homes reaching $562,000 and condominium units at $459,000. Lihue/East Kauai has shown similar trending, with median single-family home prices in Kapaa up by nearly six percent in 2016 (over 2015), and showing double-digit appreciation through mid-2017. General indicators point to up-cycle conditions with increasing demand, sales velocity, and prices in the context of limited supply additions.

- Lihue/East Kauai is one of the three centers of the island's tourism industry, called "the Coconut Coast", and along with Poipu/South Kauai and the North Shore (Princeville/Hanalei), has evolved into a primary region for economic activity and employment; attracting significant development and capital investment over the past four-plus decades. This trend is anticipated to continue over the long-term, increasing in cumulative attraction as the economy further strengthens. It is also the region with most of the commercial and industrial space on the island, the most businesses, and most employment opportunities. It is currently the focus of economic activity on the island and will continue to be an expanding, increasingly diversified market on a going-forward basis. Its desirable climate, in-place critical mass, expanding population, and availability of well-located development lands, undergird a favorable outlook which will require more housing for working Kauai families.

- The University of Hawaii Economic Research Organization (UHERO) *Forecast Project County Forecast* (May 2017) forecasts slowing but continuing annual percentile growth over the next two-plus years for Kauai County for all six projected factors. The UHERO Kauai forecasts are shown below.

COUNTY MAJOR ECONOMIC INDICATORS YEAR-OVER-YEAR % CHANGE	2014	2015	2016	2017	2018	2019
KAUAI						
Visitor Arrivals	0.5	4.8	1.2	2.1	2.2	1.8
U.S. Visitor Arrivals	-0.6	4.8	2.7	2.4	2.3	1.7
Japan Visitor Arrivals	-19.0	7.8	-11.0	3.8	3.1	3.7
Other Visitor Arrivals	9.6	4.2	-4.6	0.9	1.8	1.8
Payroll Jobs	1.6	1.6	1.1	1.0	1.2	0.8
Real Personal Income	4.9	3.9	2.9	2.4	2.2	1.7

- Though not issued on a County-basis, the most recent State of Hawaii Department of Business, Economic Development & Tourism (DBEDT) *Quarterly Outlook for the Economy* (2nd Quarter 2017) statewide forecasts show continuing gains in all 12 categories through 2020. The projections are more optimistic than their prior forecasts, and have been gaining upward momentum for the past several years.

ACTUAL AND FORECAST OF KEY ECONOMIC INDICATORS FOR HAWAII: 2014 TO 2019

Economic Indicators	2015	2016	2017	2018	2019	2020
	Actual		Forecast			
Annual Percentage Change						
Total population	0.6	0.2	0.5	0.8	0.8	0.8
Visitor arrivals [1]	4.3	3.0	2.0	1.5	1.6	1.5
Visitor days [1]	3.5	2.2	2.2	1.4	1.6	1.6
Visitor expenditures [1]	0.9	4.2	5.1	1.9	3.7	3.6
Honolulu CPI-U	1.0	2.0	2.5	2.3	2.3	2.3
Personal income	4.8	4.5	4.7	4.7	4.8	4.8
Real personal income [2]	3.8	2.7	2.4	2.3	2.5	2.6
Non-agricultural wage & salary jobs	1.8	1.4	1.0	0.9	1.0	0.8
Civilian unemployment rate [3]	-0.8	-0.6	-0.1	0.2	0.1	0.2
Gross domestic product	4.9	4.1	3.7	3.9	3.9	3.9
Real gross domestic product	2.3	2.1	1.9	1.7	1.6	1.6
Gross domestic product deflator (2009=100)	2.5	1.9	1.8	2.2	2.3	2.3

- We conclude the Kauai economy continues in its recovery up-cycle, having regained virtually all "lost" ground during the recession, is at or approaching peak indicator levels, and the overall near to mid-term outlook is favorable.

- There were some 38,101 residents in the Lihue to Moloaa Corridor as of the study date, and the resident population by 2040 (our market study period time-frame) based on County and State forecasts is expected to reach between 51,560 and 53,554 persons as shown below.

HISTORIC, CURRENT AND PROJECTED RESIDENT POPULATION TOTALS FOR THE STATE, COUNTY AND LIHUE/EAST KAUAI STUDY AREA 2017 TO 2040	2017	2020	2025	2030	2035	2040
Study Area (Lihue and East Kauai)						
1. Minimum Perspective (1, 2)	**38,101**	**39,009**	**42,366**	**45,723**	**48,566**	**51,650**
Percent of County Total	51.8%	52.2%	53.6%	54.9%	55.2%	55.5%
Average Annual Change in Persons	519	303	671	671	569	617
Average Annual Percent Growth	2.1%	0.5%	1.7%	1.6%	1.2%	1.3%
2. Maximum Perspective (3)	**38,101**	**39,679**	**43,054**	**46,554**	**50,054**	**53,554**
Percent of County Total	51.8%	53.1%	54.5%	55.9%	56.9%	57.6%
Average Annual Change in Persons	519	526	675	700	700	700
Average Annual Percent Growth	2.1%	0.8%	1.7%	1.6%	1.5%	1.4%

(1) From Appendix B - Kauai County General Plan, January 2017. Sourced to SMS Research Kauai 2035 General Plan: Socioeconomic Analysis and Forecasts (2014). 2017 figure extrapolated from State of Hawaii Data Book population estimate for Kauai County as of 2015. For 2025, figure is mid-point between 2020 and 2030 projections. 2040 figure taken from DBEDT Series 2040 projection.

(2) From same source as cited in footnote #1. Includes the districts of Lihue and East Kauai (Kawaihau). 2040 figure base on 2035 forecast and same growth rate as for 2030-2035 period.

(3) Intended to be trending marginally higher than DBEDT Series 2040 population projections.

Source: Kauai County General Plan January 2017 appendices, DBEDT "2040 Series", and The Hallstrom Team/CBRE, Inc.

- There are an estimated 19,428 single and multifamily housing units in Lihue/East Kauai, of which 3,428 (or 17.6 percent) are registered as vacation rentals. It is anticipated this percentage will remain generally constant over the long-term as the resort-residential oriented units constructed in the Coconut Plantation community and elsewhere in the region are off-set by expanding standard residential unit inventory.

- There are approximately 16,000 housing units in the study area available for standard residential use (non-resort); of these 13,120 (82 percent) house full-time Kauai resident households, with the remaining 2,880 units (18 percent) used by non-resident second/vacation home owners.

- The current average resident household size in the Lihue to Moloaa Corridor is about 2.94 persons (among the largest for the island) and is forecast to decline in coming decades as a result of evolving family/household trends and an increasingly diverse mix of unit types from new development. By 2040, the average household size in the study area is anticipated to lower to 2.85 persons.

- The median prices for residential product in the Lihue/East Kauai during the first quarter 2017 is shown below.

First Quarter 2017 MLS Median Sale Prices	Residential	Condo	Land
East Kauai (Kawaihau)	$574,000	$418,000	$327,500
% Annual Chg.	5.6%	N/A	N/A
Lihue	$500,000	$277,500	$280,000
% Annual Chg.	6.4%	N/A	23.1%

All sector price indicators have shown meaningful appreciation in recent years and have increased by more than 40 percent since reaching a recessionary nadir in 2009-11. Median prices are anticipated to increase into the long-term as thousands of higher priced new units manifesting the higher costs of land, construction, impact fees and entitlement, are added to the inventory, and appreciation (though cyclical) continues.

- We estimate the demand for new residential (non-TVR) units in the Lihue/East Kauai region through 2040 will total between 6,654 and 8,240 units, with a mid-point of 7,447 units. Single family homes and lots, which are the focus of our analysis, will comprise about 66 percent of the total demand and condominium units some 34 percent.

- We estimate approximately 72 percent of the demand for finished single family homes in the primary study area over the next 24 years will be for houses with a current price of $539,000 or less; approximately the upper-price threshold limit for meeting County affordability standards (140 percent of median household income). For multifamily units, we estimate that 76 percent will need to be priced at $480,000 or less (consistent with household incomes at 140 percent or below of median).

- Excluding Kealia Mauka Homesites, there are 3,766 currently proposed residential units in existing and planned Lihue/East Kauai projects according to the County Planning Department. There is a total of 5,197-cumulative residential and resort-residential units in the Lihue to Moloaa Corridor, with about 30 percent being resort-residential and not likely to meaningfully service the needs of resident family households.

- The subject property is a superior location for the proposed development relative to access, climate, views, topography, shape, size, lack of incompatible nearby uses. The KMH subdivision will meet County planning and infrastructure guidelines and objectives, and provide a quality lifestyle opportunity for large numbers of Kauai residents and households. It will have the attributes necessary to be competitive in the workforce and market single family housing product sectors, and will capture a reasonable market share during its offering period. It will also be somewhat desirable for non-resident second-home purchasers, although less so than projects with large lots, ocean views or in resort communities.

- Based on application of the Gross Demand, Residual Demand and Market Share (or Capture Rate) methods and their correlation we estimate the 236-finished house lots of the Kealia Mauka Homesites subdivision will require about 4.5 years to be fully absorbed following the initial lot closings (tentatively anticipated for 2020).

  Cumulatively, this absorption estimate represents only about 15 percent of total regional demand for residential housing product during the offering period; a moderate readily achievable portion of the larger Lihue/East Kauai market, which could be enlarged if some proposed projects fail to reach fruition.

  Our concluded absorption and home build-out forecasts for KMH inventory is shown below. The master developer currently envisions selling building lots only to individual or bulk purchasers who will construct the finished homes. As such the build-out projections are estimates-only based upon market experience elsewhere in the islands and reasonable allocations. We have not considered the potential for Accessory Dwelling Units ("Ohanas") on the properties.

FORECAST KEALIA MAUKA HOMESITES FINISHED HOUSE LOT ABSORPTION WITH FULL-SELL OUT ACHIEVED WITHIN SEVEN YEARS OF GROUND-BREAKING						
			Finished House Lots Sold/Closed		Finished Single Family Homes Completed (1)	
Year	Project Year	Activity	Annually	Total	Annually	Total
2018	1	Final Approvals, Survey, Clearing and Grubbing of Site				
2019	2	On and Off-Site Infrastructure Commences and is Completed. Lot Pre-Sales Begin Mid-Year.				
2020	3	Initial Lot Sales Closing, Lot Sales Continuing, Initial Vertical Home Construction Commences.	60	60		
2021	4	Lot Sales Continuing, Initial Homes Finished, Home Construction Continues	50	110	20	20
2022	5	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	160	25	45
2023	6	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	210	25	70
2024	7	Lots Are Fully-Absorbed/Sold-Out, More Homes Finished, Home Construction Continues	26	236	25	95
2025 and Beyond		Homes Continue to be Constructed and Finished by Lot Purchasers			141	236

(1) Construction timing of finished single family homes estimated for economic modeling purposes-only as their build-out is outside the purview of the master developer who at this time envisions offering all product as finished house lots only. Full build-out of the subdivision could take decades or could be faster if blocks of lots are taken down by local builders for construction of "spec/tract" homes. Does not include any allowances for possible Accessory Dwelling Units ("ohanas") which may be built on some lots.

Economic Impact Analysis

We have constructed a model depicting the economic impact of the KMH project on the Kauai and Statewide community during its "lifespan" from anticipated ground-breaking in mid to late-2018, through full-absorption/sell-out of the finished lots by 2024, equating to a seven-year project development and sales period. Construction of the homes on the lots would continue for years thereafter.

The model builds on the absorption estimates and data contained in our market study. All estimated amounts are in constant 2017 dollars. We note, that even if the timing of development, absorption of home construction moves from our projections it does not change the resultant outcomes or indicators as the use of constant dollars removes time as a determinant variable. The purpose of the model is to illustrate how capital, jobs, wages, population and business activity will flow over time for planning and budgeting purposes apart from any present value considerations.

- The development of KMH will bring in an estimated $121 million of new, direct capital investment into the Kauai economy along with significant unquantified indirect expenditures and generate $226 million in total new economic activity islandwide during its build-out over a 13-year period (forecast from circa 2018 to 2030). It will contribute some $13.7 million in annual economic activity on a stabilized basis thereafter.

- The construction of the KMH infrastructure and finished single family homes will directly create an estimated 1,048 "worker-years" of employment (the equivalent of 52 work weeks at 40 hours per week) in the trades and supply businesses during build-out, averaging about 81 worker-years annually, with an estimated $55 million in wages (averaging about $4.2 million per year).
- The Community Homeowner's Association, and the upkeep, maintenance, and renovations of the 236 homes, will create 59 worker-years of employment from 2021 through 2030 and associated wages of $3 million. Once stabilized the project will support 15 FTE positions (most made up of many short-term workers) and annual wages of $492,000.
- Associated secondary/off-site employment during the overall development and absorption time-frame will total 262 worker-years with wages of $14.2 million and a stabilized FTE job-count of 5 with total wages of $267,000 per year.
- At build-out the de facto population of the community will be some 700 persons, comprised of 658 full-time Kauai residents and a daily average of some 42 non-resident second-home owners and their guests. The cumulative resident household income during the first 10 years of occupancy (2021 through 2030) will total $99.7 million, and will stabilize at $19.9 million annually thereafter. Discretionary expenditures into Kauai businesses by the KMH population will be some $87 million during build-out and average $12.1 million per year on a stabilized basis.
- The on-going maintenance activities in the community will average $850,000 per year on a stabilized basis.
- Application of the State Input-Output Model macro multipliers depicting direct, indirect and induced economic impacts arising from development of KMH results in significantly higher economic out-flow indicators than those from our direct, subject-specific micro model.
- The total State economic impact from construction of the project would reach $256.5 million, there would be 1,868 total worker-years of jobs created, and the total increase in earnings statewide would be $73.8 million.
- The State model also estimates the total annual economic output from on-going spending and maintenance activity associated with KMH would be at $183.5 million during build-out and $27.1 million annually on a stabilized basis. The total number of worker-years islandwide attributable to the subject dollars flowing through the economy would be 246.7 positions upon stabilization.

The basic economic impact indicators from our modeling of the KMH construction and stabilized "operations" are shown on the following table.

SUMMARY COMPARISON OF MAJOR ECONOMIC IMPACTS FOR THE KEALIA MAUKA HOMESITES COMMUNITY All Amounts Expressed in Constant, Uninflated 2017 Dollars		
Analysis Item	Cumulative During Build-Out Period	Stabilized Annually Thereafter
Direct Capital Investment	$121,012,029	
Local Contractor's Profits	$12,101,203	
Local Supplier's Profits	$4,840,481	
Worker Years of Jobs	1,048	20
Employee Wages	$72,232,526	$759,635
Full-Time Resident Population		658
Total De Facto Population		700
Full-Time Resident Household Income	$99,662,800	$19,932,560
Resident Population Discretionary Expenditures	$87,041,520	$12,132,713
Total Kauai "Base" Economic Impact	$225,952,518	$13,741,947

Source: The Hallstrom Team/CBRE

Secondary Impacts

KMH will have nominal to minor impacts on the socio-economic aspects of the surrounding community that relate to real estate issues.

- The project site is adjacent to existing similar density, moderate single-family development (Kealia Town Subdivision) or otherwise surrounded by vacant lands.
- The lots of KMH will be towards the smaller end of the greater Kapaa size range, which will increase their "affordability" quotient for Kauai families, lessen their demand among non-resident second-home buyers, and not contribute to upward pricing pressures.
- The single-family homes will be consistent in size, quality, and pricing relative to the existing Kealia (mauka) community inventory and should not impact their prices or assessed/appraised values. Values are determined by activity in those projects and regional trending not by a single, new affordable to market-priced development.
- Property values throughout Lihue/East Kauai are largely driven by external, cyclical economic factors within an existing (and expanding) cumulative mass, not any single new project. KMH will not itself, drive regional market values or real property assessments of nearby real estate.
- It is not expected there will be in-migration to Kauai as a direct result of the project. It is primarily intended to provide housing opportunities for families and individuals who are already part of the existing island population base and its natural growth.

Public Fiscal Benefits

Public fiscal impacts, specifically "new" tax dollars and governmental expenditures resulting from the KMH development were estimated using a model of the primary tax receipts which will be generated during the development and stabilized use of the project.

The 658 full-time residents within the community are assumed to be relocating from elsewhere on the island and their government fiscal costs will not be "new" but are already in-place and factored into existing County and State budgets. For these persons KMH will not in itself raise government expenses; however, it may result in reallocation of some spending from one island location to another. We have therefore excluded governmental costs associated with the full-time resident households from the fiscal model.

Similarly, the taxable household income and discretionary spending on Kauai from the full-time resident households is "in-place", already flowing through the Kauai economy and government coffers, and currently being taxed the prevailing context. Again, the spending may be relocated from elsewhere on the island but is not "new" within the local economy. We have therefore excluded the taxation benefits associated with the households from the model.

The only "new" fiscal contributions from the full-time resident households are:

1. Their homes at KMH will add fresh assessments to the County real property tax rolls (while the new owners of their existing homes continue to pay real property taxes); and,

2. The maintenance/renovations associated with the houses will expand general economic activity.

The fiscal impacts associated with the estimated daily average of 42 non-resident, second home owners and their guests at KMH do represent "new" costs and benefits for the State and County. We have estimated these on a "per capita basis". This is based on a conservative assumption that each new person added to the Kauai community is "responsible for" a similar tax cost/obligation as every other person on the island.

We note the "actual" additional costs and impact on services from these part-time residents will be minimal as they will place limited demands on schools, administrative infrastructure, most governmental services or facilities, and are unlikely to push emergency services beyond an expansion-requiring threshold.

- The County of Kauai will realize "new" Real Property Taxes ($5.4 million), and other secondary receipts and development fee totaling $9 million during the 13-year build-out projection period (2018-2030), and $1.3 million annually on a stabilized basis thereafter. These figures incorporate exemptions for real property tax resident owner-occupants.

- The State of Hawaii will receive "new" Gross Excise and Income taxes and secondary revenues, of $12.7 million during the 2018-2030 modeling period, and $276,000 per year thereafter.

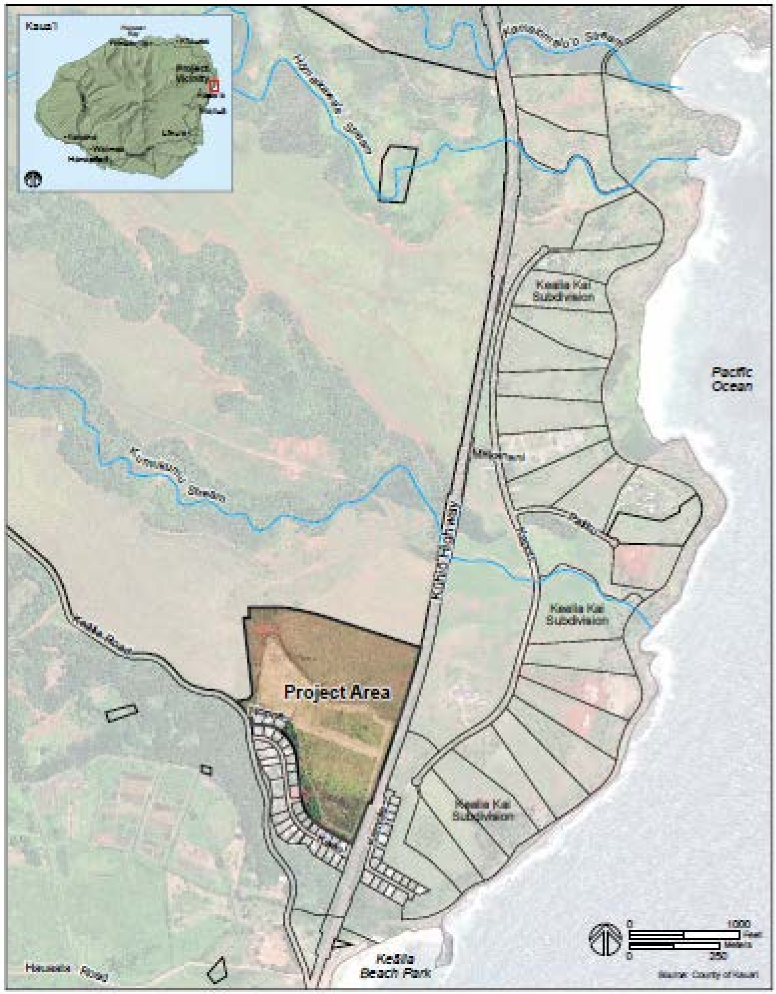
The major economic impacts and "new" public fiscal conclusions are summarized on the following table. The column on the left summarizes the cumulative impacts during the initial 13-year construction and build-out period (2018-2030) covering infrastructure emplacement, lot absorption, home construction and ramp-up to stabilization, and the right-hand column the annual impacts after stabilization.

SUMMARY COMPARISON OF MAJOR PUBLIC FISCAL BENEFITS
FOR THE KEALIA MAUKA HOMESITES COMMUNITY
Accounting for "New" Direct Impacts Only
All Amounts Expressed in Constant, Uninflated 2017 Dollars

Analysis Item	Cumulative During Build-Out Period	Stabilized Annually Thereafter
County of Kauai Gross Tax Receipts	$8,976,178	$1,289,709
State of Hawaii Gross Tax Receipts	$12,745,906	$275,594
County of Kauai Costs of Services (per capita basis)	$471,794	$94,359
State Costs of Services (per capita basis)	$1,775,910	$355,182
County of Kauai Net Benefits or (Loss)	$8,504,384	$1,195,350
State Net Benefits or (Loss)	$10,969,996	($79,588)

Source: The Hallstrom Team/CBRE

The Subject Property and Proposed Project



Project Vicinity Map
Keālia Mauka Homesites
Environmental Impact Statement Preparation Notice
Kealia Properties, LLC

Approximate Outline of Kealia Mauka Homesites Property

The proposed Kealia Mauka Homesites (KMH) subdivision will be a 236-lot master planned single family residential community to be located on some 53.4 acres fronting the mauka (west) side of Kuhio Highway, adjacent to the Kealia Town subdivision, inland from Kealia Beach, on the northerly outskirts of Kapaa Town, Kauai, Hawaii.

The project will offer finished house lots ranging in size from 5,600 square feet to 7,300 square feet, and include 5.86 acres of open space/parks and detention basins. The irregular-shaped site is generally level to slightly sloping, at street-grade, offers distant mountain views and is identified on State of Hawaii Tax Maps as Fourth Division Tax Map Key 4-7-9, Parcels 1 & 2 (portions). The holding is in the East Kauai Development Plan area, towards the northerly end of the "Coconut Coast" corridor, which stretches along the easterly shoreline of the island, it has favorable access characteristics, desirable climate, is proximate to employment and services, and is a natural expansion of the existing greater Kapaa community.

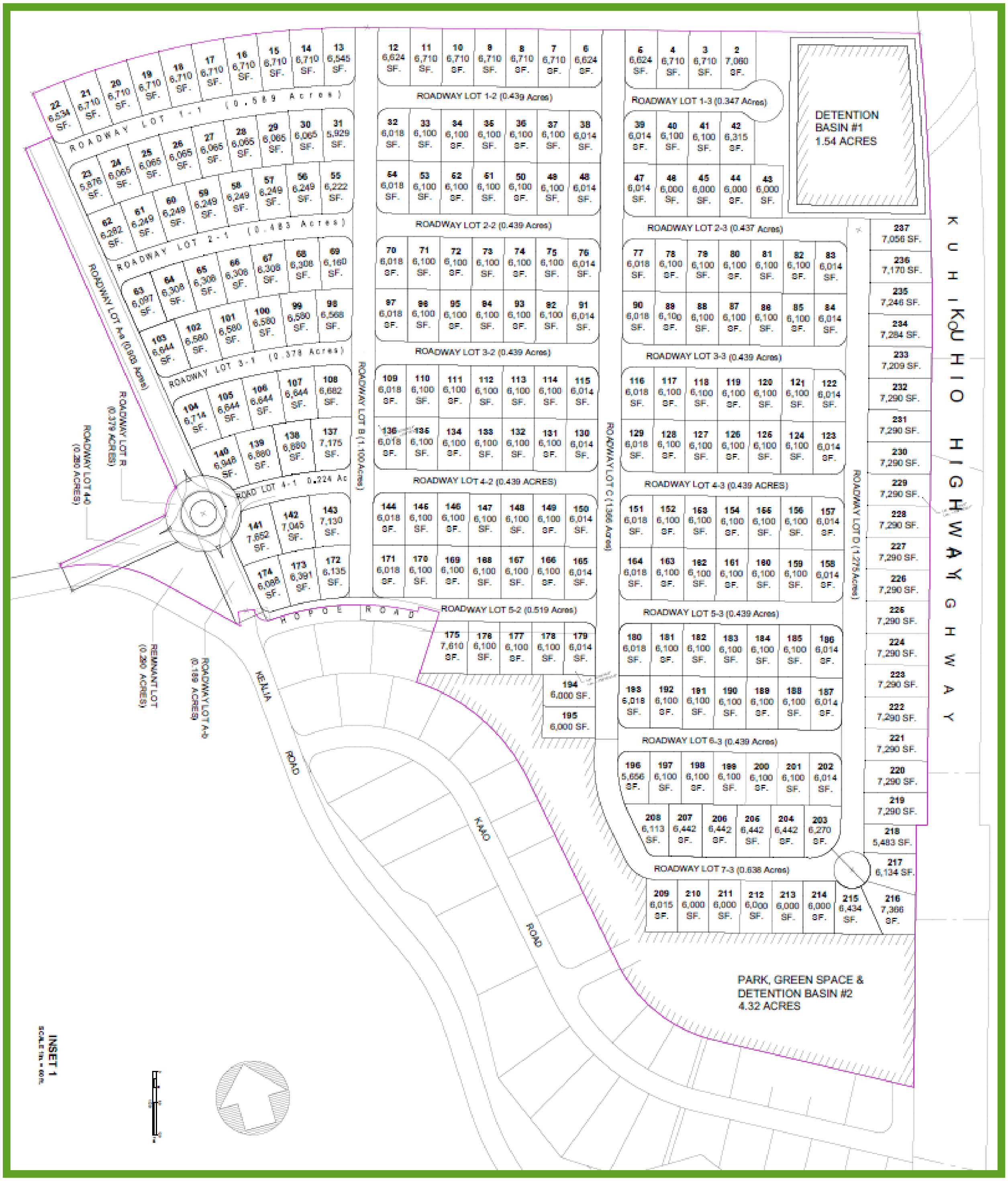
The development will be oriented towards full-time Kauai resident household buyers. Finished house lot prices will be consistent with comparable product elsewhere in the Lihue/East Kauai region with a portion designated for meeting workforce/affordable pricing guidelines established by the County. It is anticipated finished home values will range from "affordable" for low-moderate income households to market-pricing levels. The project will provide new, needed inventory in one of Kauai's primary residential and commercial regions; as a project having an unrestricted market-priced component there will be some non-resident second home/vacation purchasers.

The master developer plans to offer all subject inventory as vacant building lots. The subdivision's houses would be built by individual lot purchasers ("custom" homes) or in blocks by third-party contractors ("spec/tract" homes). Lot/home owners may elect to build an Accessory Dwelling Unit (ADU) on their property as then-permitted by County ordinance, but we have not considered such potentials in our analyses or modeling. Homes will not be permitted to operate as Transient Vacation Rentals (TVRs). There will be a community association with a minimal monthly fee per lot.

The KMH site is currently within the State Land Use Agricultural District, is zoned "Agriculture" by the County of Kauai, and identified for "Residential Community" use on the County Kawaihau/East Kauai Planning District Land Use Map.

At present, it is anticipated the project will be developed in a single phase; however, this objective may be subject to change in accordance with market conditions and other factors.

The proposed current subdivision plan is shown below.


ROADWAY LOT 1-2 (0.439 Acres)
ROADWAY LOT 1-3 (0.347 Acres)
DETENTION BASIN #1 1.54 ACRES
ROADWAY LOT 2-2 (0.439 Acres)
ROADWAY LOT 2-3 (0.437 Acres)
ROADWAY LOT 3-2 (0.439 Acres)
ROADWAY LOT 3-3 (0.439 Acres)
ROADWAY LOT 4-2 (0.439 ACRES)
ROADWAY LOT 4-3 (0.439 ACRES)
ROADWAY LOT 5-2 (0.519 Acres)
ROADWAY LOT 5-3 (0.439 Acres)
ROADWAY LOT 6-3 (0.439 Acres)
ROADWAY LOT 7-3 (0.638 Acres)
ROADWAY LOT B (1.100 Acres)
ROADWAY LOT C (1.366 Acres)
ROADWAY LOT D (1.275 Acres)
ROADWAY LOT R (0.379 ACRES)
ROADWAY LOT 4-0 (0.280 ACRES)
REMNANT LOT (0.290 ACRES)
ROADWAY LOT A-0 (0.189 ACRES)
HOPOE ROAD
KAAO ROAD
KUHIO HIGHWAY
PARK, GREEN SPACE & DETENTION BASIN #2 4.32 ACRES
INSET 1

CBRE

Appropriateness of the Site for the Proposed Development

THE SITE

The KMH project will transform a property that is:

- Currently underutilized and provides no housing, economic or lifestyle benefit to the region.
- Well-located within the East Kauai corridor, nearby Kapaa (the largest town on the island), ten miles from Lihue (the County seat and primary economic area), and mid-way between Hanalei/Princeville and Poipu, two of the major vacation destinations on the island.
- Has easy access to Kuhio Highway, the major thoroughfare in the region.
- Is nearby Kealia Beach, one of the largest white sand strands in East Kauai which (unlike others in the area) is seasonally swimmable.
- Has access to existing infrastructure/utility systems and urban services.
- Is a suitable location for the long-term expansion of the greater Kapaa community given the physical constraints of water courses/wetlands and topographical limitations, without creating isolated, new urban sprawl.
- Is consistent with the Kauai County General Plan Land Use Plan.
- Limited in alternative Highest and Best Use(s).

THE DEVELOPMENT PLAN

Actualization of the KMH development plan will create a regional asset providing:

- Needed affordable to market-priced housing to a broad-spectrum of Kauai households.
- Targeted, appropriately scaled, efficient lots/homes which should reduce interest by non-resident/second-home purchasers.
- Support for existing Kapaa business and enhanced demand for "neighborhood-type" commercial and industrial services; strengthening existing businesses, promoting business expansion, and supporting new business formation; all contributing economic activity, employment, taxes and the critical mass of the region.
- Significant "worker years" of employment for East Kauai contractors and tradespeople; many of whom otherwise must commute meaningful distances to job sites.
- An expanded real property and other tax base.
- 5.8 acres of park and open spaces.

THE MARKET CONTEXT

From a market overview perspective, the proposed development will have the necessary attributes to be compatible with, and competitive within, the Lihue/East Kauai real estate sector:

- *It will offer new high-demand single-family product at affordable to mid-market prices which are in limited supply in the study area*. The KMH homes will appeal to many resident households which comprise the broadest (base) portion of the housing demand pyramid.
- *It is within a market area (East Kauai) which has had limited new major residential development in recent years*. This has resulted in an aging housing inventory, estimated at an average of some 25-plus years, that is increasingly costly to maintain, fails to meet the evolving demographic needs of area households, and does not reflect modern design/planning and materials standards.
- *Its location in East Kauai will be desirable within the island-wide market*. The resident population of the Lihue to Moloaa corridor is anticipated to increase by up to 15,000 persons over the next quarter century. While a significant share of housing demand in the area will be focused towards Lihue, where much of the regional employment growth and many of the new units will be built in coming years, the high price of market inventory coupled with demand from non-resident purchasers, will preclude many resident households from obtaining units proximate to Kapaa employment centers. And, the relatively high cost of land, difficulties in obtaining entitlements, shortage of systems/services, creates a barrier for new development and limits the potential for affordable to mid-market priced projects.
- *In concert with market trends*. Larger developments have been part of the Hawaii real estate market for many decades, and they have generally provided higher-quality, more desirable housing and lifestyle opportunities than in standard small subdivisions. Such planned projects in the State and on Kauai have been traditionally oriented towards resort and upper-end development; however, there are newer projects in-construction and proposed on the neighbor islands which are seeking to provide more diverse product types at lower costs to better service households in the moderate-income range.
- *Maximize the reasonable development potentials of a well-located parcel*. Given the locational and access attributes of the subject property, within the context of long-term expansion of greater Kapaa, and the housing and economic benefits which will flow to Kauai from the project, the proposed plan is a reasonable confluence of market and general community objectives.

APPROPRIATENESS CONCLUSION

Our market-based analysis regarding the proposed KMH project indicates:

- The subject site is an appropriate location for low-intensity residential development.
- The proposed plan will result in a community offering a desirable lifestyle.
- Its finished inventory can be competitive in and well-received by the market.
- It is representative of a highest and best use of the property.
- There are no reasonable economic alternative mid to long-term uses evident.

Market Study of the Proposed Kealia Mauka Homesites Project

The tables containing the contributory data, analysis models, and results, excerpts from which are presented and summarized in this section, are contained in Addenda Exhibit A.

RESIDENTIAL UNIT DEMAND IN THE GENERAL STUDY AREA

The study area of our assignment stretches from Lihue to Moloaa, a 16-mile near-coastal and lower elevation corridor along the easterly shoreline of Kauai. It includes residential, agricultural, visitor-oriented, and commercial/industrial development, with Lihue and Kapaa being the largest and most urbanized communities in the region.

In 2010, the census counted 34,467 residents in the study area, or 51.4 percent of the county total. By the first quarter of 2017, the estimated population of the region had grown to 38,101 persons and 51.8 percent of the island total. Population growth was limited by lack of available housing supply more so than demand.

Two series of projections were used as the basis for our population and housing demand estimates, with the first being given most weight in our analysis:

1. "*Kauai County General Plan Kakaou – Appendices*" dated January 2017; specifically, Appendix B and Appendix D. These models have a planning horizon extending to 2035 and provide data and forecasts for the six individual planning districts comprising the island.

2. The State of Hawaii Department of Business Economic Development and Tourism "*2040 Series Report*" with population projections, historic trending, and anticipated economic expansions extending to 2040 (our projection horizon). The forecasts for Kauai are only on an island-wide basis.

As previously stated, our projections extend to 2040, or circa 22.5 years from the study date, this is to provide sufficient leeway in our modeling efforts and to illustrate potential impacts should the timing of KMH slip beyond its currently envisioned time-line.

As shown on the following table, we forecast the resident population in the Lihue to Moloaa Corridor (or greater East Kauai), our primary study area, will increase by 2040 to between 51,650 persons (a gain of 35.6% from our 2017 estimate) and 53,554 persons (up 40.6%).

HISTORIC, CURRENT AND PROJECTED RESIDENT POPULATION TOTALS FOR THE STATE, COUNTY AND LIHUE/EAST KAUAI STUDY AREA 2017 TO 2040	2017	2020	2025	2030	2035	2040
State Total (DBEDT Series 2040)	1,457,600	1,481,240	1,543,240	1,602,340	1,657,500	1,708,920
Average Annual Change in Persons	13,426	4,728	12,400	11,820	11,032	10,284
Average Annual Percent Growth	1.4%	0.3%	0.8%	0.8%	0.7%	0.6%
Kauai County General Plan (1)	73,485	74,693	79,011	83,328	88,013	93,020
Percent of State Total	5.0%	5.0%	5.1%	5.2%	5.3%	5.4%
Average Annual Change in Persons	913	242	864	864	937	1,001
Average Annual Percent Growth	1.9%	0.3%	1.2%	1.1%	1.1%	1.1%
DBEDT Forecasts 2040 Series		75,640	80,000	84,380	88,730	93,020
Persons Variance From Kauai GP		947	990	1,052	717	0
Percent Variance From Kauai GP		1.3%	1.3%	1.3%	0.8%	0.0%
Study Area (Lihue and East Kauai)						
1. Minimum Perspective (1, 2)	38,101	39,009	42,366	45,723	48,566	51,650
Percent of County Total	51.8%	52.2%	53.6%	54.9%	55.2%	55.5%
Average Annual Change in Persons	519	303	671	671	569	617
Average Annual Percent Growth	2.1%	0.5%	1.7%	1.6%	1.2%	1.3%
2. Maximum Perspective (3)	38,101	39,679	43,054	46,554	50,054	53,554
Percent of County Total	51.8%	53.1%	54.5%	55.9%	56.9%	57.6%
Average Annual Change in Persons	519	526	675	700	700	700
Average Annual Percent Growth	2.1%	0.8%	1.7%	1.6%	1.5%	1.4%

(1) From Appendix B - Kauai County General Plan, January 2017. Sourced to SMS Research Kauai 2035 General Plan: Socioeconomic Analysis and Forecasts (2014). 2017 figure extrapolated from State of Hawaii Data Book population estimate for Kauai County as of 2015. For 2025, figure is mid-point between 2020 and 2030 projections. 2040 figure taken from DBEDT Series 2040 projection.

(2) From same source as cited in footnote #1. Includes the districts of Lihue and East Kauai (Kawaihau). 2040 figure base on 2035 forecast and same growth rate as for 2030-2035 period.

Our "Minimum Perspective/Scenario" population estimate is fully consistent with the forecasts made in Appendix B of the 2017 Kauai General Plan update materials through 2035, as shown below. Out "Maximum Perspective/Scenario" is more reflective of the DBEDT Series 2040 projections which trend upwards at one percent higher than the General Plan figures.

STUDY AREA RESIDENT POPULATION FORECAST LIHUE TO MOLOAA CORRIDOR — Forecast	2035
The Hallstrrom Team/CBRE	
Minimum Scenario	48,566
Percent of County	55.2%
Maximum Scenario	53,554
Percent of County	56.9%
County General Plan Appendix B	48,566
Percent of County	55.2%

Note: 2035 selected for comparison year as that is as far as County forecasts extend. Our model projections extend to 2040.

At present, there is an estimated 19,428 "standard" residential and resort-residential housing units in the study area, with 3,428 units (17.6 percent) being registered Transient Vacation Rentals (TVRs) and unavailable for meeting standard residential housing needs.

Of the approximately 16,000 available standard residential units in Lihue/East Kauai, 13,120 units (or 82 percent) are occupied/available for full-time Kauai households and the remaining 2,880 units (18% of the standard inventory) are owned by non-resident second-home owners and not available to meet local resident housing needs; a percentage which has shown steady growth over the years. Apart from restricted ownership provisions within some designated workforce housing/affordable-priced development, all projects offering market-priced product will have some degree of non-resident purchasers which must be accounted for in forecasting future inventory demands.

We have projected the housing demand which will be associated with the expanding regional population to 2040 based on the following assumptions:

- Anticipated declining average household size from a current level of 2.94 persons to 2.85 persons over the next quarter-century;
- An increasing share of units being used by non-residents and visitors, moving upwards to between 23 to 26 percent of total resident housing demand; and
- The inclusion of a nominal "vacancy allowance" of 2 to 3 percent, to provide for household movement, units closed for rehabilitation, and promote market stability.

Our forecast model estimates demand for new housing units in Lihue/East Kauai will range from 6,654 to 8,240 units by 2040, with a mid-point of 7,447 units, as shown following.

QUANTIFICATION OF HOUSING UNIT DEMAND FOR THE
LIHUE-EAST KAUAI STUDY AREA 2017 TO 2040

	2017	2020	2025	2030	2035	2040	Additional Units Required by 2040
Scenario One: Minimum Based on Appendix B - Kauai General Plan Projections							
Resident Population	38,101	39,009	42,366	45,723	48,566	51,650	
Average Household Size (1)	2.94	2.93	2.91	2.89	2.87	2.85	
Total Resident Units Required	12,959	13,314	14,559	15,821	16,922	18,123	
Vacancy Allowance (2 % of resident unit demand)	259	266	291	316	338	362	
Non-Resident Purchaser Allowance (2) (23% Stabilized of resident unit demand)	2,981	3,062	3,349	3,639	3,892	4,168	
TOTAL MARKET UNIT DEMAND	16,199	16,642	18,198	19,776	21,152	22,654	6,654
Scenario Two: Maximum Based on DBEDT Series 2040 Projections and Marginally Higher Trending							
Resident Population	38,101	39,679	43,054	46,554	50,054	53,554	
Average Household Size (1)	2.94	2.93	2.91	2.89	2.87	2.85	
Total Resident Units Required	12,959	13,542	14,795	16,109	17,440	18,791	
Vacancy Allowance (2% to 3% of resident unit demand)	259	305	370	443	523	564	
Non-Resident Purchaser Allowance (2) (23% to 26% of resident unit demand)	2,981	3,115	3,551	3,947	4,360	4,886	
TOTAL MARKET UNIT DEMAND	16,199	16,962	18,716	20,498	22,324	24,240	8,240

CONCLUDED HOUSING UNIT DEMAND RANGE

	2017	2017-2020	2021-2025	2026-2030	2031-2035	2036-2040	Totals
MINIMUM DEMAND							
Periodic	199	443	1,556	1,578	1,376	1,501	6,654
Cumulative	199	692	2,331	3,909	5,285	6,786	
Average Annual Demand (3)		164	328	316	275	300	
MAXIMUM DEMAND							
Periodic	199	762	1,754	1,782	1,825	1,916	8,240
Cumulative	199	1,011	2,849	4,631	6,456	8,373	
Average Annual Demand (3)		271	367	356	365	383	
MID-POINT DEMAND							
Periodic	199	603	1,655	1,680	1,601	1,709	7,447
Cumulative	199	852	2,590	4,270	5,871	7,580	
Average Annual Demand (3)		217	348	336	320	342	

(1) Census data for 2011 -2015 reported average resident household size for Primary Study Area in ranged from 2.68 persons in Wailua Homesteads CDP to 3.15 in Lihue CCD, with average of about 2.90 to 2.95 persons. County Planners estimated East Kauai wil have average household size of 2.95 in 2020. We have used 2.94 persons as current figure and starting point for our trend analysis.

(2) There were an estimated 19,428 total residential and resort-residential units in the Lihue to Moloaa Corridor (East Kauai) as of the second quarter of 2017. These included 3,428 registered TVR units and 16,000 residential units, of which 13,120 units (82% of total residential inventory) are occupied/available for full-time resident Kauai households and 2,880 (18% of inventory) are owned by non-Kauai residents (second homes).

(3) Existing (or latent) demand is assumed absorbed evenly from 2017 though 2025.

Source: US Census, County of Kauai, DBEDT and The Hallstrom Team/CBRE.

Again, our figures for 2035 are generally consistent with the adjusted County/SMS 2014 technical study output.

STUDY AREA HOUSING DEMAND FORECAST LIHUE TO KEKAHA CORRIDOR Forecast	2035
The Hallstrrom Goup, Inc.	
Minimum	4,953
Maximum	6,124
County Technical Studies (SMS) (1)	6,139

(1) Adjusted for period between 2014 forecasts and 2017 study date.

Note: 2035 selected for comparison year as that is as far as County forecasts extend. Our model projections extend to 2040.

Having established there will be demand for a significant number of new housing units in the study area, we striated the demand according to unit mix (single family versus multifamily) and unit pricing (for single family product). We also present a summary of census data that contributed to our analysis and a brief discussion of other in-development projects offering single family inventory in the study area.

1. Unit Mix

Presently, about 70 percent of the housing stock from Lihue to Moloaa is in single family homes and 30 percent is multifamily units; with most of the latter being concentrated in Lihue, the Coconut Plantation community and Kapaa.

It is anticipated that as land costs increase, housing prices continue rising, the population ages, and newer master planned developments are built-out more of the new housing inventory will be multifamily, with a 66 percent single family and 34 percent multifamily mix forecast by 2036 to 2040, as shown. The proportionate increase in multifamily units relative to single family homes is anticipated will be slightly less in the study area than in South Kauai and the North Shore.

Our analysis is focused on the projected demand for between 4,403 and 5,454 single family housing opportunities in Lihue/East Kauai from 2017 through 2040.

DIVISION OF PROJECTED DEMAND BY UNIT TYPE FOR HOUSING UNITS IN LIHUE-MOLOAA STUDY AREA 2017 TO 2040	2017 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	Total Demand 2017-2040
1. Using Minimum Demand Projections						
Single Family Homes	391	1,115	1,041	894	961	4,403
Percent of Total	70%	68%	66%	65%	64%	66%
Multifamily Units	168	525	536	482	540	2,251
Percent of Total	30%	32%	34%	35%	36%	34%
Total	559	1,639	1,578	1,376	1,501	6,653
	100%	100%	100%	100%	100%	100%
2. Using Maximum Demand Projections						
Single Family Homes	615	1,249	1,176	1,187	1,227	5,454
Percent of Total	70%	68%	66%	65%	64%	66%
Multifamily Units	264	588	606	639	690	2,786
Percent of Total	30%	32%	34%	35%	36%	34%
Total	879	1,837	1,782	1,825	1,916	8,240
	0%	0%	0%	0%	0%	0%
Mid-Point						
Single Family Homes	503	1,182	1,109	1,040	1,094	**4,928**
Multifamily Units	216	556	571	560	615	**2,519**
Total	719	1,738	1,680	1,601	1,709	7,447

Source: The Hallstrom Team/CBRE, Inc.

2. Unit Pricing

We have allocated the demand for single-family housing units at various price points based on:

- County/HUD 2017 "affordability" pricing and rental criteria for households making 140 percent or less of the median Kauai household income.
- Conventional financing standards for other households.
- Analysis of the proposed supply.
- Historic and forecast trends in the ratio between Kauai household income and housing prices.
- Acknowledgement of the impact of non-resident purchasers on market pricing.

The County of Kauai Housing Agency has released the 2017 median household income estimates, the pricing criteria to be used in assessing "for sale" housing unit affordability on the island. Their results are shown on the following tables (taken from their website. The "For Sale Price" refers to single-family homes, the "CPR Sales Price" refers to multifamily/condominium units.

The median household income for a family of four on Kauai for 2017 is estimated at $79,200.

COUNTY OF KAUAI
2017 ANNUAL INCOME LIMITS

Effective: 4/14/2017
Kauai Median Household Income: $79,200

Household Size:	1	2	3	4	5	6	7	8
HUD Income Limits*:								
30% Limits (Extremely Low)	17,950	20,500	23,500	28,300	33,100	37,950	42,750	47,550
50% Limits (Very Low)	29,900	34,150	38,400	42,650	46,100	49,500	52,900	56,300
60% Limits	35,880	40,980	46,080	51,180	55,320	59,400	63,480	67,560
80% Limits (Low)	47,800	54,600	61,450	68,250	73,750	79,200	84,650	90,100
Workforce Housing Income Limits*:								
100% Limits	55,450	63,400	71,300	79,200	85,550	91,900	98,250	104,550
120% Limits	66,550	76,050	85,550	95,050	102,700	110,300	117,900	125,500
140% Limits	77,650	88,750	99,850	110,900	119,800	128,650	137,550	146,400
Gap Group Income Limits*:								
160% Limits	88,750	101,400	114,100	126,750	136,900	147,050	157,150	167,300
180% Limits	99,800	114,100	128,350	142,600	154,000	165,400	176,800	188,250

*Annual income limits are rounded upwards to the nearest $50

COUNTY OF KAUAI
FOR SALE LIMITS BY BEDROOM COUNT

Effective: 4/14/2017
Kauai Median Household Income: $79,200
4.25%

Bedroom Size:		Studio	1-Bedroom	2-Bedroom	3-Bedroom	4-Bedroom	5-Bedroom
HUD Income Limits:							
30% Limits (Extremely Low)	For Sale Price	42,400	49,200	72,000	110,450	149,100	187,600
	CPR Sale Price	-	6,650	29,300	67,800	106,500	144,900
50% Limits (Very Low)	For Sale Price	106,200	117,550	151,500	183,400	210,800	238,000
	CPR Sale Price	63,500	74,850	108,900	140,700	168,100	195,300
80% Limits (Low)	For Sale Price	201,700	219,850	274,500	304,150	369,300	412,850
	CPR Sale Price	159,000	177,150	231,800	282,800	326,600	370,150
Work Force Housing Income Limits:							
100% Limits	For Sale Price	242,500	263,700	327,100	386,200	437,000	487,700
	CPR Sale Price	199,800	221,050	284,400	343,500	394,300	445,000
120% Limits	For Sale Price	301,800	352,400	403,100	474,200	535,200	596,050
	CPR Sale Price	259,100	309,800	360,400	431,550	492,500	553,350
140% Limits	For Sale Price	361,000	390,600	479,400	562,150	633,100	704,200
	CPR Sale Price	318,300	347,900	436,800	519,450	590,400	661,500
Gap Group Income Limits:							
160% Limits	For Sale Price	420,200	453,950	555,500	650,050	731,300	812,300
	CPR Sale Price	377,500	411,250	512,800	607,400	688,600	769,600
180% Limits	For Sale Price	479,200	517,350	631,500	738,000	829,200	920,550
	CPR Sale Price	436,500	474,650	588,800	695,300	786,500	877,950

*For sale prices are rounded upwards to the nearest $100, is based on a conventional 30-year fixed rate mortgage, and assumes the following:

Assumptions

30-Year Fixed Interest Rate:	4.25%
Monthly Property Tax and Home Insurance:	$250
Monthly Maintenance and Association Fees for CPR:	$200
Down Payment:	5.00%

CBRE

COUNTY OF KAUAI
FOR SALE LIMITS BY FAMILY SIZE

Effective: 4/14/2017
Kauai Median Household Income: $79,200

4.25%

Household Size:		1	2	3	4	5	6	7	8
HUD Income Limits:									
30% Limits (Extremely Low)	**Annual Income**	**17,950**	**20,500**	**23,500**	**28,300**	**33,100**	**37,950**	**42,750**	**47,550**
	For Sale Price	42,400	56,000	72,000	97,600	123,300	149,100	174,800	200,400
	CPR Sale Price	-	13,300	29,300	55,000	80,600	106,500	132,100	157,700
50% Limits (Very Low)	**Annual Income**	**29,900**	**34,150**	**38,400**	**42,650**	**46,100**	**49,500**	**52,900**	**56,300**
	For Sale Price	106,200	128,900	151,500	174,200	192,600	210,800	228,900	247,100
	CPR Sale Price	63,500	86,200	108,900	131,500	149,900	168,100	186,200	204,400
80% Limits (Low)	**Annual Income**	**47,800**	**54,600**	**61,450**	**68,250**	**73,750**	**79,200**	**84,650**	**90,100**
	For Sale Price	201,700	238,000	274,500	310,800	340,200	369,300	398,300	427,400
	CPR Sale Price	159,000	195,300	231,800	268,100	297,500	326,600	355,600	384,700
Work Force Housing Income Limits:									
100% Limits	**Annual Income**	**55,450**	**63,400**	**71,300**	**79,200**	**85,550**	**91,900**	**98,250**	**104,550**
	For Sale Price	242,500	284,900	327,100	369,300	403,100	437,000	470,900	504,500
	CPR Sale Price	199,800	242,300	284,400	326,600	360,400	394,300	428,200	461,800
120% Limits	**Annual Income**	**66,550**	**76,050**	**85,550**	**95,050**	**102,700**	**110,300**	**117,900**	**125,500**
	For Sale Price	301,800	352,400	403,100	453,800	494,600	535,200	575,800	616,300
	CPR Sale Price	259,100	309,800	360,400	411,100	452,000	492,500	533,100	573,600
140% Limits	**Annual Income**	**77,650**	**88,750**	**99,850**	**110,900**	**119,800**	**128,650**	**137,550**	**146,400**
	For Sale Price	361,000	420,200	479,400	538,400	585,900	633,100	680,600	727,800
	CPR Sale Price	318,300	377,500	436,800	495,700	543,200	590,400	637,900	685,100
Gap Group Income Limits:									
160% Limits	**Annual Income**	**88,750**	**101,400**	**114,100**	**126,750**	**136,900**	**147,050**	**157,150**	**167,300**
	For Sale Price	420,200	487,700	555,500	623,000	677,100	731,300	785,200	839,400
	CPR Sale Price	377,500	445,000	512,800	580,300	634,500	688,600	742,500	796,700
180% Limits	**Annual Income**	**99,800**	**114,100**	**128,350**	**142,600**	**154,000**	**165,400**	**176,800**	**188,250**
	For Sale Price	479,200	555,500	631,500	707,600	768,400	829,200	890,000	951,100
	CPR Sale Price	436,500	512,800	588,800	664,900	725,700	786,500	847,400	908,500

*For sale prices are rounded upwards to the nearest $100, is based on a conventional 30-year fixed rate mortgage, and assumes the following:

Assumptions

30-Year Fixed Interest Rate:	4.25%
Monthly Property Tax and Home Insurance:	$250
Monthly Maintenance and Association Fees for CPR:	$200
Down Payment:	5.00%

Prepared by the Kauai County Housing Agency

Unlike in past years, the County has not released affordable pricing guidelines for vacant house lots, as will be offered at KMH. We have estimated the appropriate affordable lot prices based on application of formulae used in past years to 2017 income levels, with the results as shown following.

ESTIMATE OF AFFORDABLE PRICING FOR A KAUAI HOUSE LOT BASED ON FAMILY INCOME ASSUMING FAMILY OF FOUR				
Household Income As a Percent of Median Income	Household Income For Family of Four	Affordable Price for Single Family Home at 4.25 Percent Mortgage Interest Rate (1)	Percent of Total Home Price Available for Lot Purchase (2)	Affordable Finished House Lot Price for Income Group
80%	$68,250	$310,800	32%	**$100,000**
100%	$79,200	$369,300	32%	**$120,000**
120%	$95,050	$453,800	32%	**$150,000**
140%	$110,900	$538,400	32%	**$170,000**

(1) From "County of Kauai For Sale Limits by Family Size" assuming 4.25% 30-Year Fixed Interest Rate.
(2) Extrapolated from 2016 County of Kauai Affordable Pricing Guidelines.

Source: County of Kauai Housing Agency and The Hallstrom Team/CBRE.

The median sales prices for housing units within the greater study area during the first quarter of 2017 were as shown.

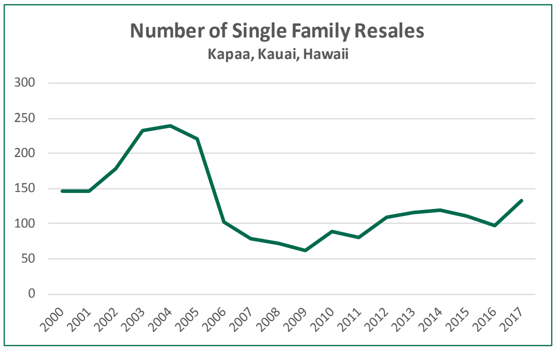
First Quarter 2017 MLS Median Sale Prices	Residential	Condo	Land
East Kauai (Kawaihau)	$574,000	$418,000	$327,500
% Annual Chg.	5.6%	N/A	N/A
Lihue	$500,000	$277,500	$280,000
% Annual Chg.	6.4%	N/A	23.1%

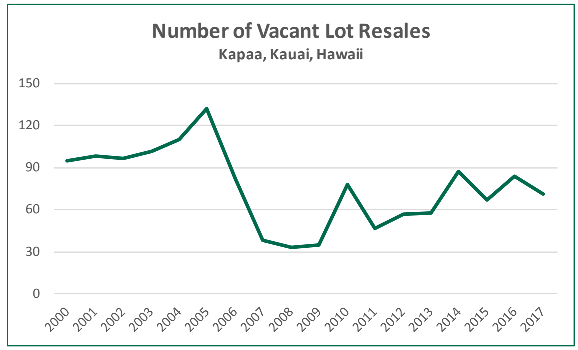
In general, the Lihue/East Kauai regional market serves the median (100% income households) and gap group (up to 140% of County median) somewhat functionally for larger households. However, inventory is limited for those families earning below the median level.

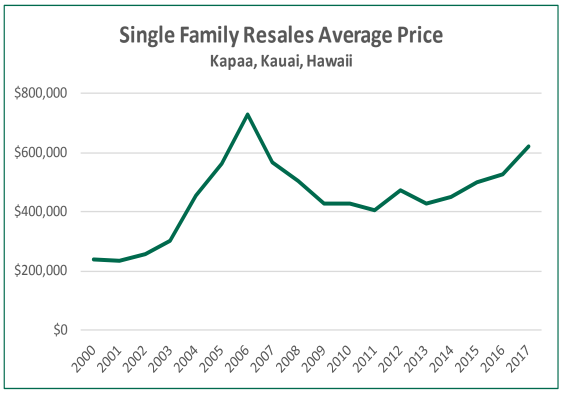
The Kauai Board of Realtors Multiple Listing Data for single family homes and vacant lots in the Kapaa area (the primary market area) for the period 2000 through mid-May 2017 are summarized following. We note the land/vacant lot category also includes bulk acreage, agricultural and development sites in addition to house lots, skewing some indicators (notably average prices).

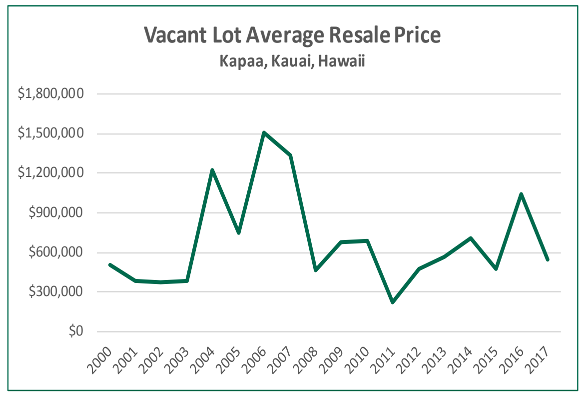
KAUAI MLS LAND/VACANT LOT STATISTICS KAPAA, KAUAI, HAWAII			
Year	# of Sales	Sales Average	Sales Volume
2000	95	$500,639	$47,560,693
2001	98	$386,182	$37,845,864
2002	97	$375,950	$36,467,197
2003	102	$379,878	$38,747,530
2004	110	$1,218,468	$134,031,430
2005	132	$747,437	$98,661,655
2006	82	$1,510,082	$123,826,691
2007	38	$1,339,125	$50,886,750
2008	33	$461,932	$15,243,767
2009	35	$681,310	$23,845,833
2010	78	$688,631	$53,713,248
2011	47	$221,575	$10,414,005
2012	57	$474,157	$27,026,973
2013	58	$570,196	$33,071,373
2014	87	$706,660	$61,479,392
2015	67	$475,073	$31,829,908
2016	84	$1,042,211	$87,545,689
2017	22	$548,736	$12,072,196
Compiled by CBRE			

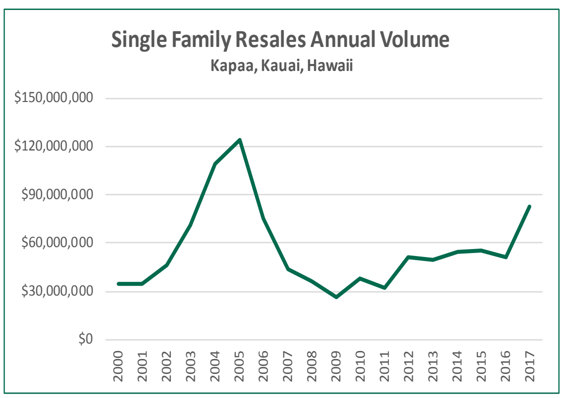
KAUAI MLS SINGLE FAMILY STATISTICS KAPAA, KAUAI, HAWAII			
Year	# of Sales	Sales Average	Sales Volume
2000	147	$237,996	$34,985,350
2001	147	$234,726	$34,504,785
2002	179	$256,233	$45,865,755
2003	233	$304,722	$71,000,163
2004	240	$455,236	$109,256,621
2005	220	$563,580	$123,987,549
2006	103	$727,703	$74,953,379
2007	78	$566,299	$44,171,297
2008	72	$504,649	$36,334,737
2009	62	$428,978	$26,596,655
2010	89	$429,467	$38,222,600
2011	80	$406,492	$32,519,393
2012	109	$473,773	$51,641,276
2013	116	$427,212	$49,556,582
2014	120	$451,082	$54,129,800
2015	111	$499,122	$55,402,585
2016	97	$527,380	$51,155,877
2017	41	$619,591	$25,403,249
Compiled by CBRE			

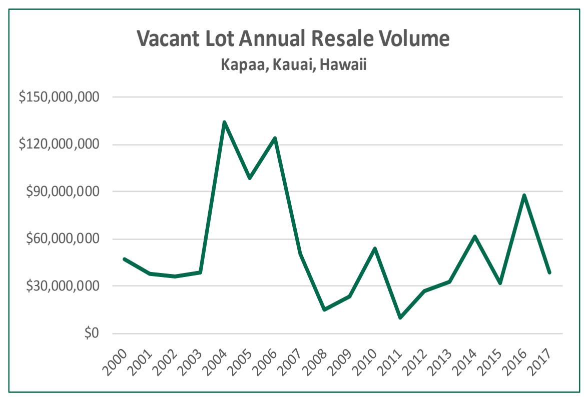












Based on our analysis we project the following price striations for single family homes would best serve market demand in the study corridor between 2017 and 2040, with:

- Approximately 27 percent of inventory needing to be priced at less than $311,000 (current price/2017 constant dollars) which would be affordable to families making 80 percent of Kauai median household income;
- Some 45 percent of inventory will need to be priced between $311,000 and $539,000 which would be affordable for purchasers earning 81 percent to 140 percent of Kauai median household income; and,
- About 28 percent of demand will be for market-priced homes above $539,000.

We note, it is very common on Kauai (and throughout Hawaii) for households to purchase units well-above their quantified affordability quotient using equity/profit from their prior home ownership, loans and monetary gifts from family members ("generational equity"), atypical financing arrangements and other methods.

STRIATED PROJECTIONS OF SINGLE FAMILY HOUSING UNIT DEMAND
BY SELLING PRICE IN THE LIHUE-MOLOAA STUDYAREA 2017 TO 2040

Expressed in Constant 2017 Dollars

Period	2017 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	Total Demand 2017-2040
1. Minimum Demand Forecasts						
Less Than $311,000 (1)	110	307	281	237	250	1,184
Percent of Total Demand	28.00%	27.50%	27.00%	26.50%	26.00%	26.90%
$311,000 to $539,000 (2)	172	496	469	407	442	1,986
Percent of Total Demand	44.00%	44.50%	45.00%	45.50%	46.00%	45.10%
$539,000 to $1,000,000	86	245	229	197	211	969
Percent of Total Demand	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%
Over $1,000,000	23	67	62	54	58	264
Percent of Total Demand	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Total Market Demand	391	1,115	1,041	894	961	4,403
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
2. Maximum Demand Forecasts						
Less Than $311,000 (1)	172	344	318	314	319	1,467
Percent of Total Demand	28.00%	27.50%	27.00%	26.50%	26.00%	26.89%
$311,000 to $539,000 (2)	271	556	529	540	564	2,460
Percent of Total Demand	44.00%	44.50%	45.00%	45.50%	46.00%	45.11%
$539,000 to $1,000,000	135	275	259	261	270	1,200
Percent of Total Demand	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%
Over $1,000,000	37	75	71	71	74	327
Percent of Total Demand	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Total Market Demand	615	1,249	1,176	1,187	1,227	5,454
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

First Quarter 2017 MLS Median Sale Prices

	Residential	Condo	Land
Kawaihau	$574,000	$418,000	$327,500
% Annual Chg.	5.6%	N/A	N/A
Lihue	$500,000	$277,500	$280,000
% Annual Chg.	6.4%	N/A	23.1%

(1) This price is considered "affordable" for four-person households earning 80% of the median county household income ("Low Income").
(2) This price is considered "affordable" for four-person households earning from 81% to 140% of county median (includes "Below Moderate" to "Gap Income" categories).

Source: Kauai County, DBEDT, MLS and The Hallstrom Team/CBRE, Inc.

3. Census Data

The 2011 through 2015 census data for the "Census Designated Places" (CDP) and "Census County Divisions" (CCD) comprising the Lihue/East Kauai study region are summarized as shown following. The variance/range for the analyzed factors is in most cases large. Our primary focus are the indicators associated with the Lihue and Kapaa CCDs, and the overall County.

These factors formed the basis for many of our market and economic modeling assumptions.

SELECTED STUDY AREA CDP/CCP 2011-2015 CENSUS DATA						
Census Designated Place (CDP) & Census County Division (CCD)	Wailua Homesteads CDP	Lihue CCD	Kapaa CCD	Wailua CDP	Wailua-Anahola CCD	Kauai County
Number of Housing Units	2,268	2,555	3,545	1,409	5,591	30,328
Percent Second Home Owner	8.3%	11.8%	23.2%	32.8%	18.2%	18.9%
Percent of Housing Units						
Single Family	92.4%	66.6%	64.0%	56.4%	82.4%	69.4%
Multifamily	7.6%	33.4%	36.0%	43.6%	17.6%	30.6%
Median Value of Owner-Occupied Units	$591,400	$458,700	$426,300	$432,100	$541,300	$480,600
Median Gross Monthly Rent	$1,425	$1,235	$1,273	$1,519	$1,451	$1,267
Median Household Income	$69,527	$59,640	$63,609	$67,425	$66,384	$65,101
Percent of Resident Occupied Housing Units						
Owner-Occupied	66.9%	60.1%	55.6%	60.5%	66.5%	61.6%
Renter Occupied	33.1%	39.9%	44.4%	39.5%	33.5%	38.4%
Total Households	2,080	2,254	2,724	947	4,573	22,405
Average Household Size						
Owner-Occupied Households	2.77	3.08	3.23	2.45	2.90	3.14
Renter Households	2.51	3.25	2.92	3.16	2.68	2.96
Average	2.68	3.15	3.09	2.73	2.83	3.07

Source: US Census, and The Hallstrom Team/CBRE, Inc.

4. Comparable Project Indicators

There have been few subdivisions selling lots-only (not finished homes) on Kauai over the past decade. The most recent offering has been Puakea I, the first phase of a proposed 125-lot subdivision being developed by Grove Farm just west of downtown Lihue. The 24 lots were reserved upon offering and all closed earlier this year as shown below. To discourage speculation and purchase by non-Kauai households, the deeds have a provision splitting any profits between the homeowner and Grove Farm should they be sold within five years.

SUMMARY OF PUAKEA 1 SUBDIVISION VACANT LOT SALES BY GROVE FARM, LIHUE					
Taxkey	Sale Date	Land Area-SF	Sales Price	Price per Square Foot	Sale Grantee
4-3-3-20-1	4/28/2017	10,894	$311,500	$28.59	MATSUMURA, MICHAEL TERU
4-3-3-20-2	5/15/2017	11,879	$319,000	$26.85	METIVIER, CHARLES JEAN
4-3-3-20-3	4/28/2017	8,002	$269,000	$33.62	KUNIMURA, KARENE
4-3-3-20-4	5/3/2017	10,215	$284,000	$27.80	MUNECHIKA, MAURICE AKIRA
4-3-3-20-5	5/19/2017	8,999	$284,000	$31.56	KOUCHI, RONALD DAN
4-3-3-20-6	5/19/2017	8,999	$284,000	$31.56	KOUCHI, SCOTT NELSON
4-3-3-20-7	5/12/2017	8,999	$284,000	$31.56	CHOW, ARTHUR ALAPAI AH HOOK
4-3-3-20-8	5/3/2017	8,999	$284,000	$31.56	FUJITA, STELLA BUMACOD
4-3-3-20-9	5/24/2017	9,008	$284,000	$31.53	CARVALHO, TYLER TAKEO
4-3-3-20-10	4/28/2017	9,313	$284,000	$30.49	MIURA, TAD TADASHI
4-3-3-20-11	6/7/2017	8,002	$271,500	$33.93	RAGSAC, CHAD RYAN
4-3-3-20-12	5/11/2017	9,897	$264,000	$26.68	PASCUAL, ALEJANDRO BULOSAN
4-3-3-20-13	5/8/2017	10,010	$271,500	$27.12	RAGASA JR, ALEJANDRINO ANDY
4-3-3-20-14	5/11/2017	8,960	$264,000	$29.46	CAYCAYON, ISAIAH LAAKEA PARIES
4-3-3-20-15	5/17/2017	10,054	$271,500	$27.01	ACOBA, MICHAEL JOSEPH
4-3-3-20-16	5/10/2017	10,058	$271,500	$26.99	RACO, CAVEN KONANE
4-3-3-20-17	4/28/2017	9,021	$264,000	$29.26	APAO, DIRK KAPUALANI JOSEPH
4-3-3-20-18	5/10/2017	10,167	$271,500	$26.70	IBANEZ, MARWEEN YAGO
4-3-3-20-19	4/28/2017	8,873	$264,000	$29.75	SUMIDA, KELSON JOHN FUJIO
4-3-3-20-20	5/5/2017	9,662	$289,000	$29.91	GAMBENG, JENNY BOMBAY
4-3-3-20-21	4/28/2017	9,239	$284,000	$30.74	EBESU, DEWEY TSUYOSHI
4-3-3-20-22	5/9/2017	9,034	$284,000	$31.44	IHARA, JUSTIN LEE BRANDON SHIGERU
4-3-3-20-23	5/19/2017	8,355	$271,500	$32.50	ILORETA, ALBELARDO RAGASA
4-3-3-20-24	6/14/2017	8,490	$271,500	$31.98	RAPOZO, NOLAN RAYMOND
	Average	**9,380**	**$279,208**	**$29.94**	

Source: Hawaii Information Service, Grove Farm and The Hallstrom Team/CBRE.

The developer has a waiting list of potential purchasers and anticipates rapid, full-absorption of each subsequent increment of the project, which is the initial component within the proposed 1,450-unit Grove Farm Wailani Residential master plan.

The other major in-development project in the Lihue/East Kauai study area is Kohea Loa, a DR Horton project in Hanamaulu which will have a total of 444 finished single-family homes and multifamily units built in three phases through 2020. Forty percent of the units will be priced according to County affordability guidelines, with first phase prices starting at $232,000 for multifamily units. The initial increment will have 151 single family and duplex units.

The demand for the product has been such that product pre-sale thus far has been offered via lotteries which have been fully subscribed and is bifurcated between Kauai residents who do not currently own a home, Kauai residents who do, and other interested parties. It is anticipated all the units in the current and future phases will be reserved/pre-sold prior to build-out.

Interest is so high the County is considering offering to purchase all units that are not reserved/pre-sold via lotteries.

RESIDENTIAL UNIT SUPPLY IN THE GENERAL STUDY AREA

In the 2017 General Plan Appendices report "*Appendix G – Entitled Projects on Kauai*", the Kauai Planning Department identified a total of 3,766 potential "residential" units in 23 major projects in the Lihue to Moloaa Corridor, excluding KMH, as shown below.

There are numerous considerations in assessing the potential supply:

- Not all will be constructed as master plans invariably evolve over time and are often built out to less than maximum allowable densities.
- Infrastructure systems (including water, sewer, and access) may not be available to support development of all the holdings in a timely manner.
- Some of the projects have been long-proposed but with little forward movement in years as the market, investor/ownership and developer interests change.
- Many lack appropriate entitlements.
- 181 of the proposed units will be the remaining house lots to be developed in the Department of Hawaiian Homelands Piilani Mai He Kai project, which has offered 86 subdivided lots in two phases to date (since 2009), with the third phase scheduled to commence within the next several years. "Ownership" of the leased lots is limited to native Hawaiian households.

Kaua'i County General Plan | Appendix G

Entitled Residential Projects by District

District	Project Name	Housing Units
East Kaua'i	Pi'ilani Mai He Kai (DHHL Anahola)	181
	Kulana	172
	Kapa'a Highlands, Phase 2	769
	TOTAL	1,122
'Ele'ele	A&B 'Ele'ele Residential	201
	Lima Ola (Affordable)	450
	TOTAL	651
Līhu'e	DHHL Wailua, Phase 1	188
	Kohea Loa - D.R. Horton	444
	Pikake Subdivision	146
	Grove Farm Wailani Residential	1,450
	Koamalu	220
	Waiola Phase I	47
	Waiola Phase II	56
	Waiola Phase II	93
	TOTAL	2,644
North Shore	Kolopua (Princeville Affordable)	44
	TOTAL	44
South Kaua'i	Brydeswood Ranch (A&B)	24
	Kōloa Creekside	72
	Kukui'ula Employee Housing	100
	Kukui'ula	750
	The Village at Koloa Town	34
	Kōloa Camp - Waihononu	50
	CIRI (CLDC) Subdivision	10
	TOTAL	1,040
Waimea	Kekaha lots	40
	Kikiaola Mauka	270
	Kikialoa - Field 14	56
	TOTAL	366
	ISLAND TOTAL	5,867

Total Proposed Residential Units Within Study Area
(Excluding Kealia Mauka Homesites)

Location		No. Of Units
East Kauai		1,122
Lihue		2,644
	Total	3,766

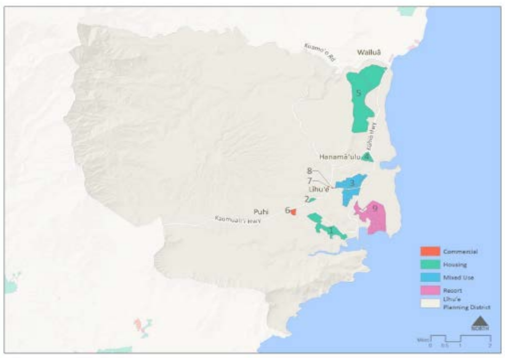
Source: County of Kauai

(Note: Kapaa Highlands, Phase II now called "Hokua Place")

The Planning Department subsequently identified a total of 5,197 total standard residential and resort-residential units in the study area, excluding KMH, as summarized following. Some 69.7 percent of the units are identified as residential, 30.3 percent as Coconut Plantation areas, many of the units will be used as TVRs or otherwise outside the available inventory to meet the housing needs of resident families.

Precise division of the proposed unit by type (single or multifamily) is not available for all projects. The standard residential projects are anticipated to be some 65 to 70-plus percent single family, and the resort-residential product up to 80 percent multifamily units.

Līhu'e District



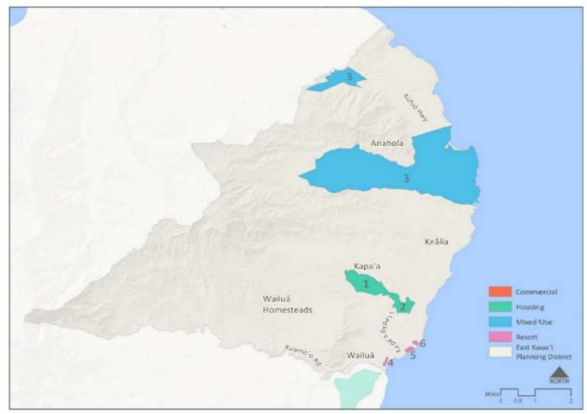
Residential

Map #	Project Name	Housing Units	GP Land Use	Status
1	Waiola Phases I-III	196	Urban Center, Open, Residential	Final Approvals
2	Koamalu	220	Urban Center	Submitted Annual Status Report
3	Grove Farm Wailani Residential	1,450	Urban Center	Negotiating infrastructure and access issues
4	Kohea Loa – D.R. Horton	444	Urban Center	Submitted 2013 Status Report
5	DHHL Wailuā, Phase I	188	Agriculture	No plans for development within GP timeframe
	TOTAL	2,498		

Resort

Map #	Project Name	Resort Units	GP Land Use	Status
9	Kaua'i Lagoons	700	Resort	Submitted annual status report (2/8/11)
	TOTAL	700		

East Kaua'i District



Residential

Map #	Project Name	Housing Units	GP Land Use Designation	Status
1	Kūlana	172	Agriculture	Permitted as an Agricultural development
2	Kapa'a Highlands Phase II	769	Urban Center, Agriculture, Open	Seeking SLU Amendment
3	Pi'ilani Mai He Kai (DHHL Anahola)	181	Urban Center, Agriculture, Open	Phase II began in 2012
	TOTAL	1,122		

Resort

Map #	Project Name	Resort Units	GP Land Use Designation	Status
4	Coconut Plantation	192	Resort	Submitted annual status report (2/8/11)
5	Coco Palms	350	Resort	Approved March 2015
6	Coconut Beach Resort	335	Resort	Construction to start 2015
	TOTAL	877		

Summary of Total Proposed Study Area Residential and Resort-Residential Units (Excluding Kealia Mauka Homesites)

Location	Residential	Resort-Residential	Total
Lihue	2,498	700	3,198
East Kauai	1,122	877	1,999
Total	3,620	1,577	5,197

Source: County of Kauai

SUBJECT UNIT ABSORPTION

The full-size tables for this section of the report are contained in Exhibit B.

We have estimated the probable market acceptance levels and resulting absorption of the 236 single family lots at KMH using three methodologies.

- Gross Demand/Supply Comparison – This technique assumes that if there is insufficient existing and planned supply to meet projected market gross demand levels during the projection period there is rational support for the subject units.

- The Residual Method – In this technique, the competitive inventory planned for the primary study area over the projection period is placed on a time-line depicting their combined anticipated rates of absorption or assuming a reasonable market share. To the extent this periodic supply of units falls short of the forecast periodic demand for product in the Lihue to Moloaa Corridor, an undersupply situation is present and there is "residual" demand remaining for the KMH inventory. This method is considered the most conservative as it allows the proposed competitive product to achieve their absorption potential before the residual demand flows to absorb the subject.

- The Market Shares Method – This approach accounts for the probable competitiveness of the subject inventory regardless of the total level of product being otherwise offered on the market. Essentially, it is an estimate of how much of the total forecast demand in the study region the subject could expect to capture on an annual basis given its location, product type, estimated pricing, perceived competitiveness, and amenity/lifestyle characteristics.

Gross Demand for additional housing units in the study area will exceed supply between 2017 and 2040. If only "entitled residential" (non-resort) units are considered as comprising the competitive supply, the regional shortfall over the next 23-years would be between 2,888 units and 4,474 units. If all entitled residential and resort-residential are considered, the shortfall in supply would be from 1,457 units to 3,043 units. **There is solid support for the KMH product during its proposed development period on a gross demand basis**.

Even if all 5,197 identified residential and resort-residential units for Lihue/East Kauai are built in the projection period and achieve reasonable development speed and absorption velocities, and an allowance of 100 available yet unsold units is provided, there will still be substantial unmet Residual Demand (using mid-point figures) for residential units in every five-year projection period from 2017 through 2040, as shown following.

PROJECTION OF POTENTIAL SUBJECT UNIT ABSORPTION USING THE RESIDUAL METHOD BASED ON TOTAL DEMAND FOR RESIDENTIAL UNITS IN THE LIHUE-MOLOAA STUDY AREA

Segment	TOTAL UNITS PROPOSED Excluding Subject	2017-2020	2021-2025	2026-2030	2031-2035	2036-2040	Total
All Residential Unit Types							
Identified Supply (1)	5,297	750	1,000	1,100	1,200	1,247	5,297
Percentage of Total Supply		14%	19%	21%	23%	24%	100%
Regional Housing Unit Demand (mid-point)	7,447	719	1,738	1,680	1,601	1,709	7,447
Shortage or (Excess) Supply	2,150	(31)	738	580	401	462	2,150
Potential Residual Subject Unit Demand							
at 75% Capture Rate	1,612	-23	554	435	301	346	1,612
at 60% Capture Rate	1,290	-19	443	348	240	277	1,290

(shaded) = Probable Kealia Mauka Homesites Absorption Period. 236 lots would require from circa three to four years.

(1) Includes allowance of 100 unsold units in completed projects not included within the identified inventory supply.

Source: The Hallstrom Team/CBRE

Using mid-point demand estimates, the residual demand available will be sufficient to absorb the subject units in a timely manner within a 3 to 4-year exposure period (initial closings to sell-out).

Given the desirable location, anticipated pricing, and lifestyle envisioned for KMH, it will achieve a solid market standing and prove strongly competitive in the regional housing market; able to garner a significant share of demand even though there may be large numbers of competing units proposed.

We estimate the subject could readily achieve an average Market Shares (or "Capture") Rate of between 15 and 20 percent of the total demand for new housing units in the Lihue to Moloaa Corridor.

A total absorption period for the subject residential product of between about 3.9 years and 5.3 years is indicated by this analysis, assuming pre-sales start in 2019, as shown. The total market capture rate of 15.16 percent during the offering period is modest in comparison with the levels being achieved by the initial phases of Pikake/Wailani (Grove Farm-Lihue) and Kohea Loa (DR Horton-Hanamaulu).

SUMMARY OF SUBJECT PROJECTED DEMAND LEVELS
USING THE MARKET SHARES METHOD

Assuming 236 Saleable House Lots with Pre-Sales Starting in Mid-2019 and First Closings in 2020

Scenario One: Using Minimum Demand Assumptions

Sales Year Date	Sales Year Period	Total Regional Demand	Effective Subject Share	Indicated Total Subject Absorption
2020	1	140	18.00%	25
2021	2	328	15.00%	49
2022	3	328	15.00%	49
2023	4	328	15.00%	49
2024	5	328	15.00%	49
2025	6	328	4.20%	14
Totals	**5.30**	**1,779**	**13.25%**	**236**

Scenario Two: Using Maximum Demand Assumptions

Sales Year Date	Sales Year Period	Total Regional Demand	Effective Subject Share	Indicated Total Subject Absorption
2020	1	220	20.00%	44
2021	2	367	18.00%	66
2022	3	367	18.00%	66
2023	4	367	16.20%	60
Totals	**3.90**	**1,322**	**17.83%**	**236**
ANALYSIS MID-POINT				
4.6 Years		1,551	15.20%	236

Source: The Hallstrom Team/CBRE, Inc.

Placing greatest weight on the indicators provided by the Market Share method, we conclude the 236 proposed lots of the Kealia Mauka Homesites subdivision will achieve full absorption within approximately 4.5 years from initial closings.

Other Market Issues

SECONDARY MARKET CONSIDERATIONS

- If there is imposition of resale limitations/exactions ("profit sharing") placed upon the designated affordable-priced lots, we do not believe it will meaningfully hamper demand for those properties. This has been demonstrated at the Puakea I subdivision (Grove Farm), which still achieved full absorption/reservation upon offering for higher-priced lots. There is such a shortage of affordably-priced lots relative to market demand, and most purchasers are seeking long-term housing, any re-sale restrictions become moot.

  We would not anticipate any re-sale restrictions to be placed on the market-priced inventory, and even were it so, do not believe it would be a significant impact on sales to full-time resident households (if the restrictions were not onerous); however, it could lessen interest among non-resident second home buyers.

- KMH will have minor impacts on the socio-economic aspects of the surrounding community that relate to real estate issues.

  1. The proposed residential components will be generally compatible and contextually consistent with the existing adjacent Kealia Town subdivision project and most mauka housing developments in the greater Kapaa area. The project will have little to no impact on the vacant feral agricultural lands which generally surround it.
  2. Property values in the region are largely driven by external, cyclical economic factors within an existing (and expanding) cumulative mass, not any single new project. KMH will not itself, drive regional market values or real property assessments of nearby real estate.
  3. It is not expected there will be any in-migration to Kauai as a direct result of the project.
  4. A portion of the subject inventory will meet Kauai County workforce housing guidelines, which coupled with the market-priced product will provide new, competitively-priced inventory across a broad-spectrum of purchaser demographics.
  5. KMH will contribute to the local and regional economy through discretionary household expenditures by the de facto population.

Economic Impacts of the Proposed Development

The tables containing the data, analysis and modeling comprising this section of our study are contained in Addenda Exhibit C, including the full-size print-outs of those excerpted into the narrative section.

The development of KMH will result in significant expenditures that will favorably impact the Kauai economy on both a direct and indirect basis, increasing the level of capital investment and capital flow in the region, which will in turn create employment and widen the tax base.

From a direct perspective, the proposed 236 house lots and eventual homes built thereon will create numerous construction, equipment operator and specialty trade jobs on- and off-site, directly and indirectly, during the planning and emplacement of the infrastructure, and building of the improvements.

After completion of the common systems and vertical construction there will be some (though limited) permanent employment positions created by the community association personnel and the buildings themselves (landscape, service, maintenance, and renovation needs during their use).

Numerous local businesses will see significant profit opportunities arising for contracting companies constructing the improvements, and for local businesses which would supply a substantial portion of the materials needed in the building efforts.

The general island economy also will benefit from the subject development, as its full and part-time residents will spend large amounts of discretionary income in off-site shops, restaurants, and service establishments throughout Lihue/East Kauai, and in purchasing goods and services. We acknowledge however, much of this will not be "new" unanticipated spending on the island from "new" residents, but continuing spending from existing Kauai households which relocate to KMH and move their spending to businesses in the Lihue to Moloaa Corridor.

The only "new" spending will come from non-resident second-home owners and their guests when they are visiting their KMH vacation homes. It is anticipated their spending patterns would be similar on a daily basis with other Kauai visitors in their income grouping. Yet, the average number of KMH non-resident owners and guests on-site at any time is limited relative to the full-time resident population.

Indirectly, as these wages, profits, and expenditures move through the regional economy, they will have a ripple, or "multiplier," effect which increases the amount of capital flowing to the entire community resulting from the development of the subject.

Construction, operational and other workers earning wages via KMH development and associated off-site economic activity will spend most of their income on living and entertainment expenses while supporting and patronizing other island businesses. Much of this spending would be then be re-directed by these businesses to other island industries, and significant portions of these secondary profits would in turn be put back through the region's economic and tax structure.

These substantial direct and indirect economic impacts associated with the proposed subject project, as quantified following, are all the result of the capital investment and entrepreneurship necessary to convert undeveloped, feral agricultural lands into a moderate-intensity, diverse, sustainable residential community. The Kauai County economy will be meaningfully stimulated by the capital investments, population/user spending and business operations of the development.

Our economic analysis was based on an assumed project build-out and finished lot absorption period of seven years from 2018 through 2024, with completion of the homes continuing thereafter (for modeling purposes assumed through 2030). The construction of the finished homes on the subject lots may take longer, as it will be controlled by the lot buyers and not the master developer. If significant numbers of lots are sold in bulk to local contractors to construct spec homes, the build-out may be faster than forecast; if the majority of lots are sold to individuals the pace of build-out could vary meaningfully. However, whether full development takes 10 or 20 years, the economic impact during the build-out period and stabilized "operation" of the community and its resident population will be the same following completion/stabilization. As constant, uninflated 2017 dollars are used throughout the model, time is not a significant variable in the analysis.

Our projected market-driven, build-out timing for KMH is summarized in the table below.

FORECAST KEALIA MAUKA HOMESITES FINISHED HOUSE LOT ABSORPTION WITH FULL-SELL OUT ACHIEVED WITHIN SEVEN YEARS OF GROUND-BREAKING

			Finished House Lots Sold/Closed		Finished Single Family Homes Completed (1)	
Year	Project Year	Activity	Annually	Total	Annually	Total
2018	1	Final Approvals, Survey, Clearing and Grubbing of Site				
2019	2	On and Off-Site Infrastructure Commences and is Completed. Lot Pre-Sales Begin Mid-Year.				
2020	3	Initial Lot Sales Closing, Lot Sales Continuing, Initial Vertical Home Construction Commences.	60	60		
2021	4	Lot Sales Continuing, Initial Homes Finished, Home Construction Continues	50	110	20	20
2022	5	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	160	25	45
2023	6	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	210	25	70
2024	7	Lots Are Fully-Absorbed/Sold-Out, More Homes Finished, Home Construction Continues	26	236	25	95
2025 and Beyond		Homes Continue to be Constructed and Finished by Lot Purchasers			141	236

(1) Construction timing of finished single family homes estimated for economic modeling purposes-only as their build-out is outside the purview of the master developer who at this time envisions offering all product as finished house lots only. Full build-out of the subdivision could take decades or could be faster if blocks of lots are taken down by local builders for construction of "spec/tract" homes. Does not include any allowances for possible Accessory Dwelling Units ("ohanas") which may be built on some lots.

It is anticipated that:

- Final approvals and planning will be completed by late 2018;
- Ground-breaking, survey and site clearing will begin in late 2018;
- Infrastructure emplacement will take place in 2019 along with the commencement of the lot pre-sales program;
- Lot closings will begin in 2020 along with initial vertical (home) construction;
- Full-Absorption/Sell-Out of the finished lot product being developed will be achieved by 2024, equating to a total KMH project period of seven years.
- The first homes would be completed and available for occupancy beginning in 2021; and,
- Vertical construction is dependent upon the lot purchasers (not master developer) and would continue after full-absorption.
- For analytical-purposes only, we have assumed all homes would be completed by 2030.

Our model assumes all infrastructure is built in a single phase; however, should it take place in two or more phases during the projection period the outputs from the model would not be significantly changed as long as there are sufficient finished lots provided to meet market-based purchaser and homebuilding demands.

CAPITAL INVESTMENT AND CONSTRUCTION COSTS

The subject will bring an estimated $121 million in direct development capital into Kauai over the build-out period for the project, as shown below.

PROPOSED KEALIA MAUKA HOMESITES DEVELOPMENT SCHEDULE AND ESTIMATED CONSTRUCTION COSTS
All Amounts Expressed in Constant 2017 Dollars

Item	Development, Sales and Build-Out Period			Totals During Build-Out
	2017 to 2020	2021 to 2025	2026 to 2030	
Infrastructure Emplacement	$26,317,029	$0	$0	**$26,317,029**
Residential Construction	$4,734,750	$42,612,750	$47,347,500	**$94,695,000**
TOTAL PERIODIC CONSTRUCTION COSTS	**$31,051,779**	**$42,612,750**	**$47,347,500**	**$121,012,029**
Contractor Profits	$3,105,178	$4,261,275	$4,734,750	**$12,101,203**
Supplier Profits	$1,242,071	$1,704,510	$1,893,900	**$4,840,481**

Source: The Hallstrom Team/CBRE

<u>Infrastructure</u> costs were provided to us by the development team and total of $26.32 million, as summarized following.

Kealia Residential Subdivision
July 11, 2017

Budgetary Proposal

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Earthwork - On-Site	53.40	ACRE	96,100.00	5,131,740.00
2	Drainage and Detention Basins - On-Site	53.40	ACRE	31,400.00	1,676,760.00
3	Sewer System - On-Site	10,243.00	LF	327.00	3,349,461.00
4	Water Distribution System - On-Site	11,514.00	LF	188.00	2,164,632.00
5	Dry Utilities incl Electrical, Comm - On-Site	12,477.00	LF	145.00	1,809,165.00
6	Roadways & Sidewalks - On-Site	12,477.00	LF	403.00	5,028,231.00
7	Bus Stop Roadway Turnout and Shelter - On-Site	1.00	EA	121,000.00	121,000.00
8	Postal Service Gang Mail Box and Turnout - On-Site	1.00	EA	38,400.00	38,400.00
OFFSITE-1	Kuhio/Kealia Intersection Improvements	1.00	LS	1,282,000.00	1,282,000.00
OFFSITE-2	Kealia Road Improvments	2,646.00	LF	143.00	378,378.00
OFFSITE-3	Sewer Pipe Connect to Existing	7,528.00	LF	234.00	1,761,552.00
OFFSITE-4	Sewer Lift Station	1.00	EA	358,000.00	358,000.00
OFFSITE-5	WW Treatment Capacity Assessment Fee	236.00	EA	4,290.00	1,012,440.00
OFFSITE-6	Waterline Connect to Existing Kealia System	2.00	EA	16,800.00	33,600.00
OFFSITE-7	0.2MG Water System Storage Tanks	1.00	EA	858,000.00	858,000.00
OFFSITE-8	Water System Source Improvements	2.00	EA	465,000.00	930,000.00
OFFSITE-9	KIUC, HTEL, Cable, Line Extension from Kuhio	2,646.00	LF	145.00	383,670.00
GRAND TOTAL					**$26,317,029.00**

Home construction costs would total $94.7 million during the vertical build-out period. This is based on average vertical construction costs per unit as shown.

ESTIMATED AVERAGE "ALL IN" HOME DEVELOPMENT COST AT KEALIA MAUKA HOMESITES SUBDIVISION BEFORE LAND

Assuming Typical Three-Bedroom, Two-Bathroom House with Two-Car Garage, Patio, Porch, Paved Driveway, and Front-Yard Landscaping

Unit Cost Item	Modest Quality Home	Upscale Quality Home	Mid-Point Single Family Home
Average Home Size in Gross Square Feet of Living Area	1,100	2,200	1,650
"All-In" Construction Cost Per Square Foot	$200	$250	$225
Site Work/Hardscape/Landscaping Cost	$25,000	$35,000	$30,000
Total Vertical Construction Cost per Home	**$245,000**	**$585,000**	**$401,250**
Plus Allocated Infrastructure Cost per Unit	$110,000	$110,000	$110,000
Total Per Home "All in" Development Cost Before Land	$355,000	$695,000	$511,250

Source: Rider Levitt Bucknall and The Hallstrom Team/CBRE

KMH development will infuse on average an anticipated $9.3 million annually into the Kauai building industry on average over the build-out period.

DIRECT BUSINESS PROFITS FROM CONSTRUCTION

While a significant percentage of the materials needed to build the subject infrastructure and residential and community structures must be imported to Kauai, a portion of the construction costs spent in the development will directly flow to local businesses in the form of contractor profits and supplier profits.

Typically, within the industry net contractor profit margins are expected to be at 8 to 20 percent of total construction costs. We have used a conservative ten percent figure. Supplier profits were extrapolated at four percent of total costs

The total Contractor's Profit generated by KMH for local building companies averages $1 million per year, with a cumulative profit of $12.1 million over the construction period. The average annual Supplier's Profit equates to $372,000 and totals $4.8 million in aggregate.

EMPLOYMENT OPPORTUNITIES CREATED

Based on indicators provided by the construction of comparable sized projects and Hawaii industry averages, we have estimated the demand for on- and off-site, direct and indirect, full-time equivalent employment positions associated with laying of initial infrastructure systems and construction of the homes in the project, and in providing continuing services to the community and occupied residences.

The construction, maintenance, and indirect/off-site employment opportunities created by the subject development will not be "new" jobs requiring new Kauai residents, but will be vitally needed new opportunities for in-place resident construction trade workers and existing local businesses. The jobs associated with the community associations and maintenance operations will represent an expansion of the employment pool.

It is assumed the off-site/indirect work created will be steered towards existing Kauai supply, equipment providers, and other service companies.

The following table summarizes our worker-years and full-time equivalent (FTE) projections for KMH during build-out and on a stabilized on-going annual basis thereafter.

ESTIMATED YEARLY FULL-TIME EQUIVALENT EMPLOYMENT POSITIONS CREATED BY DEVELOPMENT					
	Development, Sales and Build-Out Period			Totals During Build-Out	
Construction Employment (1)	2017 to 2020	2021 to 2025	2026 to 2030		
Infrastructure Emplacement	66	0	0	66	
Residential Units	32	284	316	631	
Total Periodic Construction Jobs	97	284	316	697	
On-Going Employment					Stabilized Annually
Maintenance & Common Element (2)	0	30	59	89	
Total FTE Jobs in Place at End of Period	0	9	15		15
Off-Site Employment (3)	32	105	125	262	
Total FTE Jobs in Place at End of Period	0	3	5		5
TOTAL PERIODIC WORKER YEARS	130	418	500	1,048	
TOTAL END-OF-PERIOD PERMANENT JOBCOUNT	0	12	20		20

(1) Infrastructure construction employment estimated at 1 worker-year for every $400,000 in costs. Vertical construction employment estimated at 1 worker-year for every $150,000 in costs. Includes all direct employment associated with construction, on and off-site.

(2) Includes community common element administration and maintenance staff of 3 FTE jobs and ratio of one FTE maintenance/repair worker for every 20 homes.

(3) Estimated at one cumulative off-site employment position for every three on site positions.

Source: The Hallstrom Team/CBRE

A total of 697 worker-years of direct employment in the construction trades will be needed for developing KMH.

Community association and maintenance worker-years will total 89 during the modeling period and 15 permanent FTE positions thereafter.

Off-Site/Indirect/Secondary employment created by KMH will total 262 worker-years from 2018 through 2030 and 5 FTE positions per year as stabilized.

WAGE INCOME GENERATED

In accordance with data compiled by the state Department of Labor and Industry Relations, as tempered through our analysis, we have estimated the personal income (in the form of wages) which will flow to Kauai workers from KMH construction and use. The results, expressed in constant 2017 dollars, are shown on the table below.

ESTIMATED YEARLY EMPLOYEE WAGES CREATED BY DEVELOPMENT All Amounts Expressed in Constant 2017 Dollars					
	Development, Sales and Build-Out Period			Totals During Build-Out	
Construction Wages (1)	2017 to 2020	2021 to 2025	2026 to 2030		
Infrastructure Emplacement	$5,200,245	$0	$0	$5,200,245	
Residential Units	$2,494,898	$22,454,078	$24,948,976	$49,897,952	
Total Periodic Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	
					Stabilized Annually
Maintenance & Common Element (2)	$0	$990,675	$1,973,025	$2,963,700	$492,840
Off-Site Employment Wages (3)	$1,755,033	$5,657,399	$6,758,197	$14,170,629	$266,795
TOTAL PERIODIC WAGES	$9,450,175	$29,102,152	$33,680,198	$72,232,526	$759,635

(1) Average annual wage for full-time-equivalent construction worker (all trades) at $79,040 ($38/hour X 2,080 hours).

(2) Average annual wage for full-time-equivalent maintenance and security workers at $33,300 ($16/hour).

(3) Average annual wage for full-time-equivalent general worker at $54,080 ($26/hour), the average wage for all "Total Private Workers" in the state.

Wages taken from State of Hawaii "Hawaii Workforce Infonet" "Publications and Tables> Production Worker H&E Data Hours and Earnings" for 2016.

Source: The Hallstrom Team/CBRE

Total direct construction wages paid during build-out will be $55.1 million.

Total community association and maintenance employee wages during the modeling period will be $3 million and stabilize at $493,000 thereafter.

Off-sits/indirect employee wages will total $14.2 million during build-out and be $267,000 annually on a stabilized basis.

POPULATION, INCOME AND EXPENDITURES

The single-family homes of KMH will be occupied primarily by full-time resident households. However, it is inevitable that some of the lots/homes will be purchased/owned by non-resident second-home buyers who will utilize their units as vacation homes for their families and guests on a part-time basis.

Together these groups constitute the "de facto population" of the project, or the average number of persons (full time household members and second-home owners and guests) daily residing within the subdivision.

The de facto population of the subject community and their income and discretionary expenditures will create major positive impacts on the Lihue/East Kauai economy. However, as previously noted, these income and expenditure dollars are not all considered as "new" monies flowing into the island economy as it is assumed the full-time households are already on Kauai) existing expenditures) with the "new" money being brought into the region by the non-resident component.

We have quantified these focal statistics within the modeling process. The results are shown on the table below.

ESTIMATED RESIDENT POPULATION, HOUSEHOLD INCOME AND DISCRETIONARY EXPENDITURES All Amounts Expressed in Constant 2017 Dollars	Development, Sales and Build-Out Period				
	2017 to 2020	2021 to 2025	2026 to 2030	Stabilized	Totals
Total Number of Single Family Homes Occupied (End of Period)	0	118	236	236	
Percent of Total Units	0%	50%	100%	100%	
Full-Time Resident Housholds	0	97	194	194	
Percent of Total Units	82%	82%	82%	82%	
Second Home (Non-Resident) Owner Households	0	21	42	42	
Percent of Total Units	18%	18%	18%	18%	
Average Resident Household Size (1)	3.4	3.4	3.4		
Total Resident Population End of Period	0	329	658	658	
Average Non-Resident Household Size (2)	1.0	1.0	1.0		
Average Daily Non-Resident Population End of Period	0	21	42	42	
Total De Facto (Resident and Non-Resident) Daily Population End of Period	0	350	700	700	
RESIDENT HOUSEHOLD INCOME (3)					During Build-Out
Total Annual Household Income at End of Period	$0	$9,966,280	$19,932,560	$19,932,560	
Total Household Income During Period	$0	$24,915,700	$74,747,100		$99,662,800
TOTAL DE FACTO POPULATION DISCRETIONARY EXPENDITURES (4)					
Average Annually During Period	$0	$5,275,591	$12,132,713	$12,132,713	
Total During Period	$0	$26,377,956	$60,663,564		$87,041,520

(1) Average household size of 3.4 persons.

(2) Average party-size of 3.5 persons with occupancy at 30% of year, or de facto daily household size of 1.05 persons. Rounded to 1.0 persons.

(2) Estimated at $103,000 per year or 130% of median household income for four-person household.

(4) Residents household assumed to have average of 45% of gross income as net disposable. Non-Resident Households assumed to have spending at $204 per person per day, which is the average daily spending by Kauai visitor through May 2017.

Source: The Hallstrom Team/CBRE

The top half of the table depicts the effective occupancy of the 236 finished homes.

It is assumed that 82 percent of the houses (194 total) will contain full-time Kauai resident families with an average household size of 3.4 persons, totaling 658 full-time residents at build-out and full occupancy.

The other 18 percent of the KMH homes (42 total) will be used by part-time second/vacation home owners who will occupy the unit 30 percent of the years with an average party size of 3.6 persons. This equates to an average daily population for this ownership component of 42 persons.

The total average daily de facto population at build-out will be 700 persons (658 full time residents and 42 vacationers).

We estimate the average household income for the full-time resident families will be $103,000, or about 130 percent of the 2017 Kauai median household income. During the build-out period the total resident household income will be $99.7 million, and at $20 million stabilized annually thereafter.

We estimate that full-time resident households in KMH will spend only about 45 percent of their total income on discretionary items, with the remainder going towards mortgage debt service and fixed expenses.

The part-time non-resident population of the project, which are essentially visitors, are projected to spend $204 per person daily, which was the average daily expenditure for Kauai visitors through May 2017. Although they will not have lodging costs, they will spend money on furnishings and housewares and will typically be upper-income households with larger amounts of discretionary dollars to spend. We note this spending, which totals some $3.2 million annually, is considered as "new" to Kauai and reflected accordingly in the fiscal assessment model.

By build-out, the discretionary expenditures made by the subject project de facto population (full and part-time components) in the local market will be at $12.1 million annually on a stabilized basis, in 2017 dollars. During the build-out modeling period, (through 2030), the total sum of these expenditures will be $87 million.

OPERATING ECONOMIC ACTIVITY

The on-going, on-site economic activity within the proposed KMH development will flow from the Community Association and Maintenance/Landscaping/Renovations. We have estimated these activities will generate some $850,000 in gross sales/revenues annually on a stabilized basis.

SUMMARY OF DIRECT, LOCAL ECONOMIC IMPACTS

As correlated on the table below, annual Total Base Economic Impact on a stabilized after build-out will be $13.7 million per year; however, 65 percent is from resident household spending which is not "new" economic activity being created. During the development period, the aggregate total is $226 million.

SUMMARY OF ECONOMIC IMPACTS ASSOCIATED WITH DEVELOPMENT
All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period				
	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out	Stabilized Annually
Construction Activity					
Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	
Contractor Profits	$3,105,178	$4,261,275	$4,734,750	$12,101,203	
Supplier Profits	$1,242,071	$1,704,510	$1,893,900	$4,840,481	
Other Construction Costs	$19,009,387	$14,192,887	$15,769,874	$48,972,148	
Total Construction Impact	$31,051,779	$42,612,750	$47,347,500	$121,012,029	
Maintenance & Common Element Wages	$0	$990,675	$1,973,025	$2,963,700	$492,840
Off-Site Wages	$1,755,033	$5,657,399	$6,758,197	$14,170,629	$266,795
Total Project Population Spending	$0	$26,377,956	$60,663,564	$87,041,520	$12,132,713
Unit Maintenance & Repairs (1)	$0	$169,920	$594,720	$764,640	$849,600
TOTAL BASE ECONOMIC IMPACT	$32,806,812	$75,808,700	$117,337,006	$225,952,518	$13,741,947

(1) Estimated at $3,600 annually per unit.

Source: The Hallstrom Team/CBRE

STATE INPUT/OUTPUT MODEL

We have also analyzed the impacts of the project for Kauai and Statewide using the *State Input-Output Economic Model* Type II multipliers. These factors quantify the total Direct, Indirect and Induced "effects" of various forms of business and spending activity as it flows through the economy of the islands.

In every instance, application of the macro Input-Output multipliers resulted in higher dollar, employment, and tax revenue indicators than in our subject-focused micro model which was designed to reflect Direct and upper-level Indirect impacts only.

Among the outputs using the State method:

- The $121 million in cumulative KMH construction costs will generate a total State Economic Output of $256.5 million during build-out with subsequent community "operations" averaging $27.1 in Economic Output annually statewide on a stabilized basis.
- Direct subject construction wage earnings of $55.1 million will yield $111.3 million in statewide Direct Effect Earnings during build-out and on-going economic activity will generate $5.6 million during the modeling period and $1.4 million each stabilized year.
- Indirect and induced State taxes during build-out will total $28.5 million during build-out and $2.1 million annually thereafter.
- Direct effect jobs created by construction employment will be 2.68 times the number of on-site workers, or a total of 1,868 worker years of employment. The on-going business activity will generate 65 jobs state wide through 2030 and 41 annually thereafter.

ESTIMATES OF TOTAL ECONOMIC IMPACT FROM SUBJECT CONSTRUCTION
USING STATE INPUT-OUTPUT MODEL "TYPE II" MULTIPLIERS
All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period			Totals	Stabilized
Year	2017 to 2020	2021 to 2025	2026 to 2030		Annually
Construction Costs	$31,051,779	$42,612,750	$47,347,500	$121,012,029	$127,440
1. Economic Output Multiplier	2.12	2.12	2.12	2.12	2.12
Total State Economic Output	$65,829,771	$90,339,030	$100,376,700	$256,545,501	$270,173
2. Earnings Multiplier	0.61	0.61	0.61	0.61	0.61
Total Increase in State Earnings	$18,941,585	$25,993,778	$28,881,975	$73,817,338	$77,738
3. State Tax Multipliers	0.12	0.12	0.12	0.12	0.12
Total Increase in State Taxes	$3,726,213	$5,113,530	$5,681,700	$14,521,443	$15,293
4. Total Job Multipliers	13.83	13.83	13.83	13.83	13.83
Total State Jobs Created	429.4	589.3	654.8	1,673.6	1.8
Construction Employment	97	284	316	697	6
5. Direct-Effect Job Multipliers	2.68	2.68	2.68	2.68	2.68
Total Direct Jobs Created	260.9	761.3	845.9	1,868.2	15.2
Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	$306,309
6. Direct-Effect Earnings	2.02	2.02	2.02	2.02	2.02
Total Increase in Direct Earnings	$15,544,188	$45,357,238	$50,396,932	$111,298,358	$618,744

Source: State Input-Output Model and The Hallstrom Team/CBRE

ESTIMATES OF TOTAL ECONOMIC IMPACT FROM SUBJECT OPERATIONS USING STATE INPUT-OUTPUT MODEL "TYPE II" MULTIPLIERS All Amounts Expressed in Constant 2017 Dollars					
	Development, Sales and Build-Out Period			Totals	Stabilized
Year	2017 to 2020	2021 to 2025	2026 to 2030		Annually
Household Spending & Maintenance	$0	$26,547,876	$61,258,284	$87,806,160	$12,982,313
1. Economic Output Multiplier	2.09	2.09	2.09	2.09	2.09
Total State Economic Output	$0	$55,485,061	$128,029,814	$183,514,874	$27,133,034
2. Earnings Multiplier	0.66	0.66	0.66	0.66	0.66
Total Increase in State Earnings	$0	$17,521,598	$40,430,467	$57,952,066	$8,568,326
3. State Tax Multipliers	0.16	0.16	0.16	0.16	0.16
Total Increase in State Taxes	$0	$4,247,660	$9,801,325	$14,048,986	$2,077,170
4. Total Job Multipliers	19.00	19.00	19.00	19.00	19.00
Total State Jobs Created	0.0	504.4	1,163.9	1,668.3	246.7
Operating Employment	0.0	11.9	19.7	31.6	19.7
5. Direct-Effect Job Multipliers	2.05	2.05	2.05	2.05	2.05
Total Direct Jobs Created	0.0	24.3	40.5	64.8	40.5
Operating Wages	$0	$990,675	$1,973,025	$2,963,700	$759,635
6. Direct-Effect Earnings	1.89	1.89	1.89	1.89	1.89
Total Increase in Direct Earnings	$0	$1,872,376	$3,729,017	$5,601,393	$1,435,710

Source: State Input-Output Model, and The Hallstrom Team/CBRE

ANCILLARY ECONOMIC (PHASE II) IMPACTS

From a real property/land use perspective, the subject development has the potential to present socio-economic impacts in the surrounding community. However, we do not believe the effect of the project will meaningfully escalate or negatively impact these issues, or that foregoing the project would mitigate the concerns in any notable way.

There are two potential negative market-based impacts:

Real Property Values -- Demand for developable land and residential units in the Lihue/East Kauai area have been increasing over the long-term (within discrete market cycles) for more than three decades. During this period, median prices have increased in some sectors by more than five-fold, surpassing compounded annual appreciation rates more than five percent.

These trends exist externally to the subject property, and would be anticipated to continue reasonably unabated over the long-term regardless whether KMH were developed. There is little rational or demonstrable market support suggesting regional demand and associated pricing trends will recede if the subject lands were left vacant.

Conversely, the KMH units will likely provide a moderating effect to price increases in the study area and on Kauai by placing 236 affordable to low/mid-market priced homes into an area where such are somewhat limited and with the existing inventory under strong inflationary pressure. Providing substantial amounts of new moderately-priced product will help ease buyer and pricing concerns due to an artificial scarcity of supply.

Without the 236 proposed lots/homes, which represent some 6.3 percent of all planned residential inventory additions in the Lihue to Moloaa Corridor over the next two decades, a significant undersupply situation would again develop in the area, laying the groundwork for a hyper-appreciation cycle of the type that has periodically plagued Kauai resident households since the mid-1970s.

Affordable Housing -- The inclusion affordable-priced lots, per County guidelines, on-site within KMH will constitute a significant allowance of affordable units (in total and proportionately) for East Kauai.

The subject development will be in full-compliance with Kauai County affordable/workforce housing ordinances and guidelines, and will more than off-set any needs resulting from in-migration which could be conceivably associated with the community.

Again, the impact of KMH will be positive on the study area in this regard.

Public Fiscal (Costs/Benefits) from the Proposed Development

The full-size tables depicting the modeling process summarized in this study section are presented in Addenda Exhibit D and summarized in the following table.

SUMMARY COMPARISON OF MAJOR PUBLIC FISCAL BENEFITS
FOR THE KEALIA MAUKA HOMESITES COMMUNITY
Accounting for "New" Direct Impacts Only
All Amounts Expressed in Constant, Uninflated 2017 Dollars

Analysis Item	Cumulative During Build-Out Period	Stabilized Annually Thereafter
County of Kauai Gross Tax Receipts	$7,537,607	$1,001,995
State of Hawaii Gross Tax Receipts	$12,745,906	$275,594
County of Kauai Costs of Services (per capita basis)	$471,794	$94,359
State Costs of Services (per capita basis)	$1,775,910	$355,182
County of Kauai Net Benefits or (Loss)	$7,065,813	$907,636
State Net Benefits or (Loss)	$10,969,996	($79,588)

Source: The Hallstrom Team/CBRE

We have analyzed the public fiscal impacts considering only the non-resident component of KMH, relative to tax benefits flowing to the State and County of Kauai and the cost of providing government services to them on a per capita basis.

As previously noted, the full-time households of KMH do not represent "new" fiscal benefits flowing to, or increased funding costs spending from, the State of Hawaii and County of Kauai.

It is assumed the KMH resident household income and spending which would generate tax dollars is already effectively in-place on the island, and the cost of providing government services to them is already being absorbed. The only change would be in the potential relocation of some economic and public activity to the greater Kapaa community from elsewhere on Kauai.

The exception is for real property taxes, as the "new" houses at KMH will mean increased real property assessments and taxes for the County; while their previous homes/units will continue producing assessments and real property taxes that would be paid by a subsequent owner.

Similarly, the on-going community association and maintenance/renovation costs of their "new" homes are new to the County and included in the model.

Essentially, from a household income and discretionary spending perspective, the full-time resident population of KMH is assumed to live on Kauai prior to their residing at the subject project and is therefore already contributing their State GET and Income taxes, so these are excluded from the model. They are merely moving their home from one location to the other on the island and their public fiscal footprint will remain generally unchanged apart from the additions to the County's real property tax base.

However, even when excluding the taxes on wages and spending by existing residents already integrated within the governmental tax base, Kauai County and the State of Hawaii will still receive millions of dollars in "new" tax receipts from the construction and stabilized operation of KMH from numerous revenue sources, including the "new" impacts from the non-resident (visitor) households in the project.

The purpose of this assessment is to delineate the direct areas in which the construction and long-term operation of KMH will potentially benefit the public "purse.

For the County, the primary new tax source will be from Real Property Taxes paid by the owners of the new subject residential inventory. Real Property Tax assessments were assumed to be at the total per unit cost (for infrastructure and vertical construction) presented foregoing.

It was assumed:

- The average assessment per finished home would be $631,250.
- 62 percent of all the homes would be owner-occupied by full time Kauai residents, subject to a homeowner's real property tax rates of $6.05 per $1,000 in assessments, and eligible for a $160,000 homeowners or owner/occupant exemption.
- 20 percent of all the homes would be rented by full time Kauai residents, subject to standard residential real property tax rates of $7.05 per $1,000 in assessments, and not eligible for homeowner or owner/occupant exemption.
- 18 percent of all the homes would be owned by non-resident second-home buyers subject to standard residential real property tax rates of $7.05 per $1,000 in assessments, and not eligible for a homeowner or owner/occupant exemption.
- The underlying site prior to following subdivision and during lot sales absorption will be subject to real property taxes, initially as vacant unentitled land, then as vacant entitled land, and finally as finished lots.

The potential property tax receipts were estimated by applying current prevailing tax rates against the projected market value of the houses as they are finished over time.

The total net assessed value of the KMH properties and associated real property taxes based on current tax rates for residential properties during the build-out period and on a stabilized basis are shown below.

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT All Amounts Expressed in Constant 2017 Dollars					
	Development, Sales and Build-Out Period				
Development Period	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
PUBLIC BENEFITS (Revenues)					
1. COUNTY REAL PROPERTY TAXES					
Cumulative Assessed Value During Period					
Finished Homes End of Period	0	118	236		**236**
Vacant Land/Finished Lots Prior to Sale	$93,000,000	$92,925,000	$30,975,000	$216,900,000	**$0**
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$37,243,750	$111,731,250	$148,975,000	**$29,795,000**
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$86,191,625	$258,574,875	$344,766,500	**$68,953,300**
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$33,519,375	$100,558,125	$134,077,500	**$26,815,500**
Total Assessed Value	$93,000,000	$249,879,750	$501,839,250	$844,719,000	$125,563,800
Real Property Taxes During Period					
Vacant Land/Finished Lots Prior to Sale	$584,350	$562,196	$187,399	$1,333,945	**$0**
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$262,568	$787,705	$1,050,274	**$210,055**
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$521,459	$1,564,378	$2,085,837	**$417,167**
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$236,312	$708,935	$945,246	**$189,049**
Total Real Property Taxes	$584,350	$1,582,536	$3,248,417	$5,415,302	$816,271
Source: The Hallstrom Team/CBRE					

We estimate the County will receive some $5.4 million in real property tax receipts during the build-out/projection period from 2017 through 2030 and annual collections of $816,271 on a stabilized basis thereafter.

Real Property Taxes (RPT) are forecast to generate about 63.1 percent of total Kauai County General Fund revenues in the 2017-18 fiscal-year budget, with secondary taxes and fees forming the remainder. It is logical to assume the KMH development and business activities will generate secondary taxes in proportion to RPT as does the overall Kauai community.

The secondary Kauai County receipts are equal to an additional 58 percent of the RPT total (36.9% divided by 63.1%).

Application of this ratio to the KMH property tax sum results in a cumulative total estimated County tax collection from the subject of $9 million during the initial projection period to 2030, and $1.3 million annually on a stabilized basis.

The State of Hawaii will receive an estimated $2.7 million in primary receipts from State Income Taxes from worker wages, and profits from businesses based on average statewide corporate and personal payments rates of 4.4 percent and 5.1 percent, respectively, applied against the economic model forecasts. This represents only new/added taxable items from KMH and does not include the full-time resident household incomes.

On an annualized basis after stabilization of the community in 2030, the State will generate income taxes of $51,200.

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT
All Amounts Expressed in Constant 2017 Dollars

Development Period	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
	Development, Sales and Build-Out Period				
"New" Tax Collection Monies Only, Does not Include Existing Kauai Residents Moving to Development					
2. STATE INCOME TAXES					
Taxable Personal Income (Worker Wages Only, Excludes Kealia Mauka Homsites Resident Households)	$9,450,175	$29,102,152	$33,680,198	$72,232,526	$759,635
Taxable Corporate Profits (Includes profits from wroker and non-resident spending)	$595,369	$1,778,681	$2,943,865	$4,470,831	$283,430
Personal Taxes Paid	$481,959	$1,484,210	$1,717,690	$1,966,169	$38,741
Corporate Taxes Paid	$26,196	$78,262	$129,530	$104,458	$12,471
TOTAL STATE INCOME TAXES	$508,155	$1,562,472	$1,847,220	$2,070,627	$51,212

The State will collect <u>Gross Excise Taxes</u> (GET) of 4.166 percent on the gross amount of building contracts, construction supplies, spending by workers and part-time residents, and from the on-going business activity (community association and maintenance). During the 13-year construction period these receipts will total $7.4 million and a stabilized amount of $153,000 annually.

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT
All Amounts Expressed in Constant 2017 Dollars

Development Period	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
	Development, Sales and Build-Out Period				
"New" Tax Collection Monies Only, Does not Include Existing Kauai Residents Moving to Development					
3. STATE GROSS EXCISE TAX					
Taxable Transactions (Excludes Lima Ola Resident Spending)					
Construction Contracts	$31,051,779	$42,612,750	$47,347,500	$73,664,529	$127,440
Worker and Non-Resident Disposable Income Purchases	$4,725,088	$18,504,902	$32,655,403	$55,885,393	$3,542,878
Total Taxable Transactions	$35,776,867	$61,117,652	$80,002,903	$129,549,922	$3,670,318
TOTAL STATE EXCISE TAX	$1,490,715	$2,546,589	$3,333,481	$7,370,785	$152,931

Source: The Hallstrom Team/CBRE

In recent fiscal years, Income Tax and GET have generated about 74 percent of total State revenues, and secondary taxes and fees the remainder. We anticipate KMH activity will result in similar ratios of secondary taxes flowing from the project relative to the primary sources quantified.

The secondary State receipts are equal to 35 percent times the Income Tax and GET totals (26% divided by 74%).

Application of this ratio to the KMH income tax and GET sums results in a cumulative total estimated tax collection from the subject of $12.7 million during the initial forecasting period through 2030, and $276,000 annually on a stabilized basis.

The new/additional per capita cost for the County and State associated with the non-resident population component at KMH was calculated on a per capita basis as follows based on the 2017-18 fiscal year budgets for each as shown.

CALCULATION OF PER CAPITA GOVERNMENTAL COSTS FOR FISCAL-YEAR 2017-18	
County of Kauai Operating and Capital Budget	**$208,524,331**
Divided by Total County De Facto Population (Residents & Tourists)	93,877
County Per Capita Fiscal Year Expense	**$2,221**
State of Hawaii Operating Budget	$13,473,466,599
State of Hawaii Capital Budget	$758,632,000
Total State Budget	**$14,232,098,599**
Divided by Total State De Facto Population (Residents & Tourists)	1,702,168
State Per Capita Fiscal Year Expense	**$8,361**

The per capita costs for the County and State were multiplied by the average number of non-residents and their guests within KMH daily to arrive at the maximum costs to the government for servicing the 48 "new" persons added to the de facto population of the island.

The County of Kauai costs total $472,000 during the build-out period and stabilize at $94,000 annually. State of Hawaii costs total $1.8 million during build-out and stabilize at $355,000 per year.

The County of Kauai effectively "turns a profit" of $8.5 million during build-out (2017-2030) and at $1.2 million annually thereafter. The State has a net profit of $11 million during the modeling period and a nominal "loss" of $80,000 per year on a stabilized basis.

The total revenues, costs and net benefits are summarized in the following table.

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT

All Amounts Expressed in Constant 2017 Dollars

Development Period	Development, Sales and Build-Out Period: 2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
	"New" Tax Collection And Expenditure Monies Only				
TOTAL GROSS PUBLIC REVENUES					
Real Property Taxes To County of Kauai	$584,350	$1,354,914	$2,565,551	$4,504,814	$634,174
Adjustment for Other Proportional Taxes (1)	1.58	1.58	1.58	1.58	1.58
Adjusted Kauai County Revenues	$923,273	$2,140,764	$4,053,570	$7,117,607	$1,001,995
Plus Impact Fees (Park Fees)	$420,000	$0	$0	$420,000	
Total County of Kauai Receipts	$1,343,273	$2,140,764	$4,053,570	$7,537,607	$1,001,995
To State (Income Taxes and GET)	$1,998,870	$4,109,061	$5,180,701	$9,441,412	$204,143
Adjustment for Other Proportional Taxes (2)	1.35	1.35	1.35	1.35	1.35
Adjusted State Revenues	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
Plus Impact Fees	$0	$0	$0	$0	
Total State of Hawaii Receipts	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
AGGREGATE TAX REVENUES	$3,621,747	$7,687,996	$11,047,517	$19,863,513	$1,277,588
PUBLIC COSTS (Expenses)					
By County of Kauai	$0	$117,948	$353,845	$471,794	$94,359
By State of Hawaii	$0	$443,978	$1,331,933	$1,775,910	$355,182
TOTAL PUBLIC COSTS	$0	$561,926		$2,247,704	$449,541
TOTAL NET PUBLIC BENEFITS					
County of Kauai	$1,343,273	$2,022,815	$3,699,725	$7,065,813	$907,636
State of Hawaii	$2,698,474	$5,103,255	$5,662,014	$10,969,996	($79,588)
AGGREGATE NET BENEFITS	$4,041,747	$7,126,070	$9,361,739	$18,035,809	$828,048

(1) Real property taxes comprise 63.1 percent of General Fund in the Proposed County of Kauaii 2017-18 budget. Economic activity generates other revenue items of 36.9 percent or additional 58 percent above real property taxes.

(2) In recent fiscal years, Gross Excise and Income Taxes have averaged some 74 percent of total State revenues; other revenue items 26 percent, or 35 percent above income and gross excise taxes.

Source: The Hallstrom Team/CBRE

Assumptions and Limiting Conditions

1. CBRE, Inc. through its appraiser (collectively, "CBRE") has inspected through reasonable observation the subject property. However, it is not possible or reasonably practicable to personally inspect conditions beneath the soil and the entire interior and exterior of the improvements on the subject property. Therefore, no representation is made as to such matters.
2. The report, including its conclusions and any portion of such report (the "Report"), is as of the date set forth in the letter of transmittal and based upon the information, market, economic, and property conditions and projected levels of operation existing as of such date. The dollar amount of any conclusion as to value in the Report is based upon the purchasing power of the U.S. Dollar on such date. The Report is subject to change as a result of fluctuations in any of the foregoing. CBRE has no obligation to revise the Report to reflect any such fluctuations or other events or conditions which occur subsequent to such date.
3. Unless otherwise expressly noted in the Report, CBRE has assumed that:

(i) Title to the subject property is clear and marketable and that there are no recorded or unrecorded matters or exceptions to title that would adversely affect marketability or value. CBRE has not examined title records (including without limitation liens, encumbrances, easements, deed restrictions, and other conditions that may affect the title or use of the subject property) and makes no representations regarding title or its limitations on the use of the subject property. Insurance against financial loss that may arise out of defects in title should be sought from a qualified title insurance company.

(ii) Existing improvements on the subject property conform to applicable local, state, and federal building codes and ordinances, are structurally sound and seismically safe, and have been built and repaired in a workmanlike manner according to standard practices; all building systems (mechanical/electrical, HVAC, elevator, plumbing, etc.) are in good working order with no major deferred maintenance or repair required; and the roof and exterior are in good condition and free from intrusion by the elements. CBRE has not retained independent structural, mechanical, electrical, or civil engineers in connection with this appraisal and, therefore, makes no representations relative to the condition of improvements. CBRE appraisers are not engineers and are not qualified to judge matters of an engineering nature, and furthermore structural problems or building system problems may not be visible. It is expressly assumed that any purchaser would, as a precondition to closing a sale, obtain a satisfactory engineering report relative to the structural integrity of the property and the integrity of building systems.

(iii) Any proposed improvements, on or off-site, as well as any alterations or repairs considered will be completed in a workmanlike manner according to standard practices.

(iv) Hazardous materials are not present on the subject property. CBRE is not qualified to detect such substances. The presence of substances such as asbestos, urea formaldehyde foam insulation, contaminated groundwater, mold, or other potentially hazardous materials may affect the value of the property.

(v) No mineral deposit or subsurface rights of value exist with respect to the subject property, whether gas, liquid, or solid, and no air or development rights of value may be transferred. CBRE has not considered any rights associated with extraction or exploration of any resources, unless otherwise expressly noted in the Report.

(vi) There are no contemplated public initiatives, governmental development controls, rent controls, or changes in the present zoning ordinances or regulations governing use, density, or shape that would significantly affect the value of the subject property.

(vii) All required licenses, certificates of occupancy, consents, or other legislative or administrative authority from any local, state, nor national government or private entity or organization have been or can be readily obtained or renewed for any use on which the Report is based.

(viii) The subject property is managed and operated in a prudent and competent manner, neither inefficiently or super-efficiently.

(ix) The subject property and its use, management, and operation are in full compliance with all applicable federal, state, and local regulations, laws, and restrictions, including without limitation environmental laws, seismic hazards, flight patterns, decibel levels/noise envelopes, fire hazards, hillside ordinances, density, allowable uses, building codes, permits, and licenses.

(x) The subject property is in full compliance with the Americans with Disabilities Act (ADA). CBRE is not qualified to assess the subject property's compliance with the ADA, notwithstanding any discussion of possible readily achievable barrier removal construction items in the Report.

(xi) All information regarding the areas and dimensions of the subject property furnished to CBRE are correct, and no encroachments exist. CBRE has neither undertaken any survey of the boundaries of the subject property nor reviewed or confirmed the accuracy of any legal description of the subject property.

Unless otherwise expressly noted in the Report, no issues regarding the foregoing were brought to CBRE's attention, and CBRE has no knowledge of any such facts affecting the subject property. If any information inconsistent with any of the foregoing assumptions is discovered, such information could have a substantial negative impact on the Report. Accordingly, if any such information is subsequently made known to CBRE, CBRE reserves the right to amend the Report, which may include the conclusions of the Report. CBRE assumes no responsibility for any conditions regarding the foregoing, or for any expertise or knowledge required to discover them. Any user of the Report is urged to retain an expert in the applicable field(s) for information regarding such conditions.

4. CBRE has assumed that all documents, data and information furnished by or behalf of the client, property owner, or owner's representative are accurate and correct, unless otherwise expressly noted in the Report. Such data and information include, without limitation, numerical street addresses, lot and block numbers, Assessor's Parcel Numbers, land dimensions, square footage area of the land, dimensions of the improvements, gross building areas, net rentable areas, usable areas, unit count, room count, rent schedules, income data, historical operating expenses, budgets, and related data. Any error in any of the above could have a substantial impact on the Report. Accordingly, if any such errors are subsequently made known to CBRE, CBRE reserves the right to amend the Report, which may include the conclusions of the Report. The client and intended user should carefully review all assumptions, data, relevant calculations, and conclusions of the Report and should immediately notify CBRE of any questions or errors within 30 days after the date of delivery of the Report.

5. CBRE assumes no responsibility (including any obligation to procure the same) for any documents, data or information not provided to CBRE, including without limitation any termite inspection, survey or occupancy permit.

6. All furnishings, equipment and business operations have been disregarded with only real property being considered in the Report, except as otherwise expressly stated and typically considered part of real property.

7. Any cash flows included in the analysis are forecasts of estimated future operating characteristics based upon the information and assumptions contained within the Report. Any projections of income, expenses and economic conditions utilized in the Report, including such cash flows, should be considered as only estimates of the expectations of future income and expenses as of the date of the Report and not predictions of the future. Actual results are affected by a number of factors outside the control of CBRE, including without limitation fluctuating economic, market, and property conditions. Actual results may ultimately differ from these projections, and CBRE does not warrant any such projections.

8. The Report contains professional opinions and is expressly not intended to serve as any warranty, assurance or guarantee of any particular value of the subject property. Other appraisers may reach different conclusions as to the value of the subject property. Furthermore, market value is highly related to exposure time, promotion effort, terms, motivation, and conclusions surrounding the offering of the subject property. The Report is for the sole purpose of providing the intended user with CBRE's independent professional opinion of the value of the subject property as of the date of the Report. Accordingly, CBRE shall not be liable for any losses that arise from any investment or lending decisions based upon the Report that the client, intended user, or any buyer, seller, investor, or lending institution may undertake related to the subject property, and CBRE has not been compensated to assume any of these risks. Nothing contained in the Report shall be construed as any direct or indirect recommendation of CBRE to buy, sell, hold, or finance the subject property.

9. No opinion is expressed on matters which may require legal expertise or specialized investigation or knowledge beyond that customarily employed by real estate appraisers. Any user of the Report is advised to retain experts in areas that fall outside the scope of the real estate appraisal profession for such matters.

10. CBRE assumes no responsibility for any costs or consequences arising due to the need, or the lack of need, for flood hazard insurance. An agent for the Federal Flood Insurance Program should be contacted to determine the actual need for Flood Hazard Insurance.

11. Acceptance or use of the Report constitutes full acceptance of these Assumptions and Limiting Conditions and any special assumptions set forth in the Report. It is the responsibility of the user of the Report to read in full, comprehend and thus become aware of all such assumptions and limiting conditions. CBRE assumes no responsibility for any situation arising out of the user's failure to become familiar with and understand the same.

12. The Report applies to the property as a whole only, and any pro ration or division of the title into fractional interests will invalidate such conclusions, unless the Report expressly assumes such pro ration or division of interests.

13. The allocations of the total value estimate in the Report between land and improvements apply only to the existing use of the subject property. The allocations of values for each of the land and improvements are not intended to be used with any other property or appraisal and are not valid for any such use.
14. The maps, plats, sketches, graphs, photographs, and exhibits included in this Report are for illustration purposes only and shall be utilized only to assist in visualizing matters discussed in the Report. No such items shall be removed, reproduced, or used apart from the Report.
15. The Report shall not be duplicated or provided to any unintended users in whole or in part without the written consent of CBRE, which consent CBRE may withhold in its sole discretion. Exempt from this restriction is duplication for the internal use of the intended user and its attorneys, accountants, or advisors for the sole benefit of the intended user. Also exempt from this restriction is transmission of the Report pursuant to any requirement of any court, governmental authority, or regulatory agency having jurisdiction over the intended user, provided that the Report and its contents shall not be published, in whole or in part, in any public document without the written consent of CBRE, which consent CBRE may withhold in its sole discretion. Finally, the Report shall not be made available to the public or otherwise used in any offering of the property or any security, as defined by applicable law. Any unintended user who may possess the Report is advised that it shall not rely upon the Report or its conclusions and that it should rely on its own appraisers, advisors and other consultants for any decision in connection with the subject property. CBRE shall have no liability or responsibility to any such unintended user.

ADDENDA

Addendum A

MARKET STUDY TABLES

TABLE A

FORECAST KEALIA MAUKA HOMESITES FINISHED HOUSE LOT ABSORPTION WITH FULL-SELL OUT ACHIEVED WITHIN SEVEN YEARS OF GROUND-BREAKING						
			Finished House Lots Sold/Closed		Finished Single Family Homes Completed (1)	
Year	Project Year	Activity	Annually	Total	Annually	Total
2018	1	Final Approvals, Survey, Clearing and Grubbing of Site				
2019	2	On and Off-Site Infrastructure Commences and is Completed. Lot Pre-Sales Begin Mid-Year.				
2020	3	Initial Lot Sales Closing, Lot Sales Continuing, Initial Vertical Home Construction Commences.	60	60		
2021	4	Lot Sales Continuing, Initial Homes Finished, Home Construction Continues	50	110	20	20
2022	5	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	160	25	45
2023	6	Lot Sales Continuing, More Homes Finished, Home Construction Continues	50	210	25	70
2024	7	Lots Are Fully-Absorbed/Sold-Out, More Homes Finished, Home Construction Continues	26	236	25	95
2025 and Beyond		Homes Continue to be Constructed and Finished by Lot Purchasers			141	236

(1) Construction timing of finished single family homes estimated for economic modeling purposes-only as their build-out is outside the purview of the master developer who at this time envisions offering all product as finished house lots only. Full build-out of the subdivision could take decades or could be faster if blocks of lots are taken down by local builders for construction of "spec/tract" homes. Does not include any allowances for possible Accessory Dwelling Units ("ohanas") which may be built on some lots.

TABLE A-1

HISTORIC, CURRENT AND PROJECTED RESIDENT POPULATION TOTALS FOR THE STATE, COUNTY AND LIHUE TO KEKAHA STUDY AREA 2010 TO 2040 Market Study of the Proposed Kealia Mauka Homesites Kealia, Kauai, Hawaii	2017	2020	2025	2030	2035	2040
State Total (DBEDT Series 2040)	**1,457,600**	**1,481,240**	**1,543,240**	**1,602,340**	**1,657,500**	**1,708,920**
Average Annual Change in Persons	13,426	4,728	12,400	11,820	11,032	10,284
Average Annual Percent Growth	1.4%	0.3%	0.8%	0.8%	0.7%	0.6%
Kauai County General Plan (1)	**73,485**	**74,693**	**79,011**	**83,328**	**88,013**	**93,020**
Percent of State Total	5.0%	5.0%	5.1%	5.2%	5.3%	5.4%
Average Annual Change in Persons	913	242	864	864	937	1,001
Average Annual Percent Growth	1.9%	0.3%	1.2%	1.1%	1.1%	1.1%
DBEDT Forecasts 2040 Series		**75,640**	**80,000**	**84,380**	**88,730**	**93,020**
Persons Variance From Kauai GP		947	990	1,052	717	0
Percent Variance From Kauai GP		1.3%	1.3%	1.3%	0.8%	0.0%
Study Area (Lihue and East Kauai)						
1. Minimum Perspective (1, 2)	**38,101**	**39,009**	**42,366**	**45,723**	**48,566**	**51,650**
Percent of County Total	51.8%	52.2%	53.6%	54.9%	55.2%	55.5%
Average Annual Change in Persons	519	303	671	671	569	617
Average Annual Percent Growth	2.1%	0.5%	1.7%	1.6%	1.2%	1.3%
2. Maximum Perspective (3)	**38,101**	**39,679**	**43,054**	**46,554**	**50,054**	**53,554**
Percent of County Total	51.8%	53.1%	54.5%	55.9%	56.9%	57.6%
Average Annual Change in Persons	519	526	675	700	700	700
Average Annual Percent Growth	2.1%	0.8%	1.7%	1.6%	1.5%	1.4%

(1) From Appendix B - Kauai County General Plan, January 2017. Sourced to SMS Research Kauai 2035 General Plan: Socioeconomic Analysis and Forecasts (2014). 2017 figure extrapolated from State of Hawaii Data Book population estimate for Kauai County as of 2015. For 2025, figure is mid-point between 2020 and 2030 projections. 2040 figure taken from DBEDT Series 2040 projection.

(2) From same source as cited in footnote #1. Includes the districts of Lihue and East Kauai (Kawaihau). 2040 figure base on 2035 forecast and same growth rate as for 2030-2035 period.

TABLE A-2

HISTORIC, CURRENT AND PROJECTED RESIDENT POPULATION TOTALS FOR THE
STATE, COUNTY AND SUBJECT PLANNING AREAS 2010 TO 2040
FROM APPENDIX B OF THE JANUARY 2017 GENERAL PLAN APEENDICIES
Market Study of the Proposed Kealia Mauka Homesites
Kealia, Kauai, Hawaii
2017, 2025 and 2040 are extrapolations from the forecasted years.

	2010	2017	2020	2025	2030	2035	2040
State Total	**1,363,621**	**1,457,600**	**1,481,240**	**1,543,240**	**1,602,340**	**1,657,500**	**1,708,920**
Average Annual Change in Persons		18,796	4,728	12,400	11,820	11,032	10,284
Average Annual Percent Growth		1.4%	0.3%	0.8%	0.8%	0.7%	0.6%
Kauai County General Plan	**67,091**	**73,485**	**74,693**	**79,011**	**83,328**	**88,013**	**93,020**
Percent of State Total	4.9%	5.0%	5.0%	5.1%	5.2%	5.3%	5.4%
Average Annual Change in Persons		1,279	242	864	864	937	1,001
Average Annual Percent Growth		1.9%	0.3%	1.2%	1.1%	1.1%	1.1%
Study Area (Lihue to Kekaha)							
Lihue	**14,683**	**17,350**	**18,017**	**19,806**	**21,595**	**23,456**	**25,500**
Percent of County Total	21.9%	23.6%	24.1%	25.1%	25.9%	26.7%	27.4%
Average Annual Change in Persons		533	133	358	358	372	409
Average Annual Percent Growth		3.6%	0.8%	2.0%	1.8%	1.7%	1.7%
East Kauai	**19,784**	**20,750**	**20,992**	**22,560**	**24,128**	**25,110**	**26,150**
Percent of County Total	29.5%	28.2%	28.1%	28.6%	29.0%	28.5%	28.1%
Average Annual Change in Persons		193	48	314	314	196	208
Average Annual Percent Growth		1.0%	0.2%	1.5%	1.4%	0.8%	0.8%
TOTAL STUDY AREA	**34,467**	**38,101**	**39,009**	**42,366**	**45,723**	**48,566**	**51,650**
Percent of County Total	51.4%	51.8%	52.2%	53.6%	54.9%	55.2%	55.5%
Average Annual Change in Persons		519	303	671	671	569	617
Average Annual Percent Growth		2.1%	0.5%	1.7%	1.6%	1.2%	1.3%

Source: Appendix B - Kauai County General Plan, January 2017 , and The Hallstrom Team/CBRE, Inc

TABLE A-3

QUANTIFICATION OF HOUSING UNIT DEMAND FOR THE
LIHUE-EAST KAUAI STUDY AREA 2017 TO 2040

	2017	2020	2025	2030	2035	2040	Additional Units Required by 2040
Scenario One: Minimum Based on Appendix B - Kauai General Plan Projections							
Resident Population	38,101	39,009	42,366	45,723	48,566	51,650	
Average Household Size (1)	2.94	2.93	2.91	2.89	2.87	2.85	
Total Resident Units Required	12,959	13,314	14,559	15,821	16,922	18,123	
Vacancy Allowance	259	266	291	316	338	362	
(2 % of resident unit demand)							
Non-Resident Purchaser Allowance (2)	2,981	3,062	3,349	3,639	3,892	4,168	
(23% Stabilized of resident unit demand)							
TOTAL MARKET UNIT DEMAND	16,199	16,642	18,198	19,776	21,152	22,654	6,654
Scenario Two: Maximum Based on DBEDT Series 2040 Projections and Marginally Higher Trending							
Resident Population	38,101	39,679	43,054	46,554	50,054	53,554	
Average Household Size (1)	2.94	2.93	2.91	2.89	2.87	2.85	
Total Resident Units Required	12,959	13,542	14,795	16,109	17,440	18,791	
Vacancy Allowance	259	305	370	443	523	564	
(2% to 3% of resident unit demand)							
Non-Resident Purchaser Allowance (2)	2,981	3,115	3,551	3,947	4,360	4,886	
(23% to 26% of resident unit demand)							
TOTAL MARKET UNIT DEMAND	16,199	16,962	18,716	20,498	22,324	24,240	8,240

CONCLUDED HOUSING UNIT DEMAND RANGE

	2017	2017-2020	2021-2025	2026-2030	2031-2035	2036-2040	Totals
MINIMUM DEMAND							
Periodic	199	443	1,556	1,578	1,376	1,501	6,654
Cumulative	199	692	2,331	3,909	5,285	6,786	
Average Annual Demand (3)		164	328	316	275	300	
MAXIMUM DEMAND							
Periodic	199	762	1,754	1,782	1,825	1,916	8,240
Cumulative	199	1,011	2,849	4,631	6,456	8,373	
Average Annual Demand (3)		271	367	356	365	383	
MID-POINT DEMAND							
Periodic	199	603	1,655	1,680	1,601	1,709	7,447
Cumulative	199	852	2,590	4,270	5,871	7,580	
Average Annual Demand (3)		217	348	336	320	342	

(1) Census data for 2011 -2015 reported average resident household size for Primary Study Area in ranged from 2.68 persons in Wailua Homesteads CDP to 3.15 in Lihue CCD, with average of about 2.90 to 2.95 persons. County Planners estimated East Kauai wil have average household size of 2.95 in 2020. We have used 2.94 persons as current figure and starting point for our trend analysis.

(2) There were an estimated 19,428 total residential and resort-residential units in the Lihue to Moloaa Corridor (East Kauai) as of the second quarter of 2017. These included 3,428 registered TVR units and 16,000 residential units, of which 13,120 units (82% of total residential inventory) are occupied/available for full-time resident Kauai households and 2,880 (18% of inventory) are owned by non-Kauai residents (second homes).

(3) Existing (or latent) demand is assumed absorbed evenly from 2017 though 2025.

Source: US Census, County of Kauai, DBEDT and The Hallstrom Team/CBRE.

TABLE A-4

HISTORIC, CURRENT AND PROJECTED RESIDENT HOUSEHOLD TOTALS FOR THE
COUNTY AND SUBJECT PLANNING AREAS 2010 TO 2040
FROM APPENDIX D OF THE JANUARY 2017 GENERAL PLAN APEENDICIES
Market Study of the Proposed Kealia Mauka Homesites
Kealia, Kauai, Hawaii
2017, 2025 and 2040 are extrapolations from the forecasted years.

	2010	2017	2020	2025	2030	2035	2040
Kauai County	23,240	25,370	25,902	27,345	28,788	30,349	31,974
Average Annual Change in Households		266	106	289	289	312	325
Average Annual Percent Growth		1.8%	0.4%	1.1%	1.1%	1.1%	1.1%
Study Area (Lihue to Kekaha)							
Lihue	4,983	5,837	6,051	6,666	7,281	7,923	8,623
Percent of County Total	21.4%	23.0%	23.4%	24.4%	25.3%	26.1%	27.0%
Average Annual Change in Households		171	43	123	123	128	140
Average Annual Percent Growth		3.4%	0.7%	2.0%	1.8%	1.8%	1.8%
East Kauai	7,177	7,562	7,658	7,941	8,224	8,545	8,920
Percent of County Total	30.9%	29.8%	29.6%	29.0%	28.6%	28.2%	27.9%
Average Annual Change in Households		77	19	57	57	64	75
Average Annual Percent Growth		1.1%	0.3%	0.7%	0.7%	0.8%	0.9%
TOTAL STUDY AREA	12,160	13,399	13,709	14,607	15,505	16,468	17,543
Percent of County Total	52.3%	52.8%	52.9%	53.4%	53.9%	54.3%	54.9%
Average Annual Change in Households		248	62	180	180	193	215
Average Annual Percent Growth		2.0%	0.5%	1.3%	1.2%	1.2%	1.3%
Total Increase in Resident Households 2017 Through 2040						4,144	
Average Annual Growth in Households						180	

Source: Appendix D - Kauai County General Plan, January 2017 , and The Hallstrom Team/CBRE, Inc

TABLE A-5

STRIATED PROJECTIONS OF SINGLE FAMILY HOUSING UNIT DEMAND
BY SELLING PRICE IN THE LIHUE-MOLOAA STUDYAREA 2017 TO 2040
Expressed in Constant 2017 Dollars

Period	2017 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	Total Demand 2017-2040
1. Minimum Demand Forecasts						
Less Than $311,000 (1)	**110**	**307**	**281**	**237**	**250**	**1,184**
Percent of Total Demand	28.00%	27.50%	27.00%	26.50%	26.00%	26.90%
$311,000 to $539,000 (2)	**172**	**496**	**469**	**407**	**442**	**1,986**
Percent of Total Demand	44.00%	44.50%	45.00%	45.50%	46.00%	45.10%
$539,000 to $1,000,000	**86**	**245**	**229**	**197**	**211**	**969**
Percent of Total Demand	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%
Over $1,000,000	**23**	**67**	**62**	**54**	**58**	**264**
Percent of Total Demand	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Total Market Demand	391	1,115	1,041	894	961	4,403
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
2. Maximum Demand Forecasts						
Less Than $311,000 (1)	**172**	**344**	**318**	**314**	**319**	**1,467**
Percent of Total Demand	28.00%	27.50%	27.00%	26.50%	26.00%	26.89%
$311,000 to $539,000 (2)	**271**	**556**	**529**	**540**	**564**	**2,460**
Percent of Total Demand	44.00%	44.50%	45.00%	45.50%	46.00%	45.11%
$539,000 to $1,000,000	**135**	**275**	**259**	**261**	**270**	**1,200**
Percent of Total Demand	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%
Over $1,000,000	**37**	**75**	**71**	**71**	**74**	**327**
Percent of Total Demand	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
Total Market Demand	615	1,249	1,176	1,187	1,227	5,454
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

First Quarter 2017 MLS Median Sale Prices

	Residential	Condo	Land
Kawaihau	$574,000	$418,000	$327,500
% Annual Chg.	5.6%	N/A	N/A
Lihue	$500,000	$277,500	$280,000
% Annual Chg.	6.4%	N/A	23.1%

(1) This price is considered "affordable" for four-person households earning 80% of the median county household income ("Low Income").
(2) This price is considered "affordable" for four-person households earning from 81% to 140% of county median (includes "Below Moderate" to "Gap Income" categories).

Source: Kauai County, DBEDT, MLS and CBRE, Inc.

TABLE A-6

ESTIMATE OF AFFORDABLE PRICING FOR A KAUAI HOUSE LOT BASED ON FAMILY INCOME ASSUMING FAMILY OF FOUR

Household Income As a Percent of Median Income	Household Income For Family of Four	Affordable Price for Single Family Home at 4.25 Percent Mortgage Interest Rate (1)	Percent of Total Home Price Available for Lot Purchase (2)	Affordable Finished House Lot Price for Income Group
80%	$68,250	$310,800	32%	**$100,000**
100%	$79,200	$369,300	32%	**$120,000**
120%	$95,050	$453,800	32%	**$150,000**
140%	$110,900	$538,400	32%	**$170,000**

(1) From "County of Kauai For Sale Limits by Family Size" assuming 4.25% 30-Year Fixed Interest Rate.
(2) Extrapolated from 2016 County of Kauai Affordable Pricing Guidelines.

Source: County of Kauai Housing Agency and The Hallstrom Team/CBRE.

TABLE A-7

SELECTED STUDY AREA CDP/CCP 2011-2015 CENSUS DATA Market Study of the Proposed Kealia Mauka Homesites Kealia, Kauai, Hawaii						
Census Designated Place (CDP) & Census County Division (CCD)	Wailua Homesteads CDP	Lihue CCD	Kapaa CCD	Wailua CDP	Wailua-Anahola CCD	Kauai County
Number of Housing Units	2,268	2,555	3,545	1,409	5,591	30,328
Percent Second Home Owner	8.3%	11.8%	23.2%	32.8%	18.2%	18.9%
Percent of Housing Units						
Single Family	92.4%	66.6%	64.0%	56.4%	82.4%	69.4%
Multifamily	7.6%	33.4%	36.0%	43.6%	17.6%	30.6%
Median Value of Owner-Occupied Units	$591,400	$458,700	$426,300	$432,100	$541,300	$480,600
Median Gross Monthly Rent	$1,425	$1,235	$1,273	$1,519	$1,451	$1,267
Median Household Income	$69,527	$59,640	$63,609	$67,425	$66,384	$65,101
Percent of Resident Occupied Housing Units						
Owner-Occupied	66.9%	60.1%	55.6%	60.5%	66.5%	61.6%
Renter Occupied	33.1%	39.9%	44.4%	39.5%	33.5%	38.4%
Total Households	2,080	2,254	2,724	947	4,573	22,405
Average Household Size						
Owner-Occupied Households	2.77	3.08	3.23	2.45	2.90	3.14
Renter Households	2.51	3.25	2.92	3.16	2.68	2.96
Average	2.68	3.15	3.09	2.73	2.83	3.07

Source: US Census, and CBRE, Inc.

TABLE A-8

DIVISION OF PROJECTED DEMAND BY UNIT TYPE FOR HOUSING UNITS IN LIHUE-MOLOAA STUDY AREA 2017 TO 2040	2017 to 2020	2021 to 2025	2026 to 2030	2031 to 2035	2036 to 2040	Total Demand 2017-2040
1. Using Minimum Demand Projections						
Single Family Homes	391	1,115	1,041	894	961	4,403
Percent of Total	70%	68%	66%	65%	64%	66%
Multifamily Units	168	525	536	482	540	2,251
Percent of Total	30%	32%	34%	35%	36%	34%
Total	**559**	**1,639**	**1,578**	**1,376**	**1,501**	**6,653**
	100%	100%	100%	100%	100%	100%
2. Using Maximum Demand Projections						
Single Family Homes	615	1,249	1,176	1,187	1,227	5,454
Percent of Total	70%	68%	66%	65%	64%	66%
Multifamily Units	264	588	606	639	690	2,786
Percent of Total	30%	32%	34%	35%	36%	34%
Total	**879**	**1,837**	**1,782**	**1,825**	**1,916**	**8,240**
	0%	0%	0%	0%	0%	0%
Mid-Point						
Single Family Homes	503	1,182	1,109	1,040	1,094	**4,928**
Multifamily Units	216	556	571	560	615	**2,519**
Total	719	1,738	1,680	1,601	1,709	7,447

Source: CBRE, Inc.

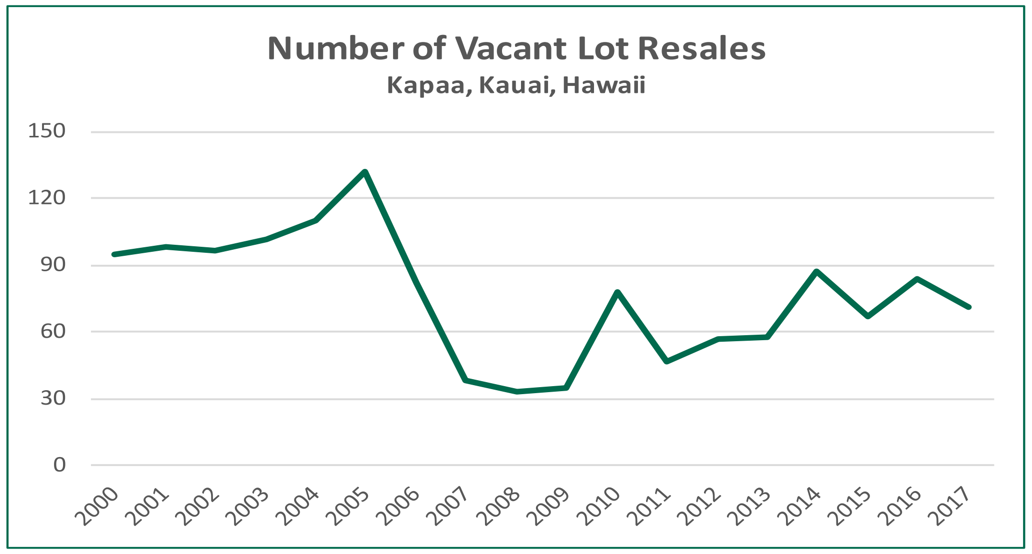
TABLE A-9

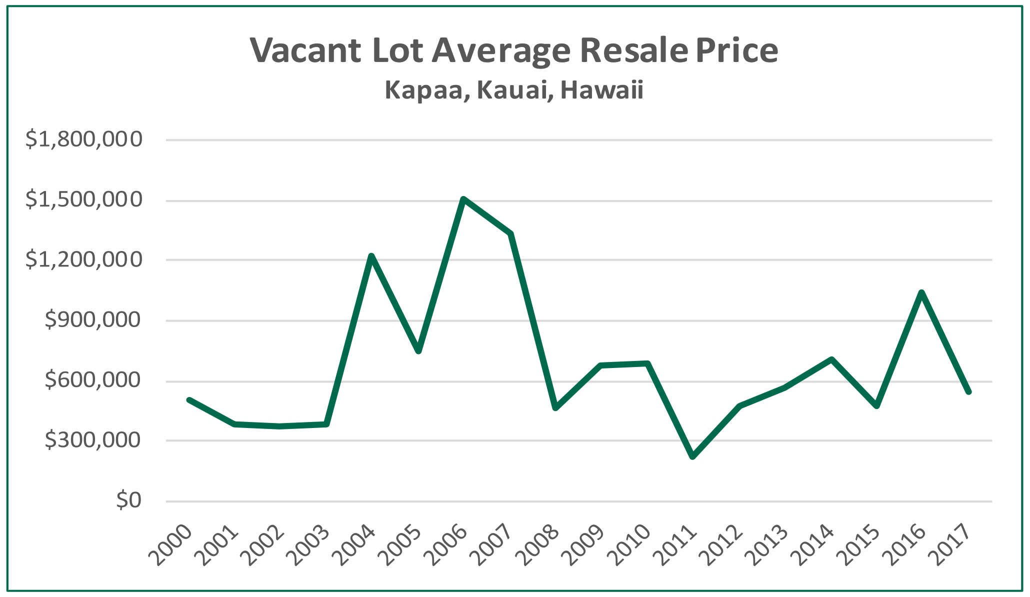
KAUAI MULTIPLE LISTING SERVICE SALES DATA FOR KAPAA AREA

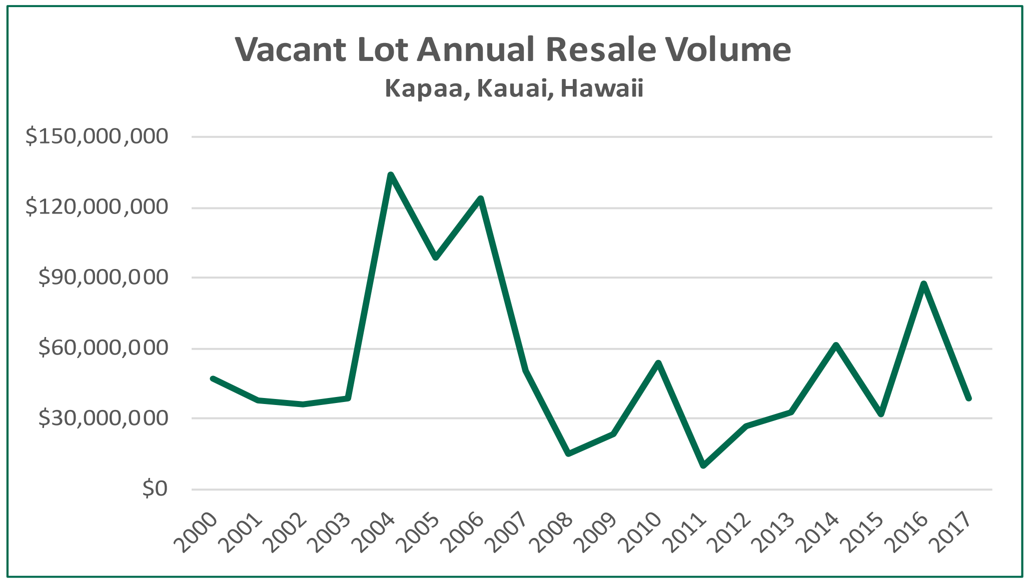
KAUAI MLS LAND/VACANT LOT STATISTICS
KAPAA, KAUAI, HAWAII

Year	# of Sales	Sales Average	Sales Volume
2000	95	$500,639	$47,560,693
2001	98	$386,182	$37,845,864
2002	97	$375,950	$36,467,197
2003	102	$379,878	$38,747,530
2004	110	$1,218,468	$134,031,430
2005	132	$747,437	$98,661,655
2006	82	$1,510,082	$123,826,691
2007	38	$1,339,125	$50,886,750
2008	33	$461,932	$15,243,767
2009	35	$681,310	$23,845,833
2010	78	$688,631	$53,713,248
2011	47	$221,575	$10,414,005
2012	57	$474,157	$27,026,973
2013	58	$570,196	$33,071,373
2014	87	$706,660	$61,479,392
2015	67	$475,073	$31,829,908
2016	84	$1,042,211	$87,545,689
2017	22	$548,736	$12,072,196

Compiled by CBRE







Note: 2017 data annualized for graphic plotting purposes.

Source: Kauai Multiple Listing Service and The Hallstrom Team/CBRE

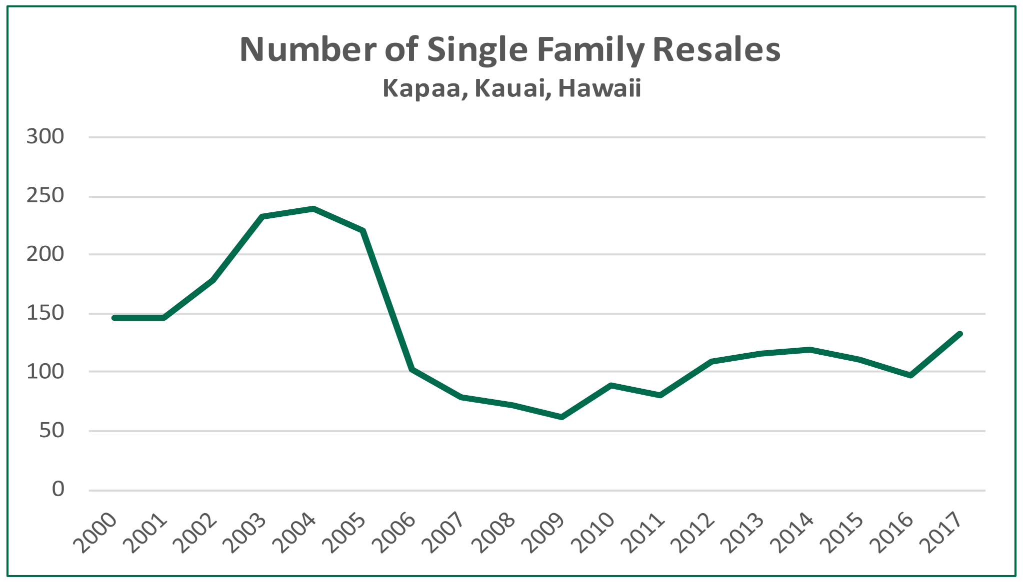
TABLE A-10

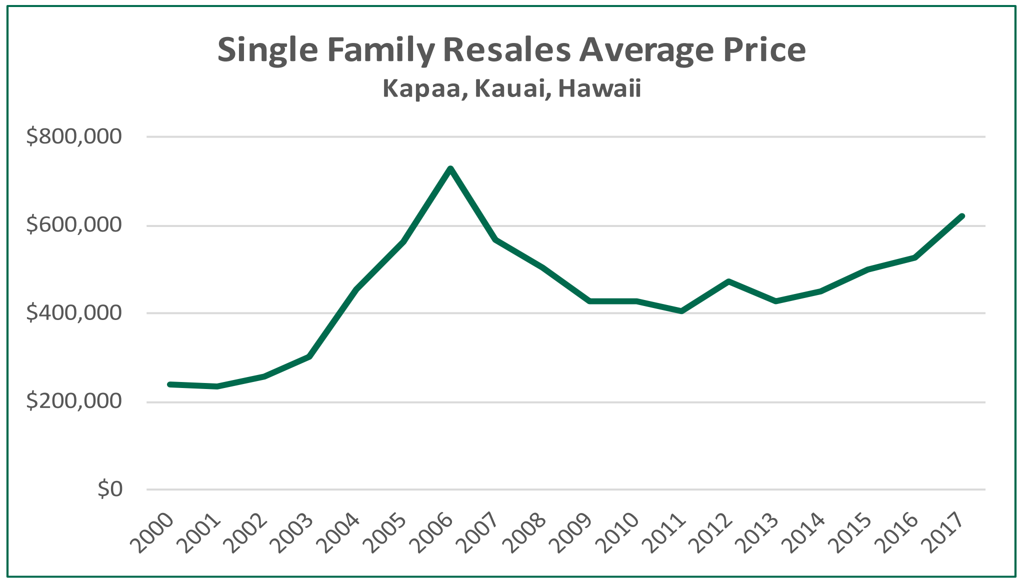
KAUAI MULTIPLE LISTING SERVICE SALES DATA FOR KAPAA AREA

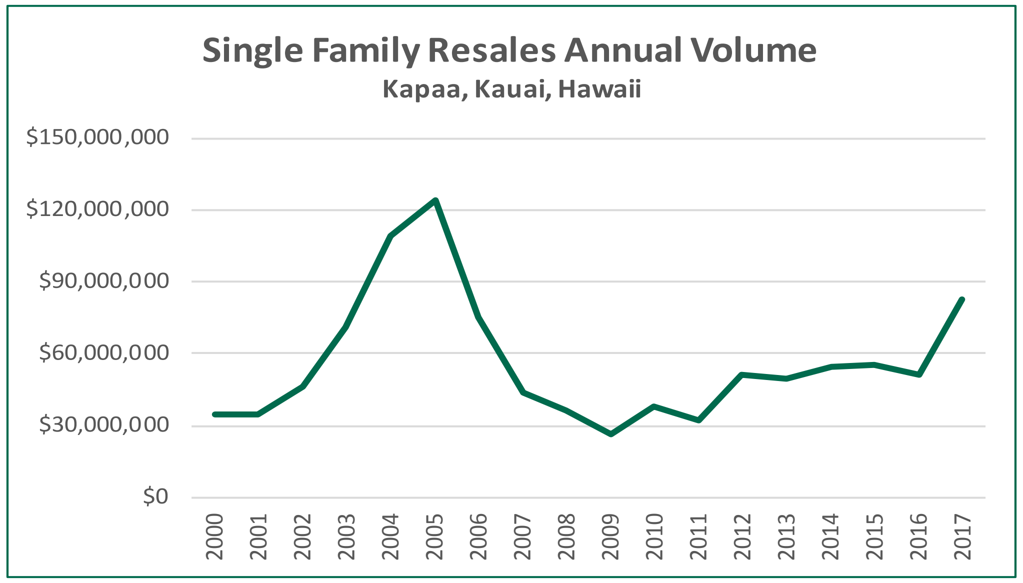
KAUAI MLS SINGLE FAMILY STATISTICS
KAPAA, KAUAI, HAWAII

Year	# of Sales	Sales Average	Sales Volume
2000	147	$237,996	$34,985,350
2001	147	$234,726	$34,504,785
2002	179	$256,233	$45,865,755
2003	233	$304,722	$71,000,163
2004	240	$455,236	$109,256,621
2005	220	$563,580	$123,987,549
2006	103	$727,703	$74,953,379
2007	78	$566,299	$44,171,297
2008	72	$504,649	$36,334,737
2009	62	$428,978	$26,596,655
2010	89	$429,467	$38,222,600
2011	80	$406,492	$32,519,393
2012	109	$473,773	$51,641,276
2013	116	$427,212	$49,556,582
2014	120	$451,082	$54,129,800
2015	111	$499,122	$55,402,585
2016	97	$527,380	$51,155,877
2017	41	$619,591	$25,403,249

Compiled by CBRE







Note: 2017 data annualized for graphic plotting purposes.

Source: Kauai Multiple Listing Service and The Hallstrom Team/CBRE

TABLE A-11

Entitled Residential Projects by District

District	Project Name	Housing Units
East Kaua'i	Pi'ilani Mai He Kai (DHHL Anahola)	181
	Kulana	172
	Kapa'a Highlands, Phase 2	769
	TOTAL	1,122
'Ele'ele	A&B 'Ele'ele Residential	201
	Lima Ola (Affordable)	450
	TOTAL	651
Līhu'e	DHHL Wailua, Phase 1	188
	Kohea Loa - D.R. Horton	444
	Pikake Subdivision	146
	Grove Farm Wailani Residential	1,450
	Koamalu	220
	Waiola Phase I	47
	Waiola Phase II	56
	Waiola Phase II	93
	TOTAL	2,644
North Shore	Kolopua (Princeville Affordable)	44
	TOTAL	44
South Kaua'i	Brydeswood Ranch (A&B)	24
	Kōloa Creekside	72
	Kukui'ula Employee Housing	100
	Kukui'ula	750
	The Village at Koloa Town	34
	Kōloa Camp - Waihononu	50
	CIRI (CLDC) Subdivision	10
	TOTAL	1,040
Waimea	Kekaha lots	40
	Kikiaola Mauka	270
	Kikialoa - Field 14	56
	TOTAL	366
	ISLAND TOTAL	5,867

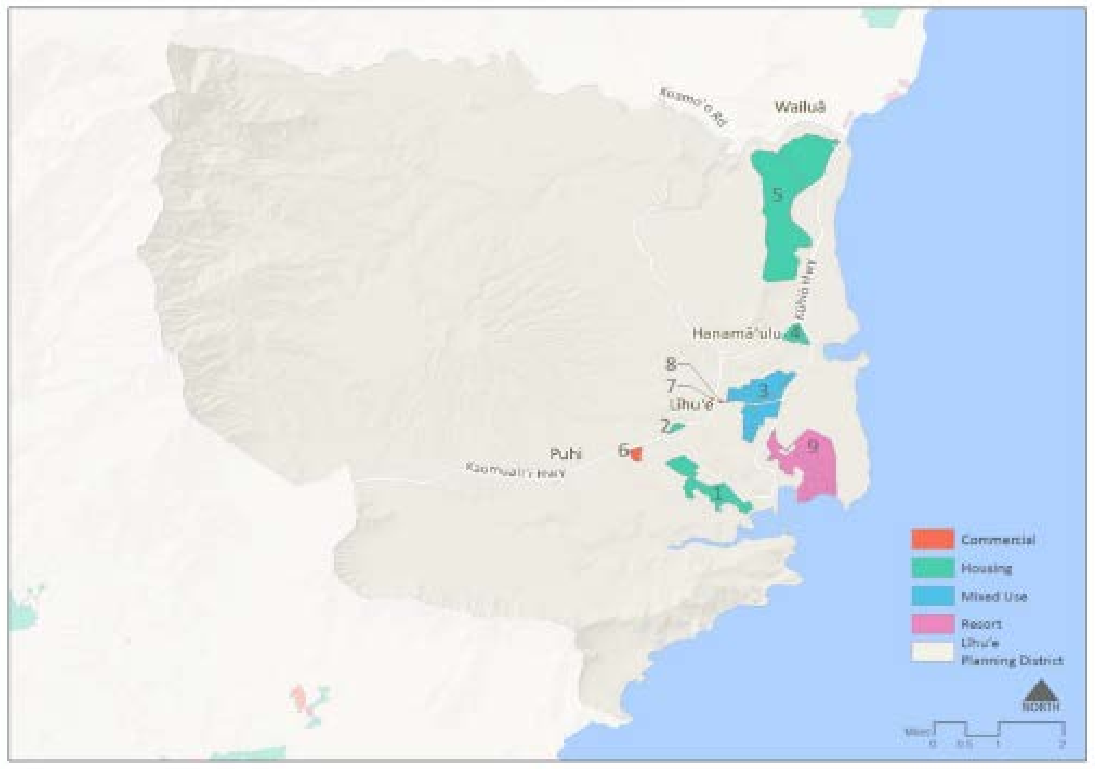
Total Proposed Residential Units Within Study Area (Excluding Kealia Mauka Homesites)

Location	No. Of Units
East Kauai	1,122
Lihue	2,644
Total	3,766

Source: County of Kauai

TABLE A-12

Līhu'e District



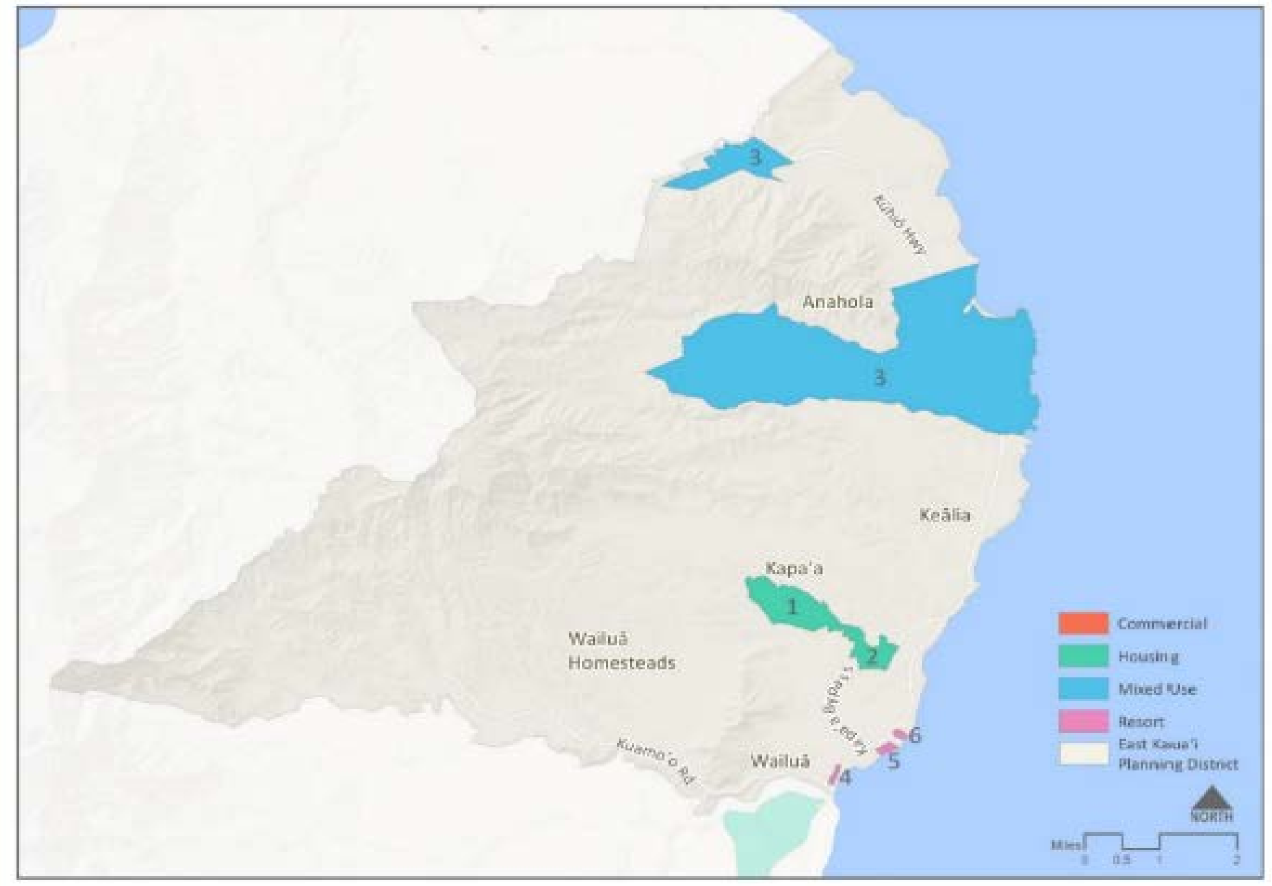
Residential

Map #	Project Name	Housing Units	GP Land Use	Status
1	Waiola Phases I-III	196	Urban Center, Open, Residential	Final Approvals
2	Koamalu	220	Urban Center	Submitted Annual Status Report
3	Grove Farm Wailani Residential	1,450	Urban Center	Negotiating infrastructure and access issues
4	Kohea Loa – D.R. Horton	444	Urban Center	Submitted 2013 Status Report
5	DHHL Wailuā, Phase I	188	Agriculture	No plans for development within GP timeframe
	TOTAL	**2,498**		

Resort

Map #	Project Name	Resort Units	GP Land Use	Status
9	Kaua'i Lagoons	700	Resort	Submitted annual status report (2/8/11)
	TOTAL	**700**		

East Kaua'i District



Residential

Map #	Project Name	Housing Units	GP Land Use Designation	Status
1	Kūlana	172	Agriculture	Permitted as an Agricultural development
2	Kapa'a Highlands Phase II	769	Urban Center, Agriculture, Open	Seeking SLU Amendment
3	Pi'ilani Mai He Kai (DHHL Anahola)	181	Urban Center, Agriculture, Open	Phase II began in 2012
	TOTAL	**1,122**		

Resort

Map #	Project Name	Resort Units	GP Land Use Designation	Status
4	Coconut Plantation	192	Resort	Submitted annual status report (2/8/11)
5	Coco Palms	350	Resort	Approved March 2015
6	Coconut Beach Resort	335	Resort	Construction to start 2015
	TOTAL	**877**		

Summary of Total Proposed Study Area Residential and Resort-Residential Units (Excluding Kealia Mauka Homesites)

Location	Residential	Resort-Residential	Total
Lihue	2,498	700	3,198
East Kauai	1,122	877	1,999
Totals	3,620	1,577	5,197

Source: County of Kauai

Addendum B

ESTIMATED SUBJECT ABSORPTION TABLES

TABLE B-1

PROJECTION OF POTENTIAL SUBJECT UNIT ABSORPTION USING THE RESIDUAL METHOD BASED ON TOTAL DEMAND FOR RESIDENTIAL UNITS IN THE LIHUE-MOLOAA STUDY AREA

Segment	TOTAL UNITS PROPOSED Excluding Subject	2017-2020	2021-2025	2026-2030	2031-2035	2036-2040	Total
All Residential Unit Types							
Identified Supply (1)	5,297	750	1,000	1,100	1,200	1,247	5,297
Percentage of Total Supply		14%	19%	21%	23%	24%	100%
Regional Housing Unit Demand (mid-point)	7,447	719	1,738	1,680	1,601	1,709	7,447
Shortage or (Excess) Supply	2,150	(31)	738	580	401	462	2,150
Potential Residual Subject Unit Demand							
at 75% Capture Rate	1,612	-23	554	435	301	346	1,612
at 60% Capture Rate	1,290	-19	443	348	240	277	1,290

= Probable Kealia Mauka Homesites Absorption Period. 236 lots would require from circa three to four years.

(1) Includes allowance of 100 unsold units in completed projects not included within the identified inventory supply.

Source: The Hallstrom Team/CBRE

TABLE B-2

SUMMARY OF SUBJECT PROJECTED DEMAND LEVELS
USING THE MARKET SHARES METHOD

Assuming 236 Saleable House Lots with Pre-Sales Starting in Mid-2019 and First Closings in 2020

Scenario One: Using Minimum Demand Assumptions

Sales Year Date	Sales Year Period	Total Regional Demand	Effective Subject Share	Indicated Total Subject Absorption
2020	1	140	18.00%	25
2021	2	328	15.00%	49
2022	3	328	15.00%	49
2023	4	328	15.00%	49
2024	5	328	15.00%	49
2025	6	328	4.20%	14
Totals	**5.30**	**1,779**	**13.25%**	**236**

Scenario Two: Using Maximum Demand Assumptions

Sales Year Date	Sales Year Period	Total Regional Demand	Effective Subject Share	Indicated Total Subject Absorption
2020	1	220	20.00%	44
2021	2	367	18.00%	66
2022	3	367	18.00%	66
2023	4	367	16.20%	60
Totals	**3.90**	**1,322**	**17.83%**	**236**
ANALYSIS MID-POINT				
4.6 Years		1,551	15.20%	236

Source: The Hallstrom Team/CBRE, Inc.

Addendum C

ECONOMIC IMPACT ANALYSIS TABLES

TABLE C-1

SUMMARY COMPARISON OF MAJOR ECONOMIC IMPACTS FOR THE KEALIA MAUKA HOMESITES COMMUNITY All Amounts Expressed in Constant, Uninflated 2017 Dollars		
Analysis Item	Cumulative During Build-Out Period	Stabilized Annually Thereafter
Direct Capital Investment	$121,012,029	
Local Contractor's Profits	$12,101,203	
Local Supplier's Profits	$4,840,481	
Worker Years of Jobs	1,048	20
Employee Wages	$72,232,526	$759,635
Full-Time Resident Population		658
Total De Facto Population		700
Full-Time Resident Household Income	$99,662,800	$19,932,560
Resident Population Discretionary Expenditures	$87,041,520	$12,132,713
Total Kauai "Base" Economic Impact	$225,952,518	$13,741,947

Source: The Hallstrom Team/CBRE

TABLE C-2

ESTIMATED AVERAGE "ALL IN" HOME DEVELOPMENT COST AT KEALIA MAUKA HOMESITES SUBDIVISION BEFORE LAND Assuming Typical Three-Bedroom, Two-Bathroom House with Two-Car Garage, Patio, Porch, Paved Driveway, and Front-Yard Landscaping			
Unit Cost Item	Modest Quality Home	Upscale Quality Home	Mid-Point Single Family Home
Average Home Size in Gross Square Feet of Living Area	1,100	2,200	1,650
"All-In" Construction Cost Per Square Foot	$200	$250	$225
Site Work/Hardscape/Landscaping Cost	$25,000	$35,000	$30,000
Total Vertical Construction Cost per Home	**$245,000**	**$585,000**	**$401,250**
Plus Allocated Infrastructure Cost per Unit	$110,000	$110,000	$110,000
Total Per Home "All in" Development Cost Before Land	**$355,000**	**$695,000**	**$511,250**

Source: Rider Levitt Bucknall and The Hallstrom Team/CBRE

TABLE C-3

PROPOSED KEALIA MAUKA HOMESITES DEVELOPMENT SCHEDULE AND ESTIMATED CONSTRUCTION COSTS All Amounts Expressed in Constant 2017 Dollars				
Item	Development, Sales and Build-Out Period			Totals During Build-Out
	2017 to 2020	2021 to 2025	2026 to 2030	
Infrastructure Emplacement	$26,317,029	$0	$0	**$26,317,029**
Residential Construction	$4,734,750	$42,612,750	$47,347,500	**$94,695,000**
TOTAL PERIODIC CONSTRUCTION COSTS	**$31,051,779**	**$42,612,750**	**$47,347,500**	**$121,012,029**
Contractor Profits	$3,105,178	$4,261,275	$4,734,750	**$12,101,203**
Supplier Profits	$1,242,071	$1,704,510	$1,893,900	**$4,840,481**

Source: The Hallstrom Team/CBRE

TABLE C-4

ESTIMATED YEARLY FULL-TIME EQUIVALENT EMPLOYMENT POSITIONS CREATED BY DEVELOPMENT					
	Development, Sales and Build-Out Period			Totals During Build-Out	
Construction Employment (1)	2017 to 2020	2021 to 2025	2026 to 2030		
Infrastructure Emplacement	66	0	0	**66**	
Residential Units	32	284	316	**631**	
Total Periodic Construction Jobs	**97**	**284**	**316**	**697**	
On-Going Employment					Stabilized Annually
Maintenance & Common Element (2)	0	30	59	89	
Total FTE Jobs in Place at End of Period	0	9	15		15
Off-Site Employment (3)	32	105	125	262	
Total FTE Jobs in Place at End of Period	0	3	5		5
TOTAL PERIODIC WORKER YEARS	**130**	**418**	**500**	**1,048**	
TOTAL END-OF-PERIOD PERMANENT JOBCOUNT	**0**	**12**	**20**		**20**

(1) Infrastructure construction employment estimated at 1 worker-year for every $400,000 in costs. Vertical construction employment estimated at 1 worker-year for every $150,000 in costs. Includes all direct employment associated with construction, on and off-site.

(2) Includes community common element administration and maintenance staff of 3 FTE jobs and ratio of one FTE maintenance/repair worker for every 20 homes.

(3) Estimated at one cumulative off-site employment position for every three on site positions.

Source: The Hallstrom Team/CBRE

TABLE C-5

ESTIMATED YEARLY EMPLOYEE WAGES CREATED BY DEVELOPMENT

All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period			Totals During Build-Out	
Construction Wages (1)	2017 to 2020	2021 to 2025	2026 to 2030		
Infrastructure Emplacement	$5,200,245	$0	$0	$5,200,245	
Residential Units	$2,494,898	$22,454,078	$24,948,976	$49,897,952	
Total Periodic Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	
					Stabilized Annually
Maintenance & Common Element (2)	$0	$990,675	$1,973,025	$2,963,700	$492,840
Off-Site Employment Wages (3)	$1,755,033	$5,657,399	$6,758,197	$14,170,629	$266,795
TOTAL PERIODIC WAGES	$9,450,175	$29,102,152	$33,680,198	$72,232,526	$759,635

(1) Average annual wage for full-time-equivalent construction worker (all trades) at $79,040 ($38/hour X 2,080 hours).

(2) Average annual wage for full-time-equivalent maintenance and security workers at $33,300 ($16/hour).

(3) Average annual wage for full-time-equivalent general worker at $54,080 ($26/hour), the average wage for all "Total Private Workers" in the state.

Wages taken from State of Hawaii "Hawaii Workforce Infonet" "Publications and Tables> Production Worker H&E Data Hours and Earnings" for 2016.

Source: The Hallstrom Team/CBRE

TABLE C-6

ESTIMATED RESIDENT POPULATION, HOUSEHOLD INCOME AND DISCRETIONARY EXPENDITURES

All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period				
	2017 to 2020	2021 to 2025	2026 to 2030	Stabilized	Totals
Total Number of Single Family Homes Occupied (End of Period)	0	118	236	236	
Percent of Total Units	0%	50%	100%	100%	
Full-Time Resident Housholds	0	97	194	194	
Percent of Total Units	82%	82%	82%	82%	
Second Home (Non-Resident) Owner Households	0	21	42	42	
Percent of Total Units	18%	18%	18%	18%	
Average Resident Household Size (1)	3.4	3.4	3.4		
Total Resident Population End of Period	0	329	658	658	
Average Non-Resident Household Size (2)	1.0	1.0	1.0		
Average Daily Non-Resident Population End of Period	0	21	42	42	
Total De Facto (Resident and Non-Resident) Daily Population End of Period	0	350	700	700	
					During Build-Out
RESIDENT HOUSEHOLD INCOME (3)					
Total Annual Household Income at End of Period	$0	$9,966,280	$19,932,560	$19,932,560	
Total Household Income During Period	$0	$24,915,700	$74,747,100		$99,662,800
TOTAL DE FACTO POPULATION DISCRETIONARY EXPENDITURES (4)					
Average Annually During Period	$0	$5,275,591	$12,132,713	$12,132,713	
Total During Period	$0	$26,377,956	$60,663,564		$87,041,520

(1) Average household size of 3.4 persons.

(2) Average party-size of 3.5 persons with occupancy at 30% of year, or de facto daily household size of 1.05 persons. Rounded to 1.0 persons.

(2) Estimated at $103,000 per year or 130% of median household income for four-person household.

(4) Residents household assumed to have average of 45% of gross income as net disposable. Non-Resident Households assumed to have spending at $204 per person per day, which is the average daily spending by Kauai visitor through May 2017.

Source: The Hallstrom Team/CBRE

TABLE C-7

SUMMARY OF ECONOMIC IMPACTS ASSOCIATED WITH DEVELIOPMENT

All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period				
	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out	Stabilized Annually
Construction Activity					
Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	
Contractor Profits	$3,105,178	$4,261,275	$4,734,750	$12,101,203	
Supplier Profits	$1,242,071	$1,704,510	$1,893,900	$4,840,481	
Other Construction Costs	$19,009,387	$14,192,887	$15,769,874	$48,972,148	
Total Construction Impact	$31,051,779	$42,612,750	$47,347,500	$121,012,029	
Maintenance & Common Element Wages	$0	$990,675	$1,973,025	$2,963,700	$492,840
Off-Site Wages	$1,755,033	$5,657,399	$6,758,197	$14,170,629	$266,795
Total Project Population Spending	$0	$26,377,956	$60,663,564	$87,041,520	$12,132,713
Unit Maintenance & Repairs (1)	$0	$169,920	$594,720	$764,640	$849,600
TOTAL BASE ECONOMIC IMPACT	$32,806,812	$75,808,700	$117,337,006	$225,952,518	$13,741,947

(1) Estimated at $3,600 annually per unit.

Source: The Hallstrom Team/CBRE

TABLE C-8

ESTIMATES OF TOTAL ECONOMIC IMPACT FROM SUBJECT CONSTRUCTION USING STATE INPUT-OUTPUT MODEL "TYPE II" MULTIPLIERS All Amounts Expressed in Constant 2017 Dollars	Development, Sales and Build-Out Period			Totals	Stabilized
Year	2017 to 2020	2021 to 2025	2026 to 2030		Annually
Construction Costs	$31,051,779	$42,612,750	$47,347,500	$121,012,029	$127,440
1. Economic Output Multiplier	2.12	2.12	2.12	2.12	2.12
Total State Economic Output	$65,829,771	$90,339,030	$100,376,700	$256,545,501	$270,173
2. Earnings Multiplier	0.61	0.61	0.61	0.61	0.61
Total Increase in State Earnings	$18,941,585	$25,993,778	$28,881,975	$73,817,338	$77,738
3. State Tax Multipliers	0.12	0.12	0.12	0.12	0.12
Total Increase in State Taxes	$3,726,213	$5,113,530	$5,681,700	$14,521,443	$15,293
4. Total Job Multipliers	13.83	13.83	13.83	13.83	13.83
Total State Jobs Created	429.4	589.3	654.8	1,673.6	1.8
Construction Employment	97	284	316	697	6
5. Direct-Effect Job Multipliers	2.68	2.68	2.68	2.68	2.68
Total Direct Jobs Created	260.9	761.3	845.9	1,868.2	15.2
Construction Wages	$7,695,143	$22,454,078	$24,948,976	$55,098,197	$306,309
6. Direct-Effect Earnings	2.02	2.02	2.02	2.02	2.02
Total Increase in Direct Earnings	$15,544,188	$45,357,238	$50,396,932	$111,298,358	$618,744

Source: State Input-Output Model and The Hallstrom Team/CBRE

TABLE C-9

ESTIMATES OF TOTAL ECONOMIC IMPACT FROM SUBJECT OPERATIONS
USING STATE INPUT-OUTPUT MODEL "TYPE II" MULTIPLIERS
All Amounts Expressed in Constant 2017 Dollars

	Development, Sales and Build-Out Period			Totals	Stabilized
Year	2017 to 2020	2021 to 2025	2026 to 2030		Annually
Household Spending & Maintenance	$0	$26,547,876	$61,258,284	$87,806,160	$12,982,313
1. Economic Output Multiplier	2.09	2.09	2.09	2.09	2.09
Total State Economic Output	$0	$55,485,061	$128,029,814	$183,514,874	$27,133,034
2. Earnings Multiplier	0.66	0.66	0.66	0.66	0.66
Total Increase in State Earnings	$0	$17,521,598	$40,430,467	$57,952,066	$8,568,326
3. State Tax Multipliers	0.16	0.16	0.16	0.16	0.16
Total Increase in State Taxes	$0	$4,247,660	$9,801,325	$14,048,986	$2,077,170
4. Total Job Multipliers	19.00	19.00	19.00	19.00	19.00
Total State Jobs Created	0.0	504.4	1,163.9	1,668.3	246.7
Operating Employment	0.0	11.9	19.7	31.6	19.7
5. Direct-Effect Job Multipliers	2.05	2.05	2.05	2.05	2.05
Total Direct Jobs Created	0.0	24.3	40.5	64.8	40.5
Operating Wages	$0	$990,675	$1,973,025	$2,963,700	$759,635
6. Direct-Effect Earnings	1.89	1.89	1.89	1.89	1.89
Total Increase in Direct Earnings	$0	$1,872,376	$3,729,017	$5,601,393	$1,435,710

Source: State Input-Output Model, and The Hallstrom Team/CBRE

Addendum D

PUBLIC FISCAL ASSESSMENT TABLES

TABLE D-1

SUMMARY COMPARISON OF MAJOR PUBLIC FISCAL BENEFITS FOR THE KEALIA MAUKA HOMESITES COMMUNITY Accounting for "New" Direct Impacts Only All Amounts Expressed in Constant, Uninflated 2017 Dollars		
Analysis Item	Cumulative During Build-Out Period	Stabilized Annually Thereafter
County of Kauai Gross Tax Receipts	$8,976,178	$1,289,709
State of Hawaii Gross Tax Receipts	$12,745,906	$275,594
County of Kauai Costs of Services (per capita basis)	$471,794	$94,359
State Costs of Services (per capita basis)	$1,775,910	$355,182
County of Kauai Net Benefits or (Loss)	$8,504,384	$1,195,350
State Net Benefits or (Loss)	$10,969,996	($79,588)

Source: The Hallstrom Team/CBRE

TABLE D-2

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT

All Amounts Expressed in Constant 2017 Dollars

Development Period	Development, Sales and Build-Out Period 2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
PUBLIC BENEFITS (Revenues)					
1. COUNTY REAL PROPERTY TAXES					
Cumulative Assessed Value During Period					
Finished Homes End of Period	0	118	236		236
Vacant Land/Finished Lots Prior to Sale	$93,000,000	$92,925,000	$30,975,000	$216,900,000	$0
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$37,243,750	$111,731,250	$148,975,000	$29,795,000
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$86,191,625	$258,574,875	$344,766,500	$68,953,300
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$33,519,375	$100,558,125	$134,077,500	$26,815,500
Total Assessed Value	$93,000,000	$249,879,750	$501,839,250	$844,719,000	$125,563,800
Real Property Taxes During Period					
Vacant Land/Finished Lots Prior to Sale	$584,350	$562,196	$187,399	$1,333,945	$0
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$262,568	$787,705	$1,050,274	$210,055
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$521,459	$1,564,378	$2,085,837	$417,167
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$236,312	$708,935	$945,246	$189,049
Total Real Property Taxes	$584,350	$1,582,536	$3,248,417	$5,415,302	$816,271
"New" Tax Collection Monies Only, Does not Include Existing Kauai Residents Moving to Development					
2. STATE INCOME TAXES					
Taxable Personal Income (Worker Wages Only, Excludes Kealia Mauka Homsites Resident Households)	$9,450,175	$29,102,152	$33,680,198	$72,232,526	$759,635
Taxable Corporate Profits (Includes profits from worker and non-resident spending)	$595,369	$1,778,681	$2,943,865	$4,470,831	$283,430
Personal Taxes Paid	$481,959	$1,484,210	$1,717,690	$1,966,169	$38,741
Corporate Taxes Paid	$26,196	$78,262	$129,530	$104,458	$12,471
TOTAL STATE INCOME TAXES	$508,155	$1,562,472	$1,847,220	$2,070,627	$51,212
3. STATE GROSS EXCISE TAX					
Taxable Transactions (Excludes Lima Ola Resident Spending)					
Construction Contracts	$31,051,779	$42,612,750	$47,347,500	$73,664,529	$127,440
Worker and Non-Resident Disposable Income Purchases	$4,725,088	$18,504,902	$32,655,403	$55,885,393	$3,542,878
Total Taxable Transactions	$35,776,867	$61,117,652	$80,002,903	$129,549,922	$3,670,318
TOTAL STATE EXCISE TAX	$1,490,715	$2,546,589	$3,333,481	$7,370,785	$152,931
"New" Tax Collection And Expenditure Monies Only					
TOTAL GROSS PUBLIC REVENUES					
Real Property Taxes To County of Kauai	$584,350	$1,582,536	$3,248,417	$5,415,302	$816,271
Adjustment for Other Proportional Taxes (1)	1.58	1.58	1.58	1.58	1.58
Adjusted Kauai County Revenues	$923,273	$2,500,406	$5,132,499	$8,556,178	$1,289,709
Plus Impact Fees (Park Fee)	$420,000	$0	$0	$420,000	
Total County of Kauai Receipts	$1,343,273	$2,500,406	$5,132,499	$8,976,178	$1,289,709
To State (Income Taxes and GET)	$1,998,870	$4,109,061	$5,180,701	$9,441,412	$204,143
Adjustment for Other Proportional Taxes (2)	1.35	1.35	1.35	1.35	1.35
Adjusted State Revenues	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
Plus Impact Fees	$0	$0	$0	$0	
Total State of Hawaii Receipts	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
AGGREGATE TAX REVENUES	$3,621,747	$8,047,639	$12,126,445	$21,302,084	$1,565,303
PUBLIC COSTS (Expenses)					
By County of Kauai	$0	$117,948	$353,845	$471,794	$94,359
By State of Hawaii	$0	$443,978	$1,331,933	$1,775,910	$355,182
TOTAL PUBLIC COSTS	$0	$561,926	$1,685,778	$2,247,704	$449,541
TOTAL NET PUBLIC BENEFITS					
County of Kauai	$1,343,273	$2,382,458	$4,778,653	$8,504,384	$1,195,350
State of Hawaii	$2,698,474	$5,103,255	$5,662,014	$10,969,996	($79,588)
AGGREGATE NET BENEFITS	$4,041,747	$7,485,713	$10,440,667	$19,474,380	$1,115,762

(1) Real property taxes comprise 63.1 percent of General Fund in the Proposed County of Kauaii 2017-18 budget. Economic activity generates other revenue items of 36.9 percent or additional 58 percent above real property taxes.

(2) In recent fiscal years, Gross Excise and Income Taxes have averaged some 74 percent of total State revenues; other revenue items 26 percent, or 35 percent above income and gross excise taxes.

Source: The Hallstrom Team/CBRE

TABLE D-3

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT All Amounts Expressed in Constant 2017 Dollars					
	Development, Sales and Build-Out Period				
Development Period	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
PUBLIC BENEFITS (Revenues)					
1. COUNTY REAL PROPERTY TAXES					
Cumulative Assessed Value During Period					
Finished Homes End of Period	0	118	236		**236**
Vacant Land/Finished Lots Prior to Sale	$93,000,000	$92,925,000	$30,975,000	$216,900,000	**$0**
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$37,243,750	$111,731,250	$148,975,000	**$29,795,000**
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$86,191,625	$258,574,875	$344,766,500	**$68,953,300**
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$33,519,375	$100,558,125	$134,077,500	**$26,815,500**
Total Assessed Value	$93,000,000	$249,879,750	$501,839,250	$844,719,000	$125,563,800
Real Property Taxes During Period					
Vacant Land/Finished Lots Prior to Sale	$584,350	$562,196	$187,399	$1,333,945	**$0**
Resident Rental Single Family Homes - No Exemptions (20% of homes)	$0	$262,568	$787,705	$1,050,274	**$210,055**
Resident Owner-Occupied Single Family Homes - All with Exemptions (62% of homes)	$0	$521,459	$1,564,378	$2,085,837	**$417,167**
Non-Resident "Second" Single Family Homes - No Exemptions (18% of homes)	$0	$236,312	$708,935	$945,246	**$189,049**
Total Real Property Taxes	$584,350	$1,582,536	$3,248,417	$5,415,302	$816,271

Source: The Hallstrom Team/CBRE

TABLE D-4

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT All Amounts Expressed in Constant 2017 Dollars					
	Development, Sales and Build-Out Period				
Development Period	2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
PUBLIC BENEFITS (Revenues)					
"New" Tax Collection Monies Only, Does not Include Existing Kauai Residents Moving to Development					
2. STATE INCOME TAXES					
Taxable Personal Income (Worker Wages Only, Excludes Kealia Mauka Homsites Resident Households)	$9,450,175	$29,102,152	$33,680,198	$72,232,526	$759,635
Taxable Corporate Profits (Includes profits from wroker and non-resident spending)	$595,369	$1,778,681	$2,943,865	$4,470,831	$283,430
Personal Taxes Paid	$481,959	$1,484,210	$1,717,690	$1,966,169	$38,741
Corporate Taxes Paid	$26,196	$78,262	$129,530	$104,458	$12,471
TOTAL STATE INCOME TAXES	$508,155	$1,562,472	$1,847,220	$2,070,627	$51,212
3. STATE GROSS EXCISE TAX					
Taxable Transactions (Excludes Lima Ola Resident Spending)					
Construction Contracts	$31,051,779	$42,612,750	$47,347,500	$73,664,529	$127,440
Worker and Non-Resident Disposable Income Purchases	$4,725,088	$18,504,902	$32,655,403	$55,885,393	$3,542,878
Total Taxable Transactions	$35,776,867	$61,117,652	$80,002,903	$129,549,922	$3,670,318
TOTAL STATE EXCISE TAX	$1,490,715	$2,546,589	$3,333,481	$7,370,785	$152,931

Source: The Hallstrom Team/CBRE

TABLE D-5

QUANTIFICATION OF PUBLIC FISCAL COSTS AND BENEFITS TO COUNTY AND STATE FROM THE KEALIA MAUKA HOMESITES DEVELOPMENT

All Amounts Expressed in Constant 2017 Dollars

Development Period	Development, Sales and Build-Out Period 2017 to 2020	2021 to 2025	2026 to 2030	Totals During Build-Out Period	Stabilized Annually After Build-out
"New" Tax Collection And Expenditure Monies Only					
TOTAL GROSS PUBLIC REVENUES					
Real Property Taxes To County of Kauai	$584,350	$1,582,536	$3,248,417	$5,415,302	$816,271
Adjustment for Other Proportional Taxes (1)	1.58	1.58	1.58	1.58	1.58
Adjusted Kauai County Revenues	$923,273	$2,500,406	$5,132,499	$8,556,178	$1,289,709
Plus Impact Fees (Park Fees)	$420,000	$0	$0	$420,000	
Total County of Kauai Receipts	$1,343,273	$2,500,406	$5,132,499	$8,976,178	$1,289,709
To State (Income Taxes and GET)	$1,998,870	$4,109,061	$5,180,701	$9,441,412	$204,143
Adjustment for Other Proportional Taxes (2)	1.35	1.35	1.35	1.35	1.35
Adjusted State Revenues	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
Plus Impact Fees	$0	$0	$0	$0	
Total State of Hawaii Receipts	$2,698,474	$5,547,232	$6,993,947	$12,745,906	$275,594
AGGREGATE TAX REVENUES	$3,621,747	$8,047,639	$12,126,445	$21,302,084	$1,565,303
PUBLIC COSTS (Expenses)					
By County of Kauai	$0	$117,948	$353,845	$471,794	$94,359
By State of Hawaii	$0	$443,978	$1,331,933	$1,775,910	$355,182
TOTAL PUBLIC COSTS	$0	$561,926		$2,247,704	$449,541
TOTAL NET PUBLIC BENEFITS					
County of Kauai	$1,343,273	$2,382,458	$4,778,653	$8,504,384	$1,195,350
State of Hawaii	$2,698,474	$5,103,255	$5,662,014	$10,969,996	($79,588)
AGGREGATE NET BENEFITS	$4,041,747	$7,485,713	$10,440,667	$19,474,380	$1,115,762

(1) Real property taxes comprise 63.1 percent of General Fund in the Proposed County of Kauaii 2017-18 budget. Economic activity generates other revenue items of 36.9 percent or additional 58 percent above real property taxes.

(2) In recent fiscal years, Gross Excise and Income Taxes have averaged some 74 percent of total State revenues; other revenue items 26 percent, or 35 percent above income and gross excise taxes.

Source: The Hallstrom Team/CBRE

Addendum E

PROFESSIONAL QUALIFICATIONS

PROFESSIONAL QUALIFICATIONS OF THOMAS W. HOLLIDAY, CRE, FRICS

Business Affiliation

Director	The Hallstrom Team | CBRE, Inc. Valuation & Advisory Services Honolulu, Hawaii (2015 – Present)
Senior Analyst/ Supervisor	The Hallstrom Group, Inc. Honolulu, Hawaii (1980 – 2014)
Former Staff Appraiser	Davis-Baker Appraisal Co. Avalon, Santa Catalina Island, California (1977 -1979)

International Designation and Membership

- CRE Designation (2015) - The Counselors of Real Estate
- FRICS Designation (2016)–Fellow of the Royal Institution of Chartered Surveyors

Education/Qualifications

- California State University, Fullerton (Communications/Journalism)
- More than 600 Hawaii Hotel/Hospitality Valuation and Consulting Assignments
- More than 150 Market Studies, Economic Impact Analyses and Public Fiscal Assessments for Proposed Projects and Entitlement Purposes
- Qualified expert witness testimony before State of Hawaii Land Use Commission, County Planning Commissions, County Councils and various state and county boards and agencies since 1983.
- Only certified real estate economist by County of Kauai for workforce housing assessments.
- Numerous SREA, Appraisal Institute and RICS Courses
- Numerous professional seminars and clinics.
- Contributing author to Hawaii Real Estate Investor, Honolulu Star Bulletin, Pacific Business News, Other Publications

On January 1, 1991, the American Institute of Real Estate Appraisers (AIREA) and the Society of Real Estate Appraisers (SREA) consolidated, forming the Appraisal Institute (AI).

Recent Assignments

- Market Study, Economic Impact Analyses and Public Costs/ Benefits (Fiscal Impact) Assessments

<u>Oahu</u>

-- OHA Kakaako Makai (Mixed-Use Project)
-- Howard Hughes/Ward Kewalo Basin (Retail Project)
-- Marriott Waikiki Parking Lot (Hotel/Timeshare Project)
-- Residence Inn Kapolei (Hotel)
-- Turtle Bay Resort (Destination Resort Community)
-- Waikapu Country Town (Mixed-Use Community)
-- Oahu Community Correctional Center Relocation
-- Oahu Tourism Spending/Tax Impact Analysis
-- Waikapu Country Town (Mixed-Use Community)

Maui County
-- Waikapu Country Town (Mixed-Use Community)
-- Lanai City Expansion (Mixed-Use/201H Community)
-- Polanui Garden (201H Residential Community)
-- Molokai Ranch Holdings (Mixed-Use)
-- Makila Rural Subdivision (201H Residential Community)
-- Makila Kai (201H Residential Community)
-- Maui Research & Tech Park (Mixed-Use Community)
-- Maui Lani (Mixed-Use Community)
-- Honuaula (Mixed-Use Community)
-- Makena Beach Resort
-- Maui Business Park, Phase II (Industrial/Commercial)
-- Kapalua Mauka (Master Planned Community)
-- Hailiimaile (Mixed-Use Master Planned Community)
-- Pulelehua (Master Planned Community)
-- Westin Kaanapali Ocean Villas Expansion (Resort/Timeshare)

Big Island
-- Parker Ranch Waimea Town Center (Mixed-Use)
-- West Hawaii/Gold Coast Tourism & Hotel Analysis
-- Puako Farms/Kamakoa (Residential Subdivision)
-- Kau Tea Farm (Agricultural/Mixed-Use Project)
-- Kamakana Villages (Mixed-Use Residential Development)
-- W.H. Shipman Ltd, Master Plan (Various Urban Uses)
-- Nani Kahuku Aina (Mixed-Use Resort Community
-- Kona Kai Ola (Mixed-Use Resort Community)
-- Waikoloa Highlands (Residential)
-- Waikoloa Heights (Mixed-Use Residential Development)

Kauai
-- Princeville Lodge (Hotel)
-- Princeville Phase II (Destination Resort Community)
-- Hanalei Plantation Workforce Housing (Resort)
-- Lima Ola (Residential Community)
-- Coco Palms (Hotel)
-- Sheraton Kauai Workforce Housing (Resort)
-- Coconut Coast Tourism and Hotel Analysis
-- Hanalei Plantation Resort (Resort/Residential)
-- Kukuiula (Resort/Residential)
-- Waipono/Puhi (Mixed-Use Planned Development)
-- Eleele Commercial Expansion (Commercial)
-- Village at Poipu (Resort/Residential)
-- Ocean Bay Plantation (Resort/Residential)

- Major Neighbor Island Valuation Assignments

  -- Mauna Lani Bay Hotel
  -- Courtyard Kahului Airport Hotel
  -- Maui Oceanfront Days Inn
  -- Holiday Inn Express – Kona Hotel (proposed)
  -- Keauhou Beach Hotel
  -- Courtyard King Kamehameha Kona Beach Hotel
  -- Aloha Beach Resort
  -- Coco Palms Resort
  -- Grand Hyatt Kauai
  -- Islander on the Beach
  -- Waimea Plantation Cottages
  -- Coconut Beach Resort
  -- Sheraton Maui Hotel
  -- Outrigger Wailea Resort Hotel
  -- Maui Lu Hotel
  -- Coconut Grove Condominiums
  -- Palauea Bay Holdings
  -- Wailea Ranch
  -- Maui Coast Hotel
  -- Westin Maui Hotel
  -- Maui Marriott Hotel
  -- Waihee Beach
  -- Kapalua Bay Hotel and The Shops at Kapalua

Email Address Tom.Holliday@cbre.com

Appendix G

Preliminary Engineering Report
Kodani & Associates

July 2017

PRELIMINARY ENGINEERING REPORT

for

KEALIA RESIDENTIAL SUBDIVISION

JULY 11, 2017

KODANI & ASSOCIATES ENGINEERS, LLC

LIHUE, KAUA'I, HAWAI'I

TABLE OF CONTENTS

PAGE NO.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

1. BACKGROUND INFORMATION

1.1 PROPOSED PROJECT DESCRIPTION

The proposed development, Kealia Residential Subdivision, is within the Kawaihau District on the Island of Kaua`i. Kawaihau District extends from the Wailua River north to Moloa'a, including the Kapa'a-Wailua Basin, Kealia, and Anahola.

The Subject property is located east of Kapa'a town, across Kuhio Highway from Kealia Beach Park. The property is currently one (1) large lot that is 1,075.6 acres in size and is identified as Tax Map Key No. (4) 4-7-004:001. The proposed project is contained with an approximate 53.361 acre portion of the large lot.

The Kealia Residential Subdivision will utilize the project site for single-family residential units and green space. The proposed subdivision contains single family lots ranging from 6,000 to 7,300 square feet. A total of 237 single family lots are planned. In addition, a 4.3 acre park/green space is planned for the development.

This development will address a portion of the demand for affordable housing in the County of Kaua'i.

2. CIVIL ENGINEERING

2.1 ROADWAYS

Existing Roadways

The existing right of ways near or adjacent to the project site are shown on Figure R-1. Pavement and striping described for lanes, etc. is not shown on the Roadways map for clarity.

Kuhio Highway is located to the east of the proposed residential subdivision. Kuhio Highway is under the jurisdiction of the State of Hawai`i, Department of Transportation, Highways Division. It is an asphalt concrete (AC) pavement major thoroughfare with two (2) lanes, one (1) in each direction.

There is an existing intersection on Kuhio Highway with Kealia Road. Approaching the intersection between Kuhio Highway and Kealia Road heading north, there are three (3) 12 foot wide lanes and a paved 6 foot shoulder on each side. This includes a northbound and southbound lane and a left turn lane in the middle to turn onto Kealia Road. At the intersection there is also an eastbound turn onto a beach access road, which is a dirt road that parallels Kealia beach.

Just north of the Kuhio Highway and Kealia Road intersection there is a 12 foot wide bus stop lane, one (1) on each side of the Kuhio Highway; as well as a 12 foot wide southbound left turn lane onto the beach access road. Also just north of the Kealia Road and Kuhio Highway intersection, heading south, is a right turn (westbound) onto a one (1) way, 9 foot road that feeds to Kealia Road. North of the intersection and turn, Kuhio Highway narrows to two (2) 11 foot wide lanes with 6 foot paved shoulders. At about 450 feet north up the highway, the shoulders widen to 10 feet on each side.

The intersection of Kuhio Highway and Kamole Road is approximately 1,900 feet north of the Kuhio/Kealia intersection. Kamole Road is a County road with a 40 foot right-of-way. It has a pavement width of approximately 18 feet and has no striping except at the intersection. Kamole Road services an existing small subdivision with approximately 19 lots.

Just north of the Kuhio/ Kamole intersection is a 12 foot wide bus stop lane, located on the east side of the highway heading north. North of the Kamole Road intersection and bus stop, the Kuhio Highway shoulders narrow to 6 feet wide with lanes still at 11 feet wide in both travel directions.

About 600 feet north of the Kamole Road intersection on Kuhio Highway is an intersection with a two (2)-way road, with 9 foot wide lanes onto Kapoli Street. This road is AC pavement with no striping except at the intersection. At this intersection, there is a 14 foot wide turn lane to turn right off of and back onto Kuhio Highway. Kapoli Street services the Kealia Makai Subdivision.

The primary access to and egress from the proposed project site is Kealia Road. It is a County road with a 40 foot right-of-way (ROW), two (2)-way AC pavement road, with 9 foot wide lanes (one (1) in each direction), and narrow paved shoulders. Prior to the construction of Kuhio Highway, Kealia Road was the route to get between Kapaa and Anahola. As described above, there is an existing intersection between Kuhio Highway and Kealia Road.

Approximately one (1)-half mile northbound on Kealia Rd from Kuhio Highway is an intersection with Ka’ao Road, a two (2)-way, 16 foot wide AC pavement road with no stripping past the intersection. It is a dead-end street with a 40 foot ROW that is currently suburbanized with homes contained within approximately 33 lots.

Approximately 200 feet north of the Ka’ao Rd intersection along Kealia Rd, there is an intersection with Hopoe Rd, a short, two (2)-way, 9 foot wide, AC pavement road with no striping except at the intersection. It is a dead-end street with a 30 foot ROW that serves three (3) existing house lots.

Proposed Roadways

The proposed roadways for the Kealia Residential Subdivision can be seen on Figure R-2. All proposed roads within the subdivision are to be in accordance with County of

Kaua'i 1972, *County Road Standards*[1]. It is intended that all of the proposed subdivision roads will be conveyed by the developer to the County of Kauai

A roundabout entrance to the subdivision is proposed in order to provide a safe and efficient central nexus for all adjoining subdivision roads. Proposed roads connecting to the roundabout will be "Collector" roads as defined by County road standards. Collector roads have a 56 foot ROW and 40 foot wide pavement. There are a total of two (2) Collector roads proposed for this project. One (1) of the proposed Collector roads will run in the north-south direction and the other proposed Collector road will run in the east-west direction.

The majority of the roads within the proposed subdivision will be "Minor" roads as defined by County road standards. Minor roads have a 44 foot ROW and 20 foot wide pavement. There are a total of nine (9) Minor roads proposed for this project. Three (3) Minor road will traverse the north-south direction and six (6) will traverse in the east-west direction.

2.2 DRAINAGE AND FLOOD CONSIDERATIONS

A preliminary drainage study was conducted in order to estimate existing flow patterns and runoff quantities and also proposed post-development flow patterns and runoff quantities. A detailed Drainage and Erosion Mitigation Plan will be prepared and submitted to the County Engineer for approval during the design and development stages. The U.S. Department of Agriculture, Soil Conservation Service, *Technical Report #55*[10] (TR-55), a hydrologic modeling program, was used to study drainage patterns for the existing and proposed conditions of the project area.

The proposed project site entirely located in the flood zone designation Zone X according to the Federal Emergency Management Agency's Flood Insurance Rate Map (FIRM) Community-Panel No. 1500020210F. Figure D-1 contains a map of the proposed project site produced from the State of Hawaii's *Flood Hazard Assessment Tool* (FHAT). Zone X is described as areas outside of the 100- and 500-year floodplains with minimal flooding.

Existing Condition

The existing 1075.6 acre large lot is mostly pasture land that is utilized for a cattle ranching. The large lot and proposed project site is largely undeveloped and the relatively few drainage structures are remnants of an old irrigation system from the plantation era. Approximate watershed drainage tributary areas can be found on Figure D-2.

Evaluation of the proposed project site topography, in its existing condition, indicates that the site generally drains from the mauka side towards Kuhio Highway. A relatively mild ridgeline aligned in the east-west direction causes water north of it to run off to a northern exit, and water south of it to run off to a southern exit. For analysis purposes, the area was split into two (2) subareas, Subarea 1 and Subarea 2, with the high ground as the dividing point as shown in Figure D-3.

The below Table No. 1 contains the existing condition TR-55 model results:

Table No. 1 – Storm Water Runoff for the 2 Year Storm Event, Existing Condition

Sub-Area	Land Area (Acres)	Weighted Curve Number	Time of Concentration (Hours)	Two (2) Year Storm Runoff (CFS)
E1	25.44	79	0.292	14.32
E2	28.10	79	0.420	13.69

There are three (3) existing drainage outlet points from the project site and the points are described below:

- Subarea 1 outlets to a two (2) foot diameter concrete pipe culvert on the north-east end of the proposed development area that runs under Kuhio Highway and outlets on the makai side of the highway,
- Subarea 2 partially outlets with overland flow via a natural drainage way that spills into an existing concrete swale on the mauka side of Kuhio Highway, and
- Subarea 2 remainder outlets to a 10 foot wide Drainage Right-Of-Way that connects with the proposed project site, crosses Ka`ao Road via a 2 foot diameter concrete pipe culvert and outlets on a hillside within the large lot.

Runoff that is transmitted by Subarea 2 combine with other drainage areas and are conveyed by an existing 8 foot by 5 foot rectangular concrete drainage box culvert beyond the south end of the proposed project area and within the large lot that runs under Kuhio Highway and outlets on the Kealia Beach side of the highway. Figure D-3 shows the location of the 8 foot by 5 foot rectangular concrete drainage box culvert.

Post-Development Conditions

Per County of Kauai, Department of Public Works' requirements from their *Storm Water Runoff System Manual*[7], storm water runoff cannot exceed the predevelopment conditions. The aforementioned TR-55 model was also used to analyze post-development storm water runoff. Storm water generated from each individual lot within the project area will be directed to the nearest downstream street or natural drainage way that will collect the storm water and convey it to the two (2) proposed detention basins shown on Figure D-4.

The detention basins moderate the storm flows and allow infiltration back into the soil. They were sized in accordance with the existing peak flows for both the 2 year and 100 year storm events. Detention Basin 2 on the southern end of the project area is intended to have the multiple purposes of green space / park / detention basin.

The analysis for post-developed flow, after multiple iterations of subbasin sizes, produced a runoff flow of 13.52 CFS and 12.99 CFS for the first and second sub areas, respectively. With the runoff flow being less during post-developed conditions than that of current undeveloped conditions, it is safe to assume that the Kealia Residential Subdivision area will not have a negative impact on the surrounding and downstream lands.

Table No. 2 – Storm Water Runoff for the 2 Year Storm Event, Proposed Condition

Sub-Area	Land Area (Acres)	Weighted Curve Number	Time of Concentration (Hours)	Two (2) Year Storm Runoff (CFS)
P1	24.85	87	0.114	13.52
P2	28.78	87	0.257	12.99

2.3 GRADING

Existing Topography

The site is generally gently sloping from mauka toward Kuhio Highway. The average slope from top to bottom is approximately 3%. Figure G-1 shows the existing topography of the entire 1075.6 acre lot. The lot is largely undeveloped, with the flat lands being utilized as pasture, and the valleys being occupied by trees, bushes, and other greenery.

Proposed Condition

The Proposed Grading layout as shown in Figure G-2 will be in accordance with the County of Kaua'i Ordinance 808 *Grading, Grubbing and Stockpiling*[6]. The grading plan for Kealia began with the initial elevations calculated by topographic surveys. The drainage concept was created by using these elevation calculations in combination with AutoCAD feature lines and alignments. From these structures, a 3D model of the finished grading with drainage into the detention basins.

The estimated earthwork quantity of excavation is 350,000 YD^3 and the total of estimated embankment is 347,000 YD^3. The net excavation is 3,000 YD^3. Figure G-3 demonstrates the estimated excavation and embankment quantities in addition to the contours and cross section plans of the site from two (2) directions.

Table No. 3 – Estimated Earthwork Quantities, Proposed Condition

Excavation (YD^3)	Embankment (YD^3)	Net (YD^3)
350,000	347,000	3,000

During construction of the Kealia Residential Subdivision, the contractor shall implement and maintain storm and surface water runoff Best Management practices (BMPs), subject to any applicable review and approval of the State Department of Health, designed to prevent violations of State water quality standards as a result of storm water discharges originating from the project. These BMPs will be documented in a declaration of covenants, conditions and restrictions that will be recorded against the property and will run with the land.

Potential water quality impacts during construction of the project will be alleviated by adherence to State and County water quality regulations governing grading, excavation and stockpiling. Construction BMPs will be utilized pertaining to grading, grubbing, stockpiling, soil erosion and sedimentation during construction. BMPs will also be implemented for long term development and operation of activities occurring on the site as part of pollution prevention measures.

2.4 POTABLE WATER SYSTEM

Existing Water System

The existing dwellings located near the proposed project area are serviced through a domestic water system called the Kealia Water System. The water system is identified by the State of Hawaii, Department of Health, as Public Water System #423. See Figure W-1 for a map of the water system

A well site containing two (2) wells located on the western side of Kealia Road provides source water for the system. A 12-inch waterline runs north along Kealia Road and connects the wells to two (2) 67,000 (nominal) gallon domestic water tanks. This water system also services lots along Ka'ao and Hopoe Road with an 8" waterline branching off from Kealia Road. There is also a 12-inch waterline that branches off of Kealia Road to serve the Kealia Makai Subdivision on the east side of Kuhio Highway. This waterline intersects the proposed Kealia Residential Subdivision.

According to the Kealia Water System 2017 Consumer Confidence Report[11], water for the System is obtained via a groundwater source. The Water System provides water to approximately 60 homes in the former Kealia Plantation Camp and has 35 service connections at the Kealia Makai Subdivision. Water from the Kealia Water System met all U.S. Environmental Protection Agency and state drinking water health standards.

Data was collected from testing done from January 1, 2016 through December 31, 2016. More information and data regarding the Kealia Water System's water quality can be found in the Consumer Confidence Report[11].

The Kealia Water System is owned by the entity, Kealia Water Company Holdings, LLC (Water Company). A "*Water Service Agreement*" exists between the Water Company and the current owners of the property in which the subject subdivision is proposed. **Appendix A** contains a copy of the agreement; the copy is abbreviated due to the large document size. The agreement allows a daily aggregate of 300,000 gallons of potable water per day (gpd) to be reserved for the use of the owners of property located in the subject area.

Proposed Water System

The State of Hawai'i, *Water System Standards*[9] is the guiding standard for potable water systems. The standards require that the planning and design of a water system allocate each single family unit an average of 500 gallons of water per day. Furthermore, the maximum daily demand calculations require that the average daily demand allocation be multiplied by a factor of 1.5.

The below Table No. 4 contain the water demand calculations per the *Water System Standards*:

Table No. 4 – Domestic Water Demand Estimation

Number of Proposed Units	Average Daily Demand Unit Requirement (gal/day)	Average Daily Demand Total Requirement (gal/day)	Maximum Daily Demand (gal/day)
236	500	118,000	177,250

The existing water wells within the Kealia Water System will provide the required source capacity of 177,250 gallons per day. Upgrading of the existing well pump assembly may be necessary to achieve the required demand. The existing *Water Service Agreement* allows for drawing up to 300,000 gallons per day as described above.

The *Water System Standards* also have standards for water storage reservoir sizing. The standards requires that the water reservoir for the development has enough capacity to meet fire flow requirements, in addition to the maximum daily demand. Fire flow requirements are based on land use and zoning. The proposed subdivision will have density that is roughly equivalent to R-6 zoning. Accordingly, the proposed development's fire flow requirements include being able to produce a flow of 1,000 gallons per minute, for a duration of 2 hours. The *Water System Standards*[9] require that the reservoir capacity will be sized as follows:

1. Meet maximum daily consumption. Reservoir full at the beginning of the 24-hour period with no source input to the reservoir.
2. Meet maximum day rate plus fire flow for duration of fire. Reservoir ¾ full at start of fire, with credit for incoming flow from pumps, one (1) maximum size pump out of service.
3. Minimum size reservoir shall be 0.1 MG. Reservoir size shall be as specified in Section 105.10 – RESERVOIR. Subsection A – Size.

From these calculations (shown Table W-1), the proposed Kealia Residential Subdivision will have a maximum daily demand of 177,250 gallons per day. Therefore in accordance with the *Water System Standards*[9] sizing method detailed above, 177,250 gallons water storage capacity is needed. It is proposed that a 200,000 gallon tank be installed adjacent to the two (2) existing 67,500 gallon tanks to satisfy the storage requirements. The proposed water tank will also connect to the existing water system as shown in Figure W-1.

The existing potable water transmission and distributions system will have to be upgraded to service the proposed development. Figure W-1 shows the proposed system improvements. All expansions and improvements of the Kealia Water System shall be in accordance with the *Water Service Agreement* and the *Water System Standards*.

2.5 SOLID WASTE GENERATION

Existing Condition

The County has one (1) landfill that services the entire island, the Central Kaua'i Landfill, located in Kekaha. According to the County of Kaua'i's Integrated Solid Waste Management Plan[4], the Central Kaua'i Landfill will need to undergo expansion to increase capacity. In discussions with a representative from the Department of Public Works, Solid Waste Division, there are plans to expand the landfill to give capacity until 2027.

There currently is no solid waste generation from the project site. The County does, however, service the adjacent dwellings along Ka'ao and Hopoe Roads. Figure M-1 contains a map of the County of Kaua`i solid waste infrastructure.

Residential waste is collected via the County of Kaua'i's Residential Refuse Collection program. According to the *Summary of the Residential Refuse Collection Assessment*[8], customers are able to choose a 64 gallon or 96 gallon cart for automated curbside refuse pickup. Alternatively, there is a refuse transfer station located in Kapa'a town, as shows in Figure M-1.

Proposed Condition

The project site is undeveloped and, as such, has few fixed structures that would need to be disposed as construction waste. There are remnants of current and past irrigation systems onsite, such as pipes and small concrete headwalls. Waste generated through construction will consist predominantly of vegetation and debris. Soil and debris displaced from grading and clearing will be utilized as fill throughout the site as required, minimizing disposal and transit/relocation of the materials. Construction materials that are rendered un-recyclable will be disposed of in the Central Kaua'i Landfill.

The County of Kauai provides Residential Refuse Collection via a *Pay as You Throw* (PAYT) program. Curbside refuse collection is offered on a once-per-week basis, and customers are able to choose a refuse cart size. A representative of the County of Kaua'i's Solid Waste Management Division has indicated that the County would service the proposed subdivision.

The quantity of solid waste generated from the proposed project may be estimated by assuming that each household will fill the 64 gallon cart each week. Table No. 5 below provides an estimate of the projected annual waste load.

Table No. 5 – Solid Waste Generation Estimate

Number of Proposed Units	Unit Solid Waste Disposal Rate (gallons/week)	Unit Solid Waste Disposal Rate (gallons/year)	Unit Density Solid Waste (pounds/gallons)	Waste Disposal Rate (tons/year)
236	64	3,328	4.82	8.02

Mandatory compliance with existing regulations and requirements will ensure that the project will have a less than significant impact in regards to solid waste management.

3. WASTEWATER ENGINEERING

3.1 EXISTING WASTEWATER DISPOSAL SYSTEMS

According to the *Kaua'i General Plan 2000*[5], the County operates four (4) wastewater systems serving Waimea, Hanapepe-'Ele'ele, Lihu'e-Hanama'ulu, and the Kuhio Highway corridor between Wailua and Kapa'a. All but the Waimea plant have substantial amounts of available treatment plant capacity, but this capacity is already committed to existing and planned developments.

In the Wailua ‑ Kapa'a area, wastewater treatment is accomplished with either Individual Wastewater Systems (IWS), such as cesspools or septic tanks, or at the County owned and operated Wailua Wastewater Treatment Plant (WWTP). IWSs generally used in the parcels that have water service but no sewer service.

The County completed a study of the Wailua/Kapa'a wastewater system. The study is entitled *Final Wailua Facility Plan*[2]. According to the *Wailua Facility Plan*, the Wailua Wastewater Treatment Plant was originally constructed in 1964, and is located on approximately 2.1 acres of County owned land next to Lydgate Beach Park. It receives wastewater from Kapa'a, Papaloa, Waipouli, and Wailua areas. It was originally designed to treat an average flow of 0.5 mgd, but the plant has gone through four (4) phases of construction to expand. The treatment plant's current average daily flow capacity is 1.5 mgd, with a peak flow capacity of 5.03 mgd. The wastewater treatment plant currently receives about 0.7 million gallons per day (mgd) of flow. However, it is considered to have a capacity of about 1.0 mgd due to the estimated treatment capacity of the aeration basins and the chlorine contact tank.

Because the discharge of raw waste into the ground is not beneficial to the environment, the Department of Health prohibits the construction of any new cesspools. According to the *Wailua Facility Plan*, approximately 12% of the cesspools in the Wailua-Kapa'a area have reported cesspool failures. A cesspool failure occurs when a cesspool overflows and is reported to the Department of Health.

3.2 PROPOSED WASTEWATER COLLECTION SYSTEM

In preliminary discussions with representatives from the County of Kaua'i, Department of Public Works, Wastewater Management Division, it was indicated that the County would service the proposed subdivision. The representatives indicated however, that they typically do not issue "will serve" letters to developments until such developments have obtained zoning approvals.

The County of Kaua'i, Department of Public Works, *Sewer Design Standards*[3] were utilized to estimate wastewater generation quantities. According to the standards, it is assumed each household to have four (4) occupants, with an average daily per capita flow of 100 gallons per day, giving an average of 400 gallons of wastewater per household per day. Once at total capacity, the Kealia Residential Subdivision project will produce approximately 94,400 gallons of wastewater per day. The maximum flow of sewage from the development is approximately 472,000 gallons per day (0.472 mgd), calculated by multiplying the average daily flow by a flow factor of 5 (from *Sewer Design Standards*[3]). The peak flow of sewage is the sum of the maximum flow of sewage and the rate of groundwater infiltration. The calculated peak flow of sewage from the development is 472,000 gpd. Table No. 6 below provides a summary of the wastewater generation calculations.

Table No. 6 – Domestic Wastewater Estimation

Number of Proposed Units	Unit Household Wastewater Generation Rate (gpd/household)	Average Daily Wastewater Flow (gpd)	Maximum Daily Wastewater Flow (gpd)	Peak Wastewater Flow[1] (gpd)
236	400	94,400	472,000	472,000

[1]Note: Assume no groundwater infiltration because sewer pipes are constructed of PVC piping and infiltration is not expected with PVC piping.

All wastewater will gravity flow toward sewer manhole #1 (as shown on Figure S-2). The wastewater will then gravity flow to the proposed wastewater pump station along Kuhio Highway. The proposed wastewater pump station will connect to the existing sewer line in front of the Kaiakea Fire Station, as shown on Figure S-3.

The proposed gravity and force mains will connect the Subdivision to the existing wastewater system that services the Wailua-Kapa'a area, and to the Wailua WWTP. The proposed Kealia Residential Subdivision will need to install an on-site wastewater pump station and approximately 3,884 linear feet of new 4-inch diameter force main. The proposed wastewater pump station shall be placed as close as permitted to the Kaiakea Fire Station to reduce the distance the sewage travels through the force main, which will help with odor control in the area.

4. ELECTRICAL ENGINEERING

4.1 EXISTING ELECTRICAL POWER SYSTEM

Kaua'i Island Utility Cooperative (KIUC) is Hawai'i's only member-owned electric utility. They currently have a generating capacity of 125 megawatts (MW). More than 40% of the electricity generated by KIUC comes from renewable energy resources.

The Kealia Residential Subdivision project is part of the Kawaihau region, which, according to the Kaua'i General Plan[5], is served via a tap off of the mauka transmission line that connects the Wainiha Hydroelectric Plant with Port Allen. This tap provides power via the Kapa'a Switchyard to Kapa'a Town and other developed coastal areas, as well as to residential communities in Kapa'a and Wailua homestead areas. Kapa'a

Switchyard is also linked to the Lydgate Substation and the Lihu'e Switchyard. Power is also supplied through the Anahola Substation, which was recently completed. Figure E-1 contains a map of the KIUC transmission and distribution system in the Kealia area.

Kuhio Highway in the vicinity of the proposed project contains existing KIUC transmission lines. KIUC undertook and completed a project on the Kealia vicinity Kuhio Highway transmission line within the past five (5) years in which overhead lines were placed underground. The project was part of KIUC's overall effort to reduce exposure of overhead line to endangered seabirds including the Newall Shearwater.

In the Kealia area, there are existing overhead distribution lines that service the existing dwellings along Kealia Road, as well as along Ka'ao and Hopoe Roads.

4.2 PROPOSED ELECTRICAL POWER SYSTEM

KIUC representatives have indicated that they have sufficient generating capacity to serve the proposed development. Standard electrical power transmission improvements would be required, however, the representative estimated that the improvement would likely be limited to the distance from Kuhio Highway to the proposed project site.

KIUC utilizes for planning purposes a unit demand of 3 kilovolt amps (KVA) of power per lot. KIUC typically provides 100 amp services for lots of the size proposed for this development. The utilities for the subdivision will mainly be placed underground. KIUC may utilize the remnant lot near the proposed roundabout that intersects with Kealia Road for switchgear equipment.

Table No. 7 – Electrical Power Demand Estimation

Number of Proposed Units	Unit Household Electrical Demand Rate (KVA/household)	Electrical Demand Estimation (KVA)
236	3	708

Currently, there are overhead utility lines in place that serve the existing lots along Kealia Road and the existing dwellings on Ka'ao and Hopoe Roads. However, with the proposed subdivision, these overhead lines will need to be upgraded to accommodate the new development. With these upgrades to the utilities, Kealia Road will also need to be improved to further accommodate the new development. The cost of these improvements will be paid for by the developer. The development will tie into KIUC's existing main line that runs along Kuhio Highway.

5. BIBLIOGRAPHY

1. County of Kaua'i, Department of Public Works, "*County Road Standards*" 1972

2. County of Kaua'i, Department of Public Works, Division of Wastewater Management, "*Final Wailua Facility Plan*", September 2008.

3. County of Kaua'i, Department of Public Works "*Sewer Design Standards*" June 1973

4. County of Kaua'i, Department of Public Works, Solid Waste Division, "*Integrated Solid Waste Management Plan*", March 2009

5. County of Kaua'i, "*Kauai General Plan*", 2000

6. County of Kaua'i Ordinance 808 "*Grading, Grubbing and Stockpiling*"

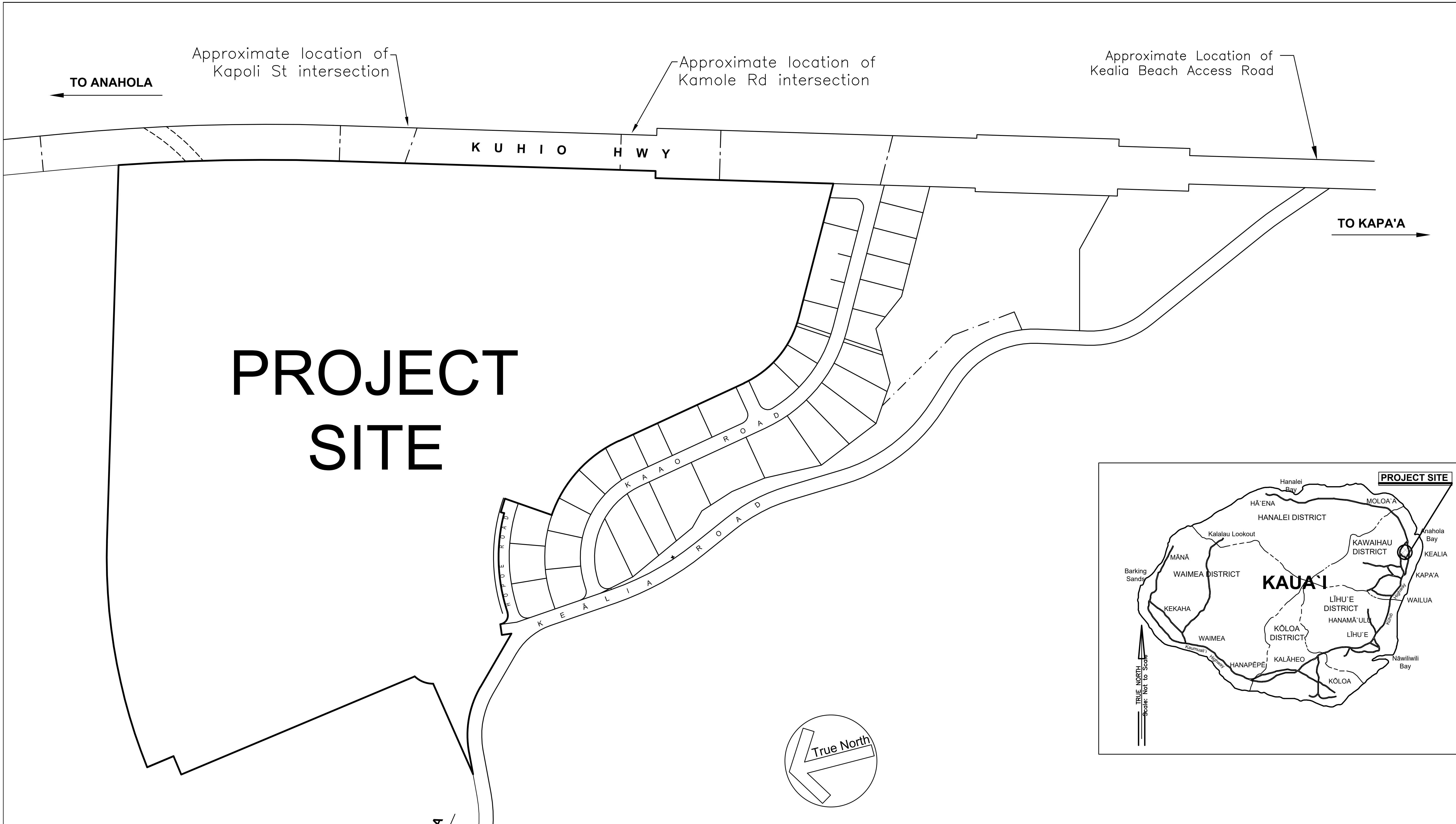
7. County of Kaua'i, Department of Public Works. "*Storm Water Runoff System Manual*"

8. County of Kauai, Department of Public Works, "*Summary of the Residential Refuse Collection Assessment*" http://www.kauai.gov/RRCA. Accessed June 2017.

9. State of Hawai'i, "*Water System Standards*" 2002

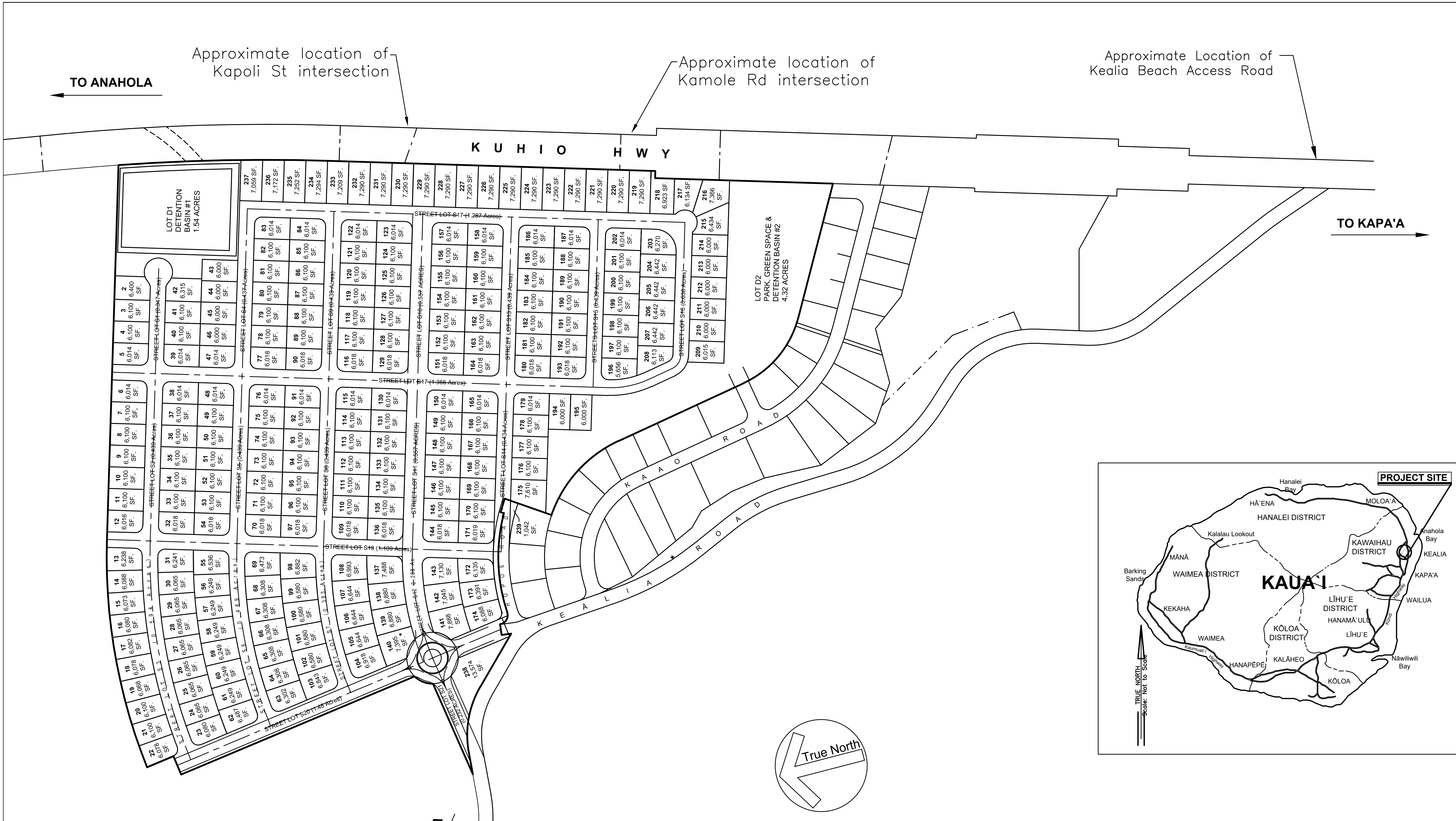
10. U.S. Department of Agriculture, Soil Conservation Service, *Technical Report #55* (TR-55)

11. Kealia Water System, 2017 *Consumer Confidence Report*



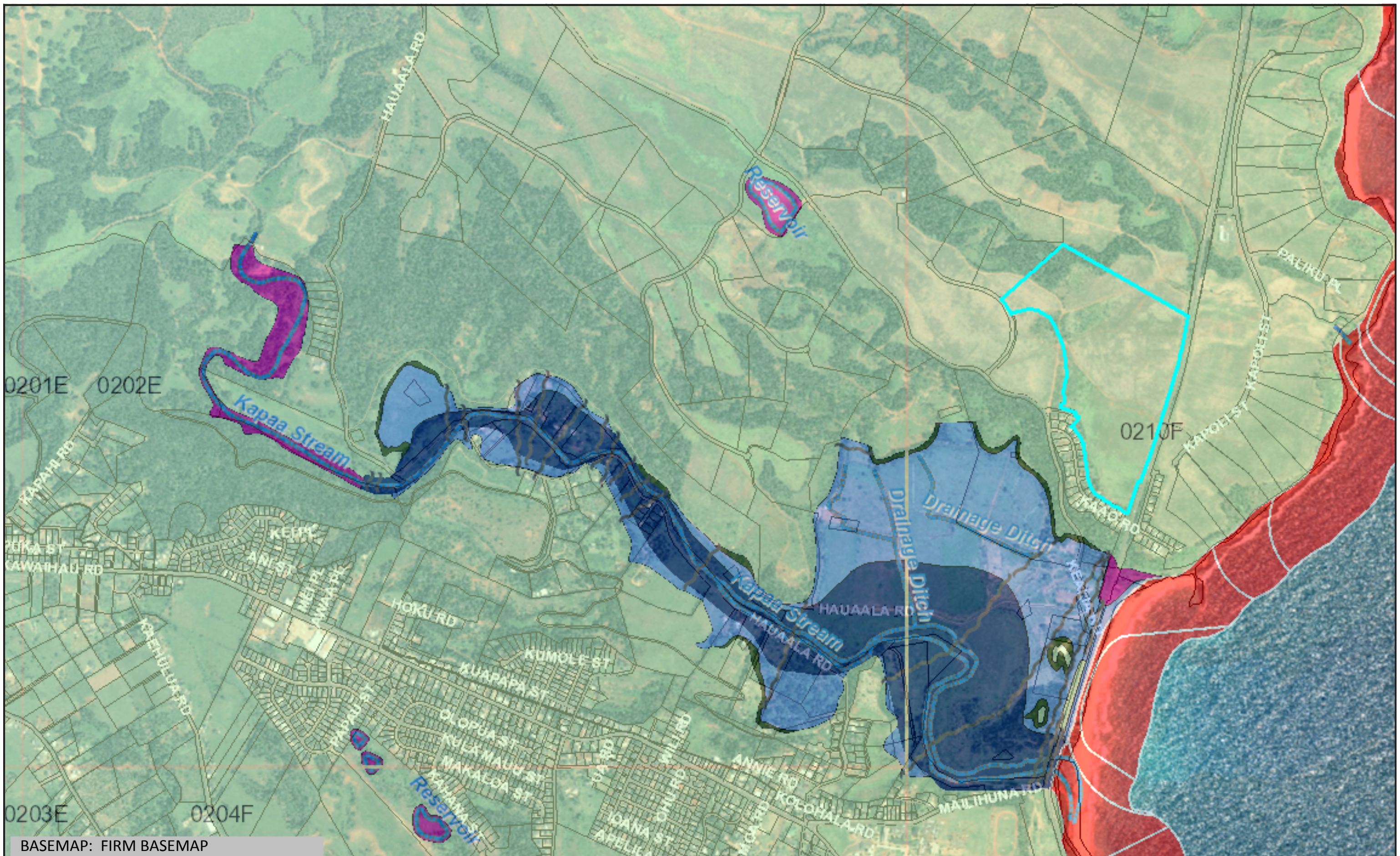
KEĀLIA RESIDENTIAL SUBDIVISION

Figure R-1 Existing Roadways



KEĀLIA RESIDENTIAL SUBDIVISION

Figure R-2 Proposed Roadways



Flood Hazard Assessment Report

www.hawaiinfip.org

Property Information

COUNTY: KAUAI

TMK NO: (4) 4-7-009:001

WATERSHED: KAPAA; KUMUKUMU

PARCEL ADDRESS: KEALIA RESIDENTIAL SUBDIVSION
KEALIA, HI 96751

Notes:

Flood Hazard Information

FIRM INDEX DATE:	NOVEMBER 26, 2010
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL:	1500020210F
PANEL EFFECTIVE DATE:	NOVEMBER 26, 2010

THIS PROPERTY IS WITHIN A TSUNAMI EVACUTION ZONE: NO
FOR MORE INFO, VISIT: http://www.scd.hawaii.gov/

THIS PROPERTY IS WITHIN A DAM EVACUATION ZONE: NO
FOR MORE INFO, VISIT: http://dlnreng.hawaii.gov/dam/

0 0.30 0.60 mi

Disclaimer: The Hawaii Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use, accuracy, completeness, and timeliness of any information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR, its officers, and employees from any liability which may arise from its use of its data or information.

If this map has been identified as 'PRELIMINARY', please note that it is being provided for informational purposes and is not to be used for flood insurance rating. Contact your county floodplain manager for flood zone determinations to be used for compliance with local floodplain management regulations.

FLOOD HAZARD ASSESSMENT TOOL LAYER LEGEND
(*Note: legend does not correspond with NFHL)*

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD - The 1% annual chance flood (100-year), also know as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. SFHAs include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A**: No BFE determined.
- **Zone AE**: BFE determined.
- **Zone AH**: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO**: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V**: Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE**: Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF**: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

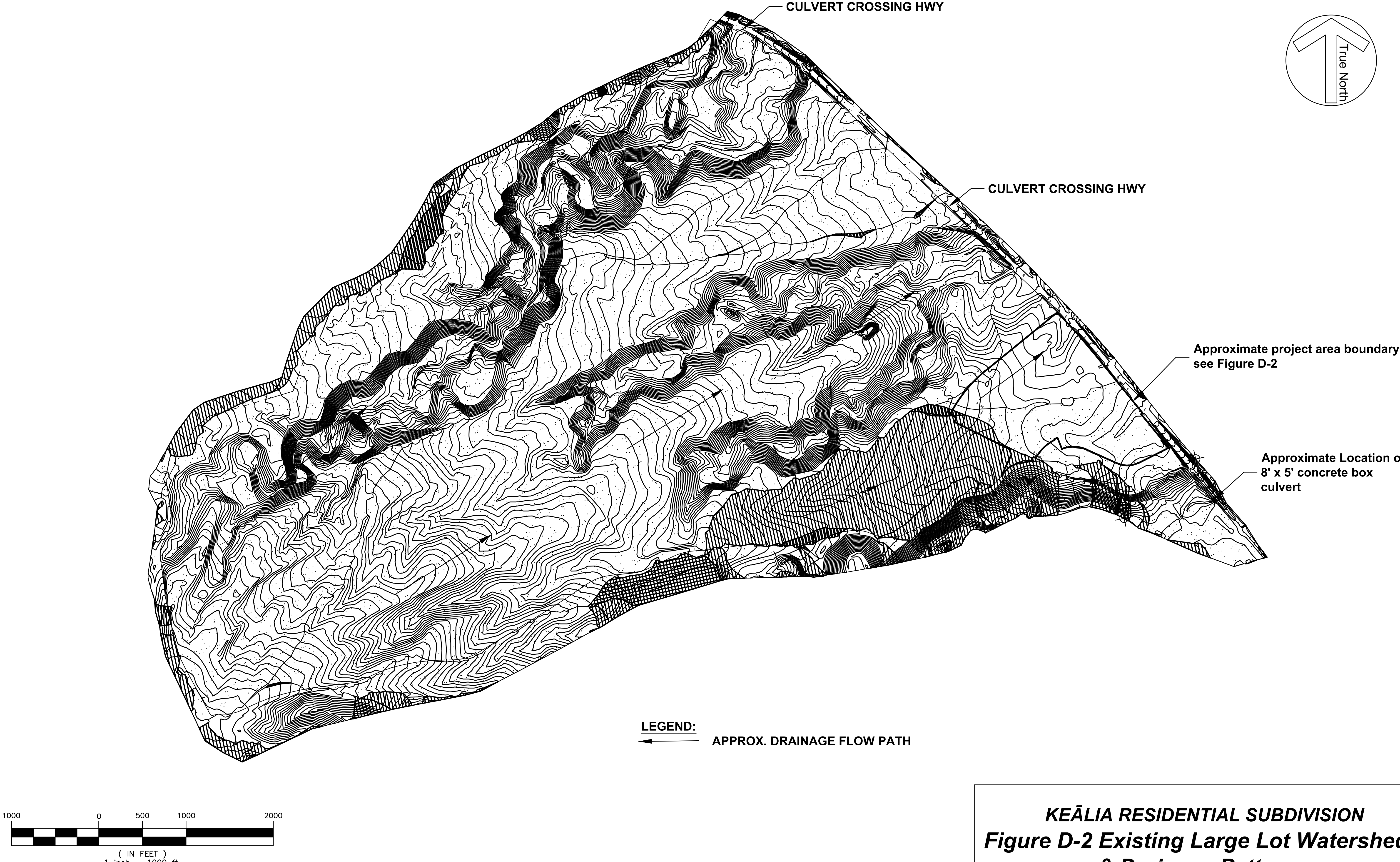
NON-SPECIAL FLOOD HAZARD AREA - An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded)**: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X**: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D**: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase apply, but coverage is available in participating communities.

FIGURE D-1



KEĀLIA RESIDENTIAL SUBDIVISION

Figure D-2 Existing Large Lot Watershed & Drainage Pattern

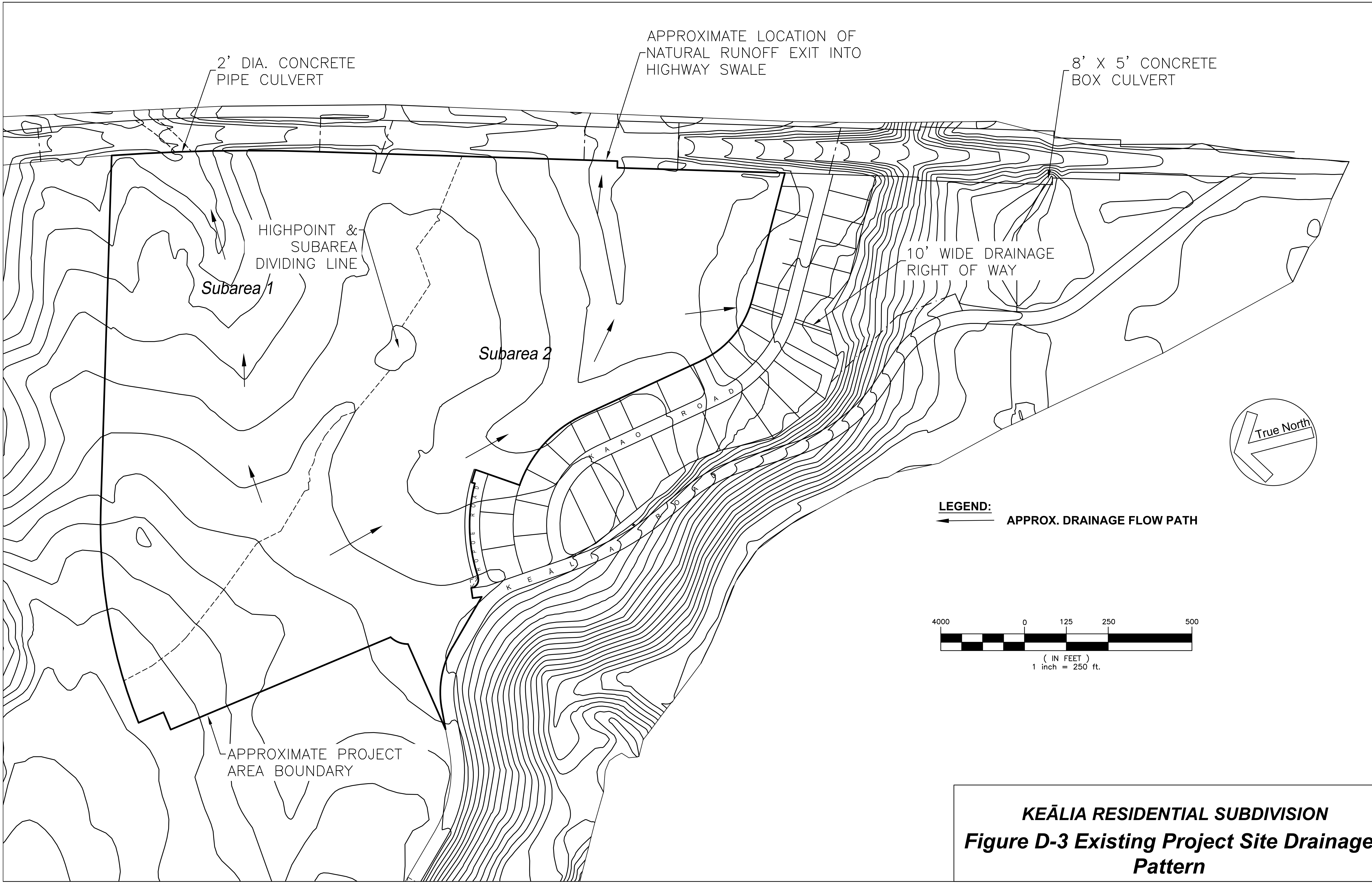


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Figure D-3 Existing Project Site Drainage Pattern

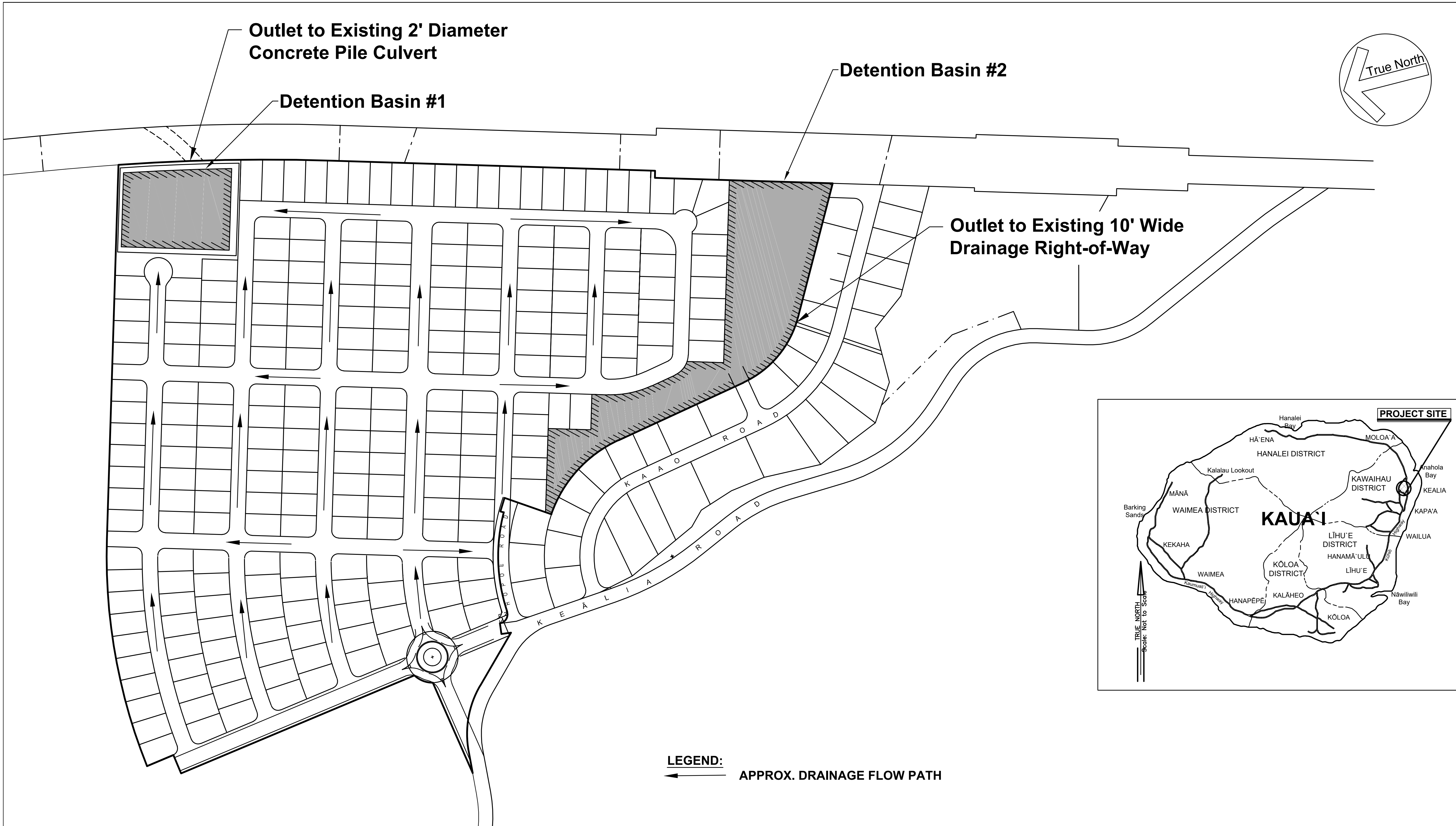

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Figure D-4 Post-Developed Drainage

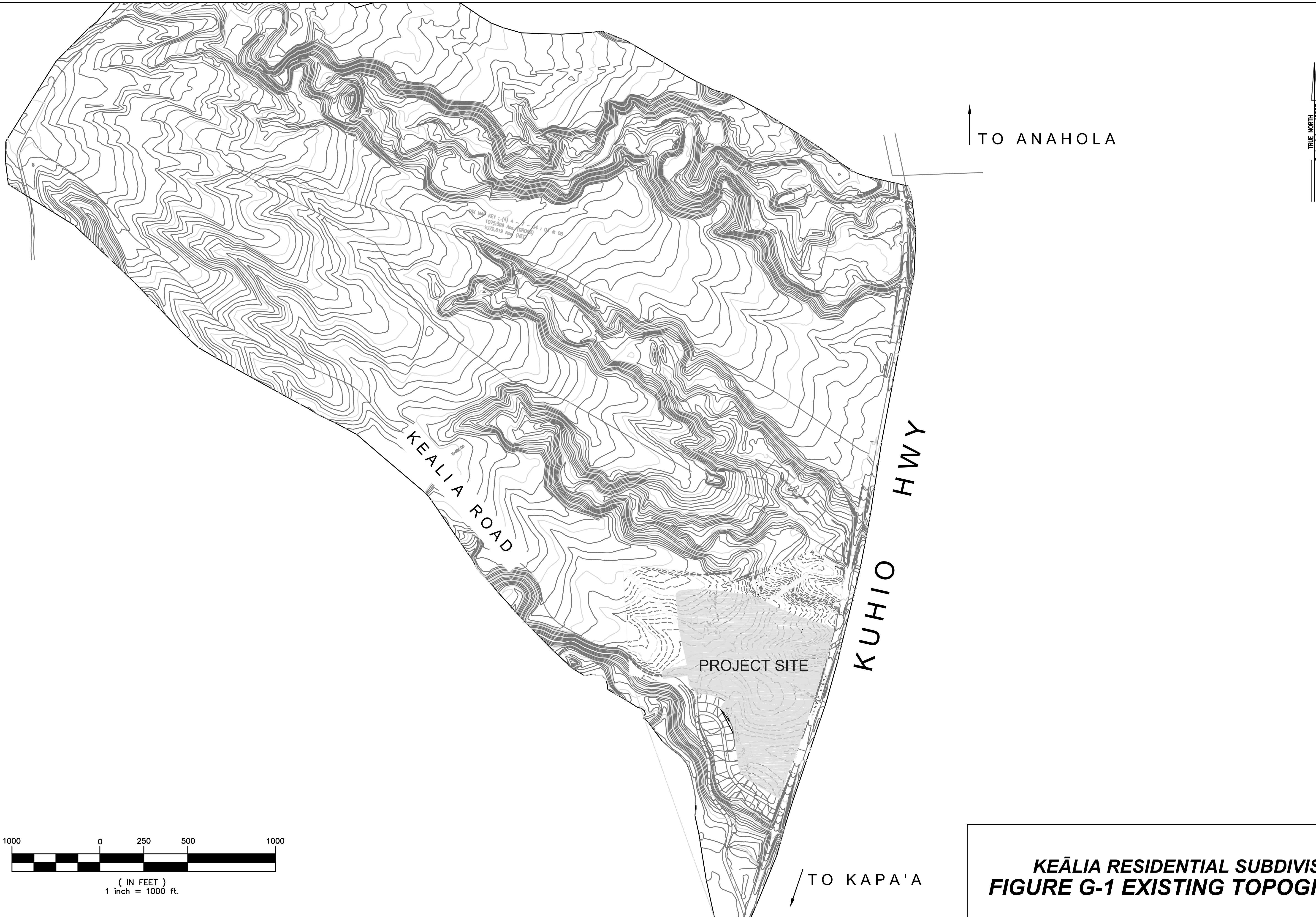

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FIGURE G-1 EXISTING TOPOGRAPHY

LEGEND:

EXISTING SURFACE CONTOURS

PROPOSED FINISHED CONTOURS

ESTIMATED QUANTITY

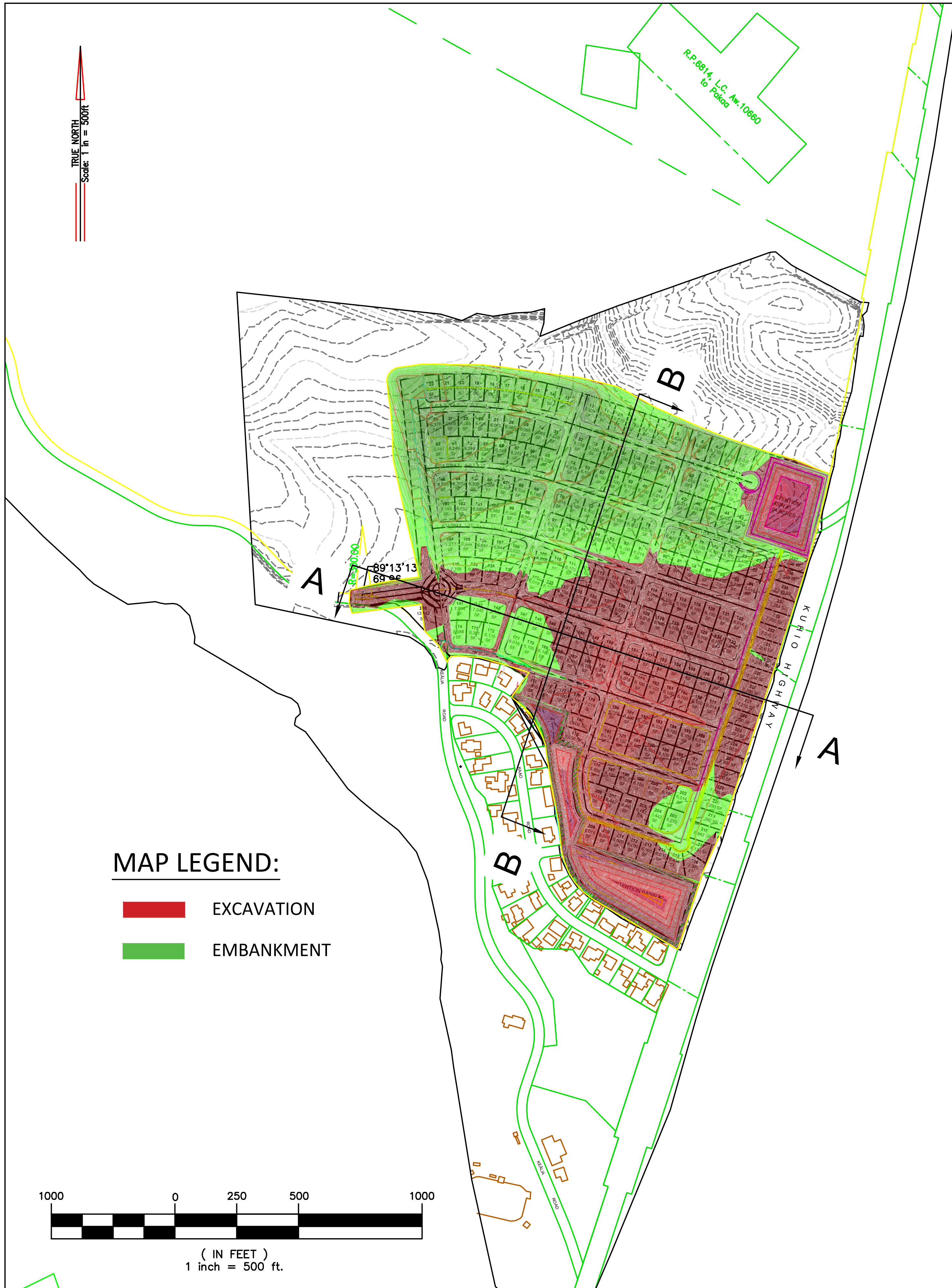
EXCAVATION = 350,000 CY

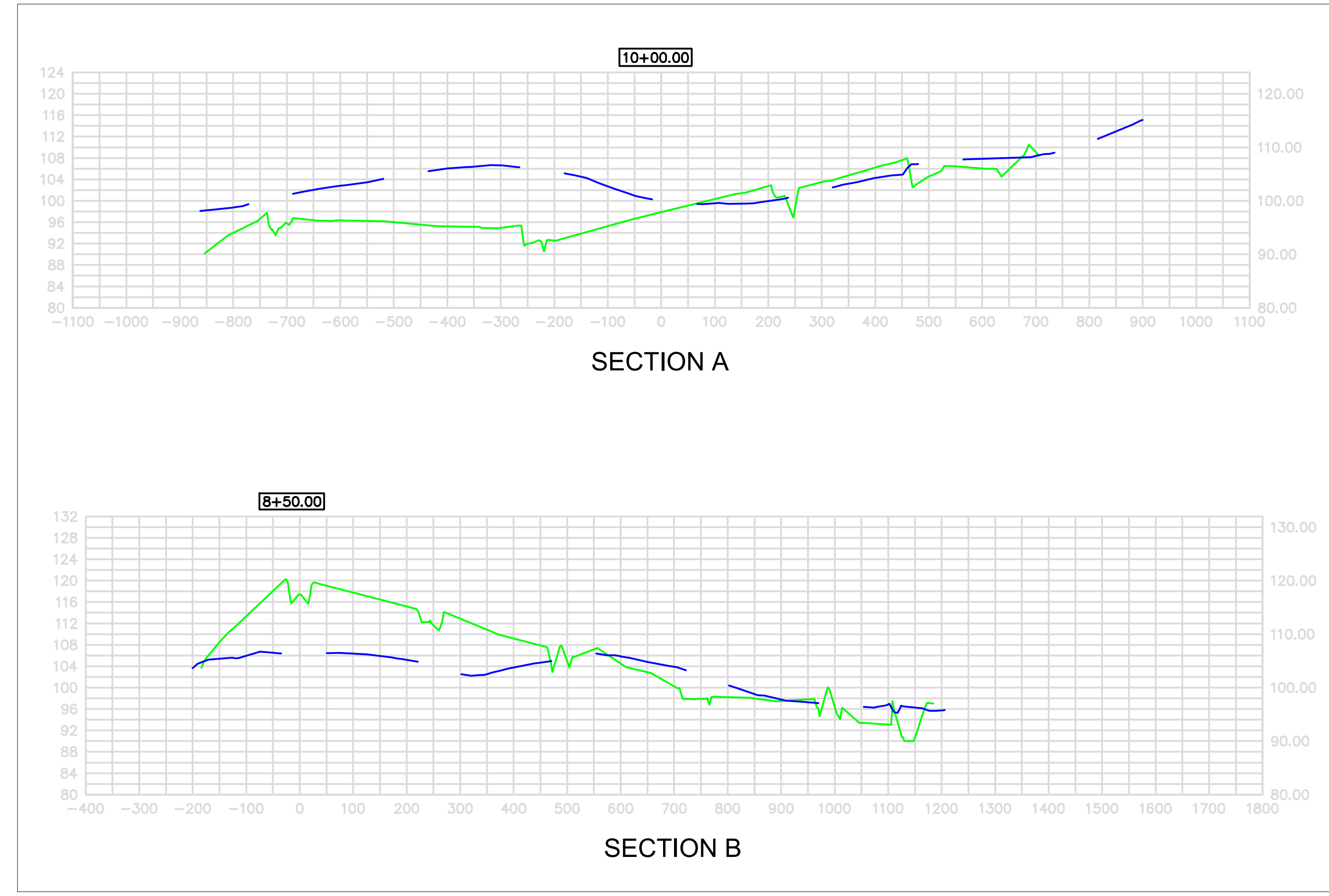
EMBANKMENT = 347,000 CY

NET EXCAVATION = 3000 CY

KEĀLIA RESIDENTIAL SUBDIVISION

FIGURE G-2 PRELIMINARY GRADING PLAN





GRADING SECTION VIEWS A & B

ESTIMATED QUANTITY

EXCAVATION = 350,000 CY

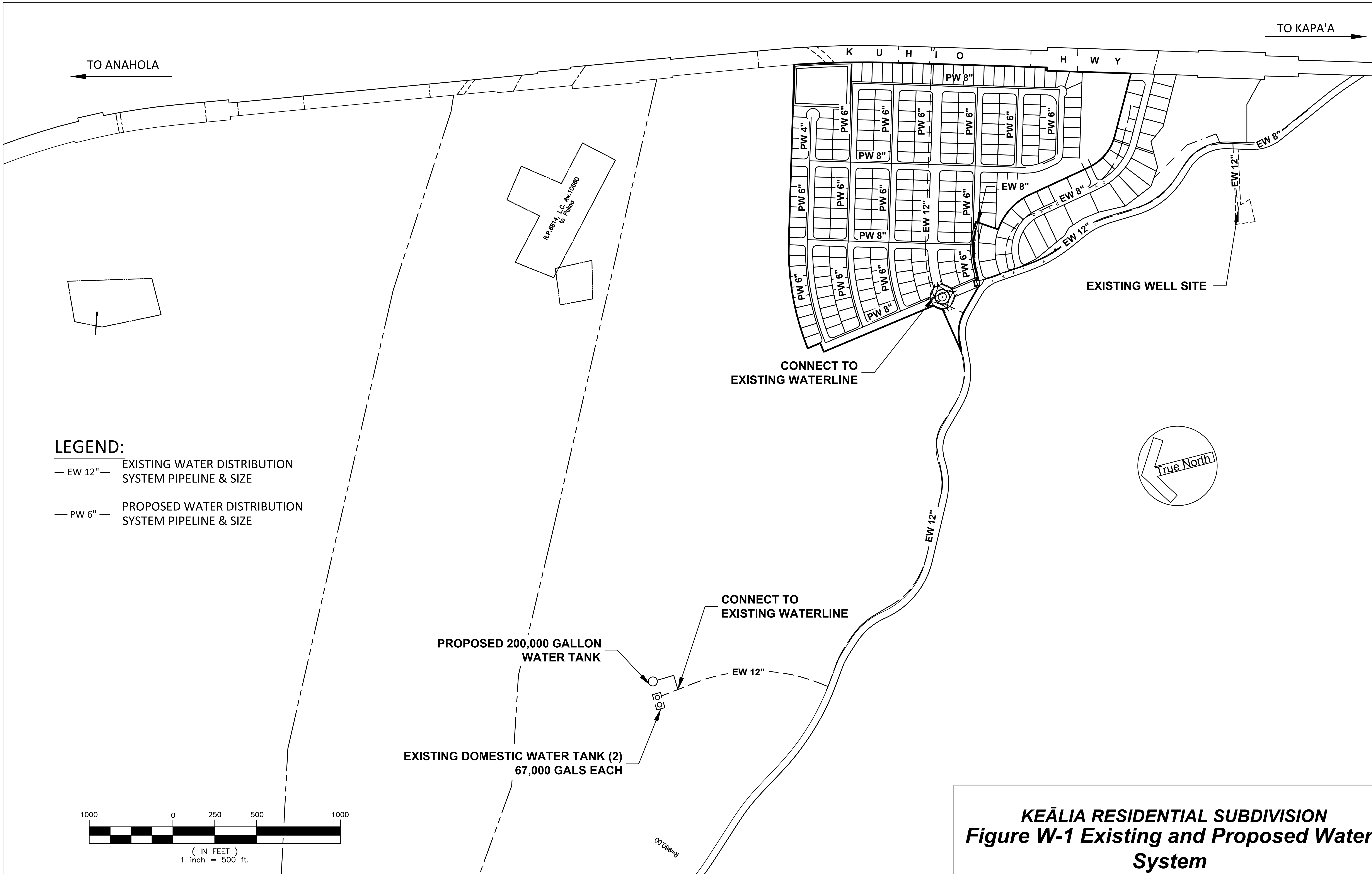
EMBANKMENT = 347,000 CY

GRAPH LEGEND:

EXISTING GROUND SURFACE

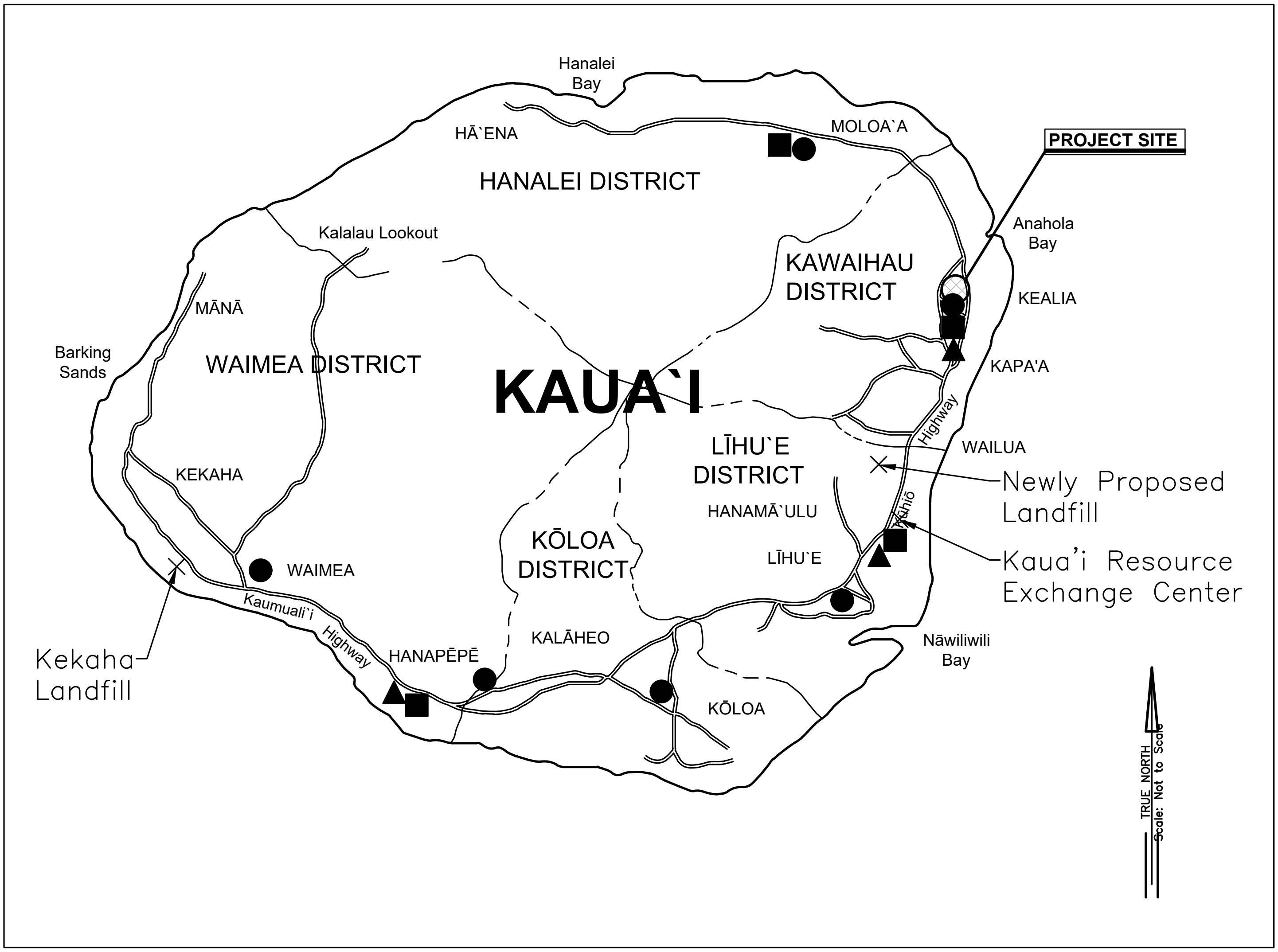
FINISHED GROUND SURFACE

KEĀLIA RESIDENTIAL SUBDIVISION
FIGURE G-3 PRELIMINARY GRADING SECTION VIEW



KEĀLIA RESIDENTIAL SUBDIVISION

Figure W-1 Existing and Proposed Water System

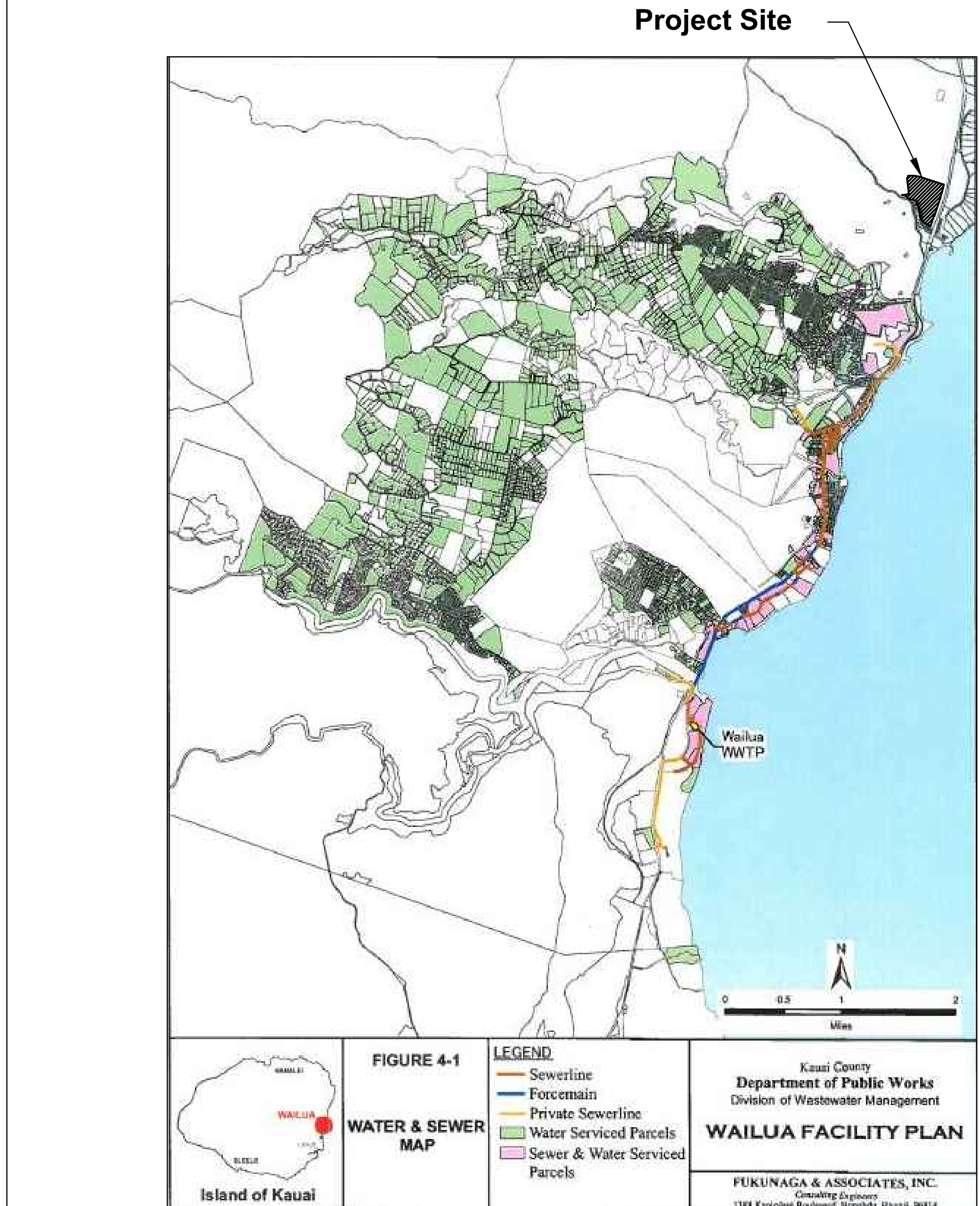


Legend

- ● Drop-off Recycling Center
- ■ Refuse Transfer Station
- ▲ Green Waste Diversion Site

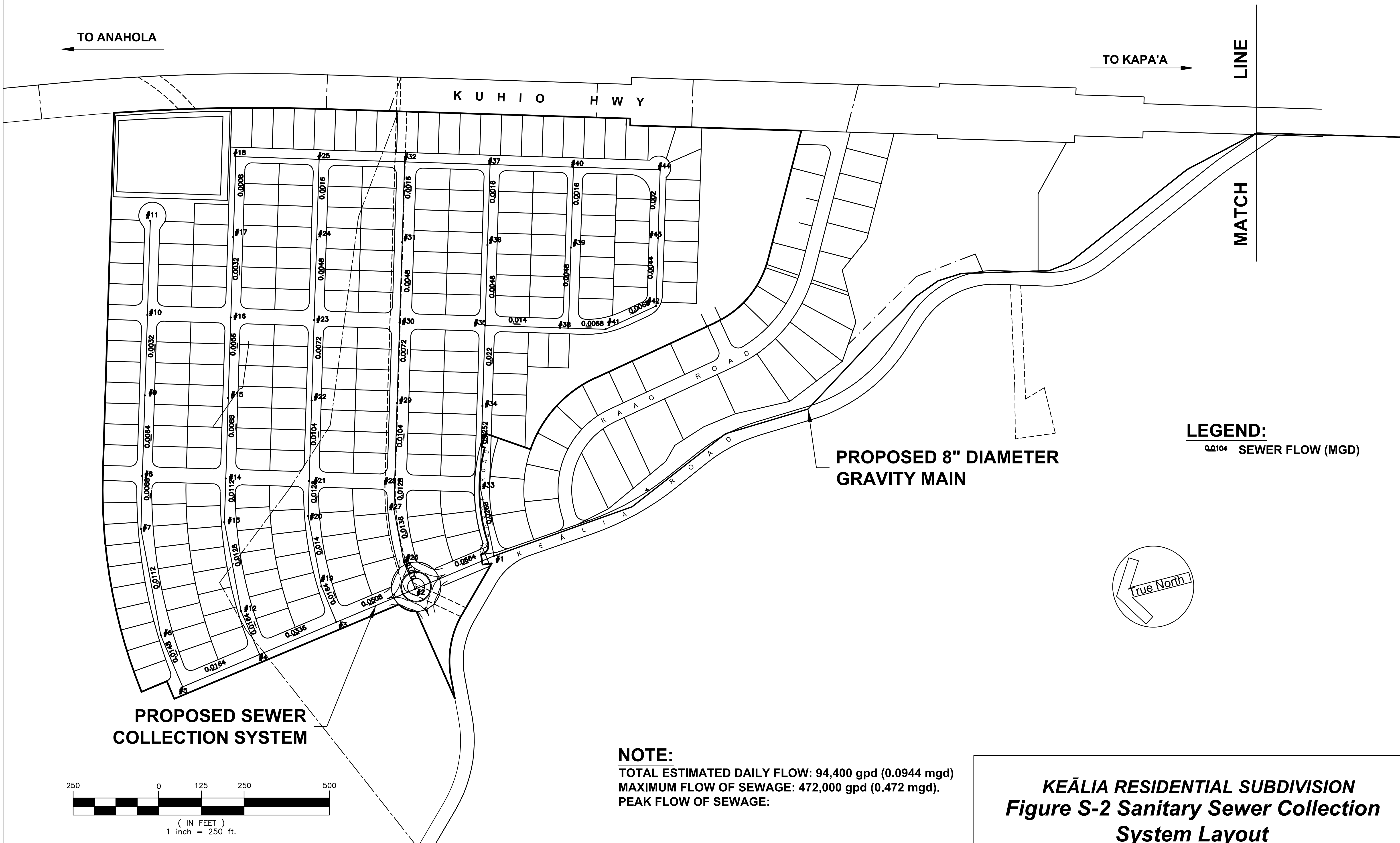
KEĀLIA RESIDENTIAL SUBDIVISION

Figure M-1 Solid Waste & Material Management



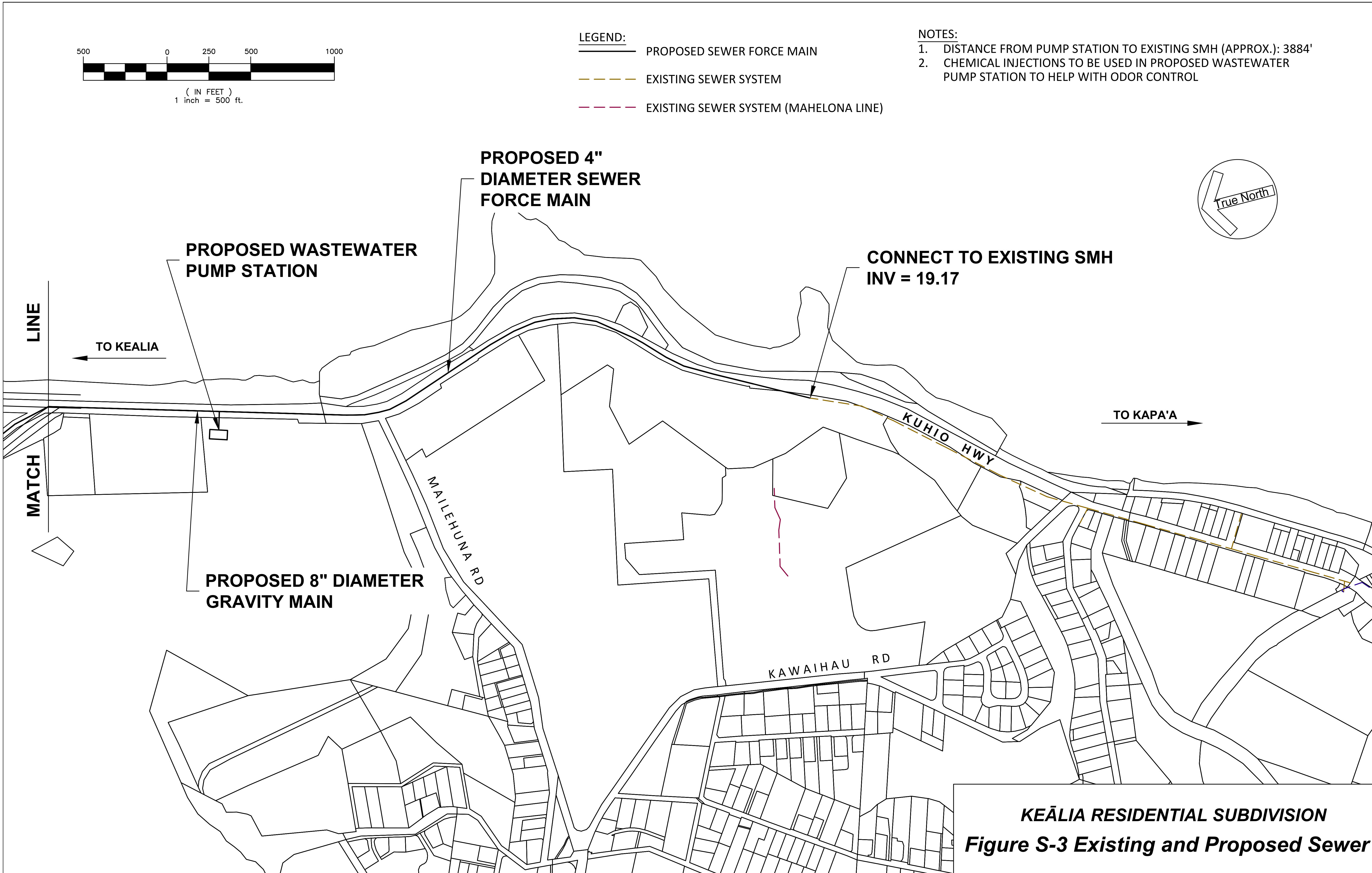
KEĀLIA RESIDENTIAL SUBDIVISION

Figure S-1 Regional Wastewater System Map



NOTE:
TOTAL ESTIMATED DAILY FLOW: 94,400 gpd (0.0944 mgd)
MAXIMUM FLOW OF SEWAGE: 472,000 gpd (0.472 mgd).
PEAK FLOW OF SEWAGE:

KEĀLIA RESIDENTIAL SUBDIVISION
Figure S-2 Sanitary Sewer Collection System Layout



KEĀLIA RESIDENTIAL SUBDIVISION

Figure S-3 Existing and Proposed Sewer

Figure E-1 – KIUC Transmission and Distribution System Map

7/11/2017

Not Yet Available

WATER SERVICE AGREEMENT

THIS WATER SERVICE AGREEMENT (this "**Agreement**") is entered into this 22nd day of December, 2004 (the "**Effective Date**"), between KEALIA WATER COMPANY HOLDINGS, LLC, a Delaware limited liability company (hereinafter, the "**Water Company**"), and KEALIA PLANTATION COMPANY, LLC, a California limited liability company (hereinafter, "**KPC**").

RECITALS

A. KPC is the owner of certain real property situated in the County of Kauai (the "**County**"), State of Hawaii, more particularly described on ***Exhibit A*** attached hereto (the "**KPC Parcels**") and denoted as "Segment B Serviced Lands" on the map attached hereto as ***Exhibit B*** (the "**Map**").

B. The Water Company was established to access, construct, operate, maintain, repair, replace, improve and expand a potable water system, including, but not limited to, well facilities, pumps, water lines, pipes, treatment facilities, storage facilities, mechanical facilities, measuring devices, and other appurtenances associated with these structures (collectively, the "**Infrastructure**"), and to divert, treat and deliver potable water. The location of the Infrastructure is shown on the survey attached hereto as ***Exhibit C*** (the "**Survey**"). The Water Company holds title to all components of the Infrastructure which constitute personal property, including fixtures. A portion of the Infrastructure is located on the KPC Parcels, as shown on the Survey.

C. The Water Company has filed an application (the "**PUC Application**") with the Public Utilities Commission of the State of Hawaii (the "**PUC**") to place the Infrastructure and the water delivered through the Infrastructure under the governance and regulation of the PUC.

D. The Water Company was formed to provide potable water service to (i) property owned by Cornerstone Hawaii Holdings, LLC, a Colorado limited liability company ("**CHH**") (which property is described on ***Exhibit D*** attached hereto and is denoted as "Segment A Serviced Lands" on the Map (the "**CHH Parcels**")), (ii) the Kealia Kai subdivision (which property is described on ***Exhibit E*** attached hereto and is denoted as "Segment B Serviced Lands" on the Map (the "**Kealia Kai Subdivision**")), (iii) the KPC Parcels, and (iv) certain water users who reside in residences situated adjacent to Kuhio Highway which historically have been connected to the Infrastructure (the "**Historical Water Users**"). The Persons (as hereinafter defined) and parcels described in the foregoing clauses (i) through (iv) shall be hereinafter referred to collectively as the "**Potable Water Users.**" In addition to the Potable Water Users, the Water Company may hereafter desire to additionally provide potable water service to future users within the Service Area (as defined in the "Rules," as hereinafter defined) of the Water Company, as such Service Area is designated and modified by the PUC from time to time (hereinafter "**Other Water Users**").

E. The Water Company and KPC desire to enter into this Agreement to set forth the manner and terms of potable water service to the KPC Parcels, as more particularly provided herein.

F. For purposes of this Agreement, KPC and successor owners of the KPC Parcels who seek to expand the Infrastructure (whether in connection with or to facilitate a Subdivision (as hereinafter defined) or otherwise) shall be referred to herein individually as a "**Developer**" and collectively as the "**Developers,**" and Persons who own or acquire legal parcels from a Developer for the purpose of constructing residences or other improvements thereon (excluding Subdivision improvements, such as roadways, utility lines, sewers and similar improvements which will be constructed by "Developers") and who establish Service Connections (as defined in the "Rules") with the Water Company shall be herein referred to individually as a "**Customer**" and collectively as "**Customers.**" As used herein, "**Person**" means any individual, corporation, partnership, limited liability company, trust or other legal entity, or any governmental or quasi-governmental agency, department or body; and "**Subdivide**" and "**Subdivision**" refer to the act of legally dividing or parcelizing a parcel of land (whether pursuant to the Subdivision Ordinance (Chapter 9, Kauai County Code), the Condominium Property Act (Chapter 514A, Hawaii Revised Statutes) or otherwise). A Person who is a KPC Owner may be a "Developer," a "Customer" or both.

NOW, THEREFORE, in consideration of the promises and agreements set forth below, and for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties agree as follows:

1. <u>Potable Water Service to KPC Parcels.</u>

(a) The Water Company hereby agrees to provide potable water service to the KPC Parcels on the terms set forth in this Agreement. Pursuant to this Agreement, a daily aggregate amount of three hundred thousand (300,000) gallons of potable water per day (gpd) (the "**KPC Allocation**") from the Infrastructure shall be reserved for the benefit of and shall be available to KPC and the owner(s) of all or any portion of the KPC Parcels from time to time (KPC and such other owner(s) being collectively referred to herein as the "**KPC Owners**"), subject to expansion of the Infrastructure in accordance with Paragraph 4 below, at locations on the KPC Parcels designated by Developers. The KPC Allocation shall be subject to reduction only in accordance with Paragraph 2 below. The KPC Owners shall have the right to use potable water from the Water Company for both Residential and Non-residential (as such terms are defined in the Rules) purposes. The KPC Allocation shall be reserved solely for the benefit of the KPC Owners, and, except as specifically provided in Paragraph 1(c) below, the Water Company shall not make any portion of the KPC Allocation available to any Person other than a KPC Owner, irrespective of the actual quantity of potable water used by the KPC Owners from time to time.

(b) (i) As between KPC and the Water Company, KPC shall have the right, exercisable from time to time in its sole and absolute discretion, to allocate and apportion the KPC Allocation to and among Persons to whom KPC sells, transfers or otherwise conveys all or any portion of the KPC Parcels. Any such transferee itself shall have the right, exercisable from time to time in its sole and absolute discretion, to allocate and apportion its share of the KPC Allocation to and among Persons to whom it sells, transfers or otherwise conveys all or any portion of the KPC Parcels it has acquired. If a Person sells a portion of its land to another Person, then the first Person shall have the right to make an allocation to the second Person, and the second Person shall, in turn, have the right to make a further allocation (of its allocation) to Persons to whom it sells its KPC Parcels. Neither KPC nor any other Person shall assign or otherwise convey all or any portion of the KPC Allocation for or to benefit property which is not presently a part of the KPC Parcels. The allocations described in this subparagraph (i) shall be herein referred to as the "**Potable Water Allocations**".

(ii) Subject to the terms of this Agreement, the Water Company shall honor and abide by the Potable Water Allocations provided that the Person properly making the Potable Water Allocation provides written notice to the Water Company, in such form reasonably acceptable to the Water Company, that sets forth the name and address of the transferee and the amount of the Potable Water Allocation (each such notice being herein referred to as an "Allocation Notice").

(iii) KPC and any other Person who is the owner of the KPC Parcels in their entirety (but not any other Person, including, without limitation, any KPC Owners' Association (as hereinafter defined)) shall have the right, exercisable from time to time, to revise and adjust any Potable Water Allocation(s) it has made in accordance with this Paragraph 1(b). Any such adjustment by KPC or such other Person shall be effective upon at least sixty (60) days' written notice (each such notice being herein referred to as a "**Reallocation Notice**") to the Water Company and the affected KPC Owner(s). KPC and any other such Person who provides a Reallocation Notice to Water Company hereby agrees to indemnify, defend and hold harmless the Water Company from and against any and all claims, costs (including, without limitation, reasonable attorneys' fees) and liabilities actually incurred by the Water Company in complying with the instructions contained in a Reallocation Notice, including, without limitation, any claims asserted by a KPC Owner whose Potable Water Allocation has been adjusted pursuant to such Reallocation Notice.

(iv) KPC and any other Person who provides an Allocation Notice or Reallocation Notice to the Water Company agrees to pay the Water Company's reasonable administrative costs and expenses to amend its books and records and take such other measures to reflect the Allocation Notice or the Reallocation Notice.

(c) Notwithstanding the terms of Paragraph 1(a) above, in the event a KPC Owner shall hereafter drill a well (each, a "**KPC Well**") on a portion of the KPC Parcels for the purpose of providing potable water service to residences constructed on such or other portions of the KPC Parcels, then such KPC Owner shall provide written notice to the Water Company designating the residences to be served by such KPC Wells (the "**Designated Residences**") at least ninety (90) days prior to the commencement of potable water service to the Designated Residences from such KPC Wells. During the period that the Designated Residences receive potable water service from such KPC Wells, and provided that KPC (and, if different, the Developer who has made a Potable Water Allocation to the parcel(s) on which such Designated Residence(s) are situated), does not and in the future will not require, in its good faith discretion, potable water service from the Water Company in the full amount of the KPC Allocation (or, as to a Developer, the Potable Water Allocation it has received), for the KPC Parcels (or, as to a Developer, the KPC Parcels it previously acquired), then the Designated Residences shall not be entitled to receive potable water from the Water Company, and the aggregate KPC Allocation (and, if applicable, the Potable Water Allocation made to the particular Developer) shall be reduced by an amount determined by multiplying the number of Designated Residences receiving potable water from such KPC Wells by the average daily usage of potable water by a detached single family residence on the Island of Kauai, as published from time to time by the Kauai Department of Water.

(d) No KPC Owner shall drill a potable water well within six hundred (600) feet of the potable water wells operated by the Water Company.

2. Deficit in Water Available for Delivery Due to Insufficient Supply. The Water Company shall not take any actions to reduce the amount of potable water available from the Infrastructure, except as may be required by law or for the safe and prudent operation of the Infrastructure, as reasonably determined in good faith by the Water Company. If at any time, due to unavailability of sufficient water supply, as a result of drought, other natural conditions, equipment problems or other problems beyond the reasonable control of the Water Company, the capacity of potable water available from the Infrastructure (the "**Available Potable Water**") is less than Nine Hundred Thirty-six Thousand (936,000) gallons per day (the "**Deemed Capacity**"), and if the Available Potable Water is insufficient to serve the then-actual needs of the Potable Water Users, then during such times the potable water provided to the Potable Water Users shall be reduced in the following manner. The KPC Owners, as a group, and CHH and its successors and assigns, as a group, shall each be entitled to an allocation of potable water determined by multiplying the Available Potable Water by a fraction, the numerator of which is Three Hundred Thousand (300,000) and the denominator of which is the Deemed Capacity. The Water Company shall have the right to allocate the remaining Available Potable Water to the Potable Water Users and Other Water Users in the Water Company's discretion.

3. Equipment Failure. In the event that any or all of the pumps and/or tanks are no longer operational and require replacement, the Water Company may install smaller pumps and/or tanks than those being replaced, if such new equipment can adequately serve the customers of the Water Company, including the KPC Owners, at the time of replacement, regardless of whether KPC has used all or any portion of the KPC Allocation; provided, however, that if the Water Company installs smaller pumps and/or tanks and if larger pumps and/or tanks are subsequently needed in order for the Water Company to fulfill a later request by KPC Owners for additional potable water, the Water Company shall install such larger pumps and/or tanks and other necessary equipment (or upgrade the existing pumps, tanks and equipment, as applicable) at KPC's expense as necessary to provide the additional water to the KPC Owners. The cost of any equipment over and above that needed to fulfill the requests of the KPC Users and the existing user's needs shall be borne by the Water Company.

4. Infrastructure Expansion.

(a) Notwithstanding the provisions of Paragraph 1 above, the parties acknowledge that the current Infrastructure needs to be expanded (meaning, for example, that additional diversion facilities, distribution lines, pipes and other equipment need to be installed) to deliver the KPC Allocation of water to the KPC Owners and the KPC Owners shall have the right to draw water from the Infrastructure in accordance with this Agreement and the Rules. In order to draw water from the Infrastructure, the KPC Owners will have to expand the Infrastructure in accordance with this Agreement and the Rules (an "**Expansion**").

(b) Any construction related to an Expansion shall be performed by a duly licensed contractor (the "**Contractor**") selected by the Developer and approved by the Water Company, which approval shall not be unreasonably withheld, conditioned or delayed. Water Company hereby approves Goodfellow Brothers, Inc. as a Contractor to construct Expansions. The Parties agree that any such Expansion for any KPC Owner shall be accomplished in accordance with the Rules as applied in a reasonable manner such that the Expansion shall not be unreasonably burdened, conditioned or delayed.

(c) Notwithstanding anything in the Rules or this Agreement to the contrary, the Water Company shall not require any Developer to pay any Water System Facilities Charge (as defined in the Rules) until the earlier of: (i) the date the Developer has listed with a realtor and/or advertised one or more Subdivided lots for sale, lease or exchange, and then only for the number of lots offered for sale, lease or exchange; or (ii) the date the Developer completes the Expansion and requires potable water for one or more KPC Parcels or Subdivided lots, and then only for the number of KPC Parcels or subdivided lots requiring potable water.

5. Dedication of Infrastructure. If the Water Company elects to dedicate or otherwise transfer or convey the Infrastructure to the County or any other Agency, and if the Water Company is required to upgrade or make improvements to the Infrastructure or any Expansion as a condition to or in connection with such dedication, transfer or other conveyance, then the Developers and, if necessary, Customers, shall execute such reasonable documents and take such other reasonable actions as the Water Company or any such Agency may reasonably request to effectuate such transfer; provided, however, that no KPC Owner shall be required to incur any costs, execute any deeds or grant any additional easements or other interests to any Person in connection with any such transfer or conveyance.

6. Will Serve Letter. If a KPC Owner elects to Subdivide any KPC Parcel, the Water Company agrees to provide such KPC Owner with a letter committing to provide potable water to such KPC Owner's parcels, subject to standard and customary terms and conditions consistent with this Agreement and the Rules.

7. Water Costs. Customers shall pay water usage charges to the Water Company for the provision of potable water at the rates approved by the PUC or pursuant to contracts approved by the PUC.

8. KPC Owners' Association.

(a) In the event that the KPC Parcels shall be Subdivided or otherwise sold or conveyed such that there shall actually be more than three (3) KPC Owners, then during the period that there is more than three (3) KPC Owners, the KPC Owners shall form an owners' association or other body (the "**KPC Owners' Association**") which shall have the authority to exercise the rights and make the elections provided to KPC under this Agreement, excluding only the rights expressly reserved under Paragraph 1(b)(iii) above to KPC and a Person who acquires the KPC Parcels in their entirety.

(b) The KPC Owners (or a Person designated by the KPC Owners' Association) shall provide the Water Company with written notice of the formation of the KPC Owners' Association, and from and after the date of receipt of such written notice the Water Company may rely on instructions from the KPC Owners' Association with respect to the matters described above. The KPC Owners shall remain liable for their respective obligations under this

Agreement notwithstanding the formation of any KPC Owners' Association pursuant to this Agreement.

(c) Notwithstanding the foregoing, in the event KPC shall hereafter elect to convey the KPC Parcels to one or more legal entities controlled directly by KPC (each, a "**KPC-Controlled Entity**"), then such entities shall not be deemed separate KPC Owners for purposes of this Paragraph 8 for so long as KPC directly controls such entities. For purposes of this Agreement, "control" shall mean the ownership of a majority of the voting interests of such entity and the right to elect a majority of the managers, directors, partners or other similar fiduciaries that govern such entity. KPC shall provide written notice to the Water Company prior to or after transferring any KPC Parcel to any such KPC-Controlled Entity, and KPC and its owners shall certify to the Water Company in writing that KPC controls such entity. Solely for purposes of the rights reserved to KPC pursuant to Paragraph 1(b)(iii) above, portions of the KPC Parcels owned by a KPC-Controlled Entity shall be deemed to be owned by KPC itself.

9. <u>Continuation of Potable Water Rights</u>. The terms and provisions of this Agreement and the rights to potable water granted hereunder shall not be affected in any manner by any grant or conveyance by KPC (or successor KPC Owner(s)) of fee title to the Potable Water Parcels to the Water Company as potentially provided for in the Grant of Easements dated as of even date herewith between KPC and the Water Company (the "**Grant of Easements**").

10. <u>Rules and Regulations</u>. As part of the PUC Application, the Water Company has filed proposed rules and regulations with the PUC which will govern the service of potable water to the customers of the Water Company. The rules and regulations, as approved by the PUC and as modified, supplemented or amended from time to time, shall be herein referred to as the "**Rules**". Notwithstanding anything herein or in the Rules to the contrary, in no event shall the Rules be interpreted, construed, enforced or applied in a manner so as to defeat, interrupt or interfere with the KPC Owners' right to the KPC Allocation in accordance with Paragraph 1(a) above (subject only to reduction in accordance with and to the extent provided in Paragraph 2 above) and the Developers' right to expand the Infrastructure in accordance with Paragraph 4 above so as to receive dependable supplies and adequate capacities of potable water at locations on the KPC Parcels designated by the Developers. In the event of any inconsistency between the terms of this Agreement and the Rules, the terms of this Agreement shall prevail.

11. <u>Miscellaneous Provisions</u>.

(a) This Agreement and the Grant of Easements contain the final and entire agreement between the parties hereto with respect to the subject matter hereof and no party shall be bound by any terms, conditions, statement or representations, oral or written, which are not expressly described herein.

(b) Any amendment to this Agreement shall be valid only if executed in writing by the Water Company, or its successors, and by KPC (or, after KPC has sold, transferred or otherwise conveyed the entirety of the KPC Parcels, the successor owner(s) of the KPC Parcels; provided, however, that if KPC has sold, transferred or otherwise conveyed any of the KPC Parcels and if a KPC Owners' Association has been formed pursuant to Paragraph 8 above, then this Agreement may be modified in writing by the Water Company, or its successors, and the

KPC Owners' Association), except that no such modification executed by the KPC Owners' Association shall be effective to diminish or otherwise affect the rights expressly reserved pursuant to Paragraph 1(b)(iii) above to KPC and a Person who acquires the KPC Parcels in their entirety. As used in this Agreement, the singular shall include the plural, the plural the singular, and the use of any gender shall be applicable to all genders.

(c) This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns (including, as to KPC, all KPC Owners), subject to the rights expressly reserved to KPC pursuant to Paragraph 1(b)(iii) above.

(d) The term "KPC Owners" as used in this Agreement means, from time to time, the then current owner(s) of the KPC Parcels, so that, in the event of any sale of the KPC Parcel(s) owned by a KPC Owner, such KPC Owner shall be and hereby is entirely freed and relieved of all covenants and obligations of such KPC Owner hereunder with respect to portions of the KPC Parcels so sold arising from and after the date of the sale, and it shall be deemed and construed, without further agreement between the parties and the purchaser at any such sale, that the purchaser has assumed and agreed to carry out any and all obligations of the transferring KPC Owner hereunder with respect to the portions of the KPC Parcels acquired by such purchaser. No such sale shall release KPC from any obligations hereunder arising or accruing prior to the date of sale.

(e) The provisions of this Agreement shall be deemed to be cumulative. No provision of this Agreement shall be deemed to be a limitation of or to exclude any other provision hereof, or any right to any remedy provided by law unless otherwise expressly stated. The captions of this Agreement are inserted only for the purpose of convenient reference and in no way define, limit or prescribe the scope or intent of this Agreement, or any part hereof.

(f)

(g) The parties to this Agreement recognize and agree that, to the extent permitted by the PUC and applicable law, the Water Company has the right to enforce its Rules. Additionally, in the event that any Potable Water User or any Person who has purchased or leased a portion of the KPC Parcels materially violates the terms of this Agreement or the Rules, the Water Company shall have all remedies available to it at law or in equity. Without limiting the foregoing rights and remedies, KPC, and its successors and assigns, agree that, to the extent permitted by the PUC and applicable law, the Water Company may also enforce such material violations by either curtailing potable water service to the defaulting Person during the period of such violation or breach, or by injunction, the parties agreeing that the damages to the Water Company from such violations are irreparable, and there is no adequate remedy at law for such violations. The Water Company shall be free from any liability arising out of the exercise of its rights under this paragraph. Notwithstanding the foregoing provisions of this paragraph, (i) if any KPC Owner (or any lessee thereunder) commits a violation with regard to water delivered to its or his owned or leased property, only that individual KPC Owner's or lessee's water service shall be disconnected, and enforcement actions will be directed toward that violator, and not toward those who are not violating this Agreement, and (ii) the Water Company shall not exercise any rights or remedies against any party upon a default hereunder without first providing such party written notice of such default and a period of thirty (30) days to cure the same; provided, however, that if due to the nature of such default the same cannot reasonably be cured within such thirty (30) day period, then the defaulting party shall have such additional time as shall be reasonably required to effect the cure, provided that the defaulting party commences the cure within such thirty (30) day period and thereafter diligently prosecutes the same to completion.

(h) If a dispute arises out of or relates to this Agreement or the breach thereof and if the dispute cannot be settled through negotiation, the parties agree first to try in good faith to settle the dispute by mediation administered by the American Arbitration Association under the Commercial Mediation Procedures before resorting to arbitration, litigation or some other dispute resolution procedure.

(i) In the event of any litigation between the parties arising under or related to this Agreement, the prevailing party shall be entitled to recover from the other its costs and expenses including reasonable attorney fees, incurred in connection therewith.

(j) If any provision of this Agreement shall be or become invalid or unenforceable, the remainder of the provisions of this Agreement shall not be affected thereby, and each and every provision shall be enforceable to the fullest extent permitted by law.

(k) The parties acknowledge and represent to each other that all procedures necessary to validly contract and execute this Agreement have been performed and that the persons signing for each party have been duly authorized to do so.

(l) This Agreement may be signed using counterpart signature pages, with the same force and effect as if all parties signed on the same signature page.

(m) Nothing set forth in this Agreement shall create or be deemed to create any real property rights or interests, and it is the parties' intent solely to create contractual rights and obligations under this Agreement.

(n) The Water Company may assign its rights and obligations hereunder, in whole but not in part, to any Person which acquires all or substantially all the assets of the Water Company, specifically including all of the Water Company's right, title and interest in the Grant of Easements and the Infrastructure, provided that such assignee shall assume in writing all obligations of the Water Company hereunder arising from and after the date of such assignment. The Water Company shall notify KPC in writing in advance of making any such assignment. In the event of any assignment of the Water Company's rights and obligations hereunder, the assignee shall be considered the "Water Company" for all purposes hereunder, and the Water Company named herein shall be and hereby is entirely freed and relived of all covenants and obligations of the Water Company hereunder arising from and after the date of the assignment, provided that the assignee assumes and agrees, in writing, to carry out any and all obligations of the Water Company hereunder. No such assignment shall release the Water Company from any obligations hereunder arising or accruing prior to the date of assignment.

(o) Without limiting the terms of Paragraph 11(n) above, the Water Company's rights and obligations hereunder shall at all times be held by the same Person who owns the Infrastructure and substantially all the other assets of the Water Company, including the interest of the Water Company under the Grant of Easements. Any assignment or purported assignment of this Agreement without a concurrent transfer and assignment to the same assignee of the Infrastructure, the Grant of Easements and the other assets of the Water Company shall be void and of no force or effect.

IN WITNESS WHEREOF, the undersigned has hereunto set its hand and seal the day and year first written above.

KPC: KEALIA PLANTATION COMPANY, LLC,
a California limited liability company

By: Justin Hughes
Justin Hughes
Manager

WATER COMPANY: KEALIA WATER COMPANY HOLDINGS LLC,
a Delaware limited liability company

By: Cornerstone Hawaii Holdings LLC,
a Colorado limited liability company,
Manager

By: ______________________________
Thomas D. McCloskey, Jr.
Manager

of the Water Company under the Grant of Easements. Any assignment or purported assignment of this Agreement without a concurrent transfer and assignment to the same assignee of the Infrastructure, the Grant of Easements and the other assets of the Water Company shall be void and of no force or effect.

IN WITNESS WHEREOF, the undersigned has hereunto set its hand and seal the day and year first written above.

KPC: KEALIA PLANTATION COMPANY, LLC,
a California limited liability company

By: ______________________________
Justin Hughes
Manager

WATER COMPANY: KEALIA WATER COMPANY HOLDINGS LLC,
a Delaware limited liability company

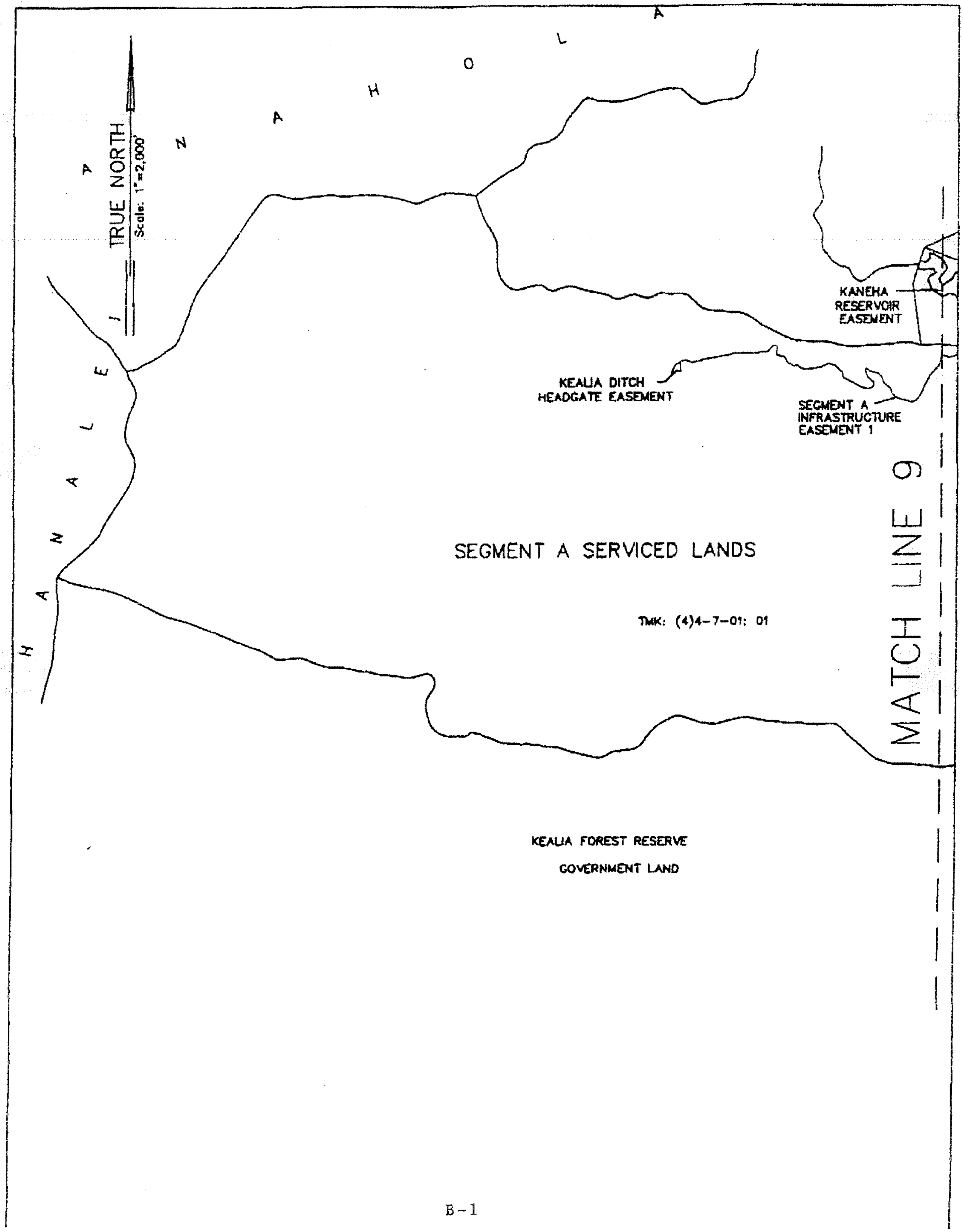
By: Cornerstone Hawaii Holdings LLC,
a Colorado limited liability company,
Manager

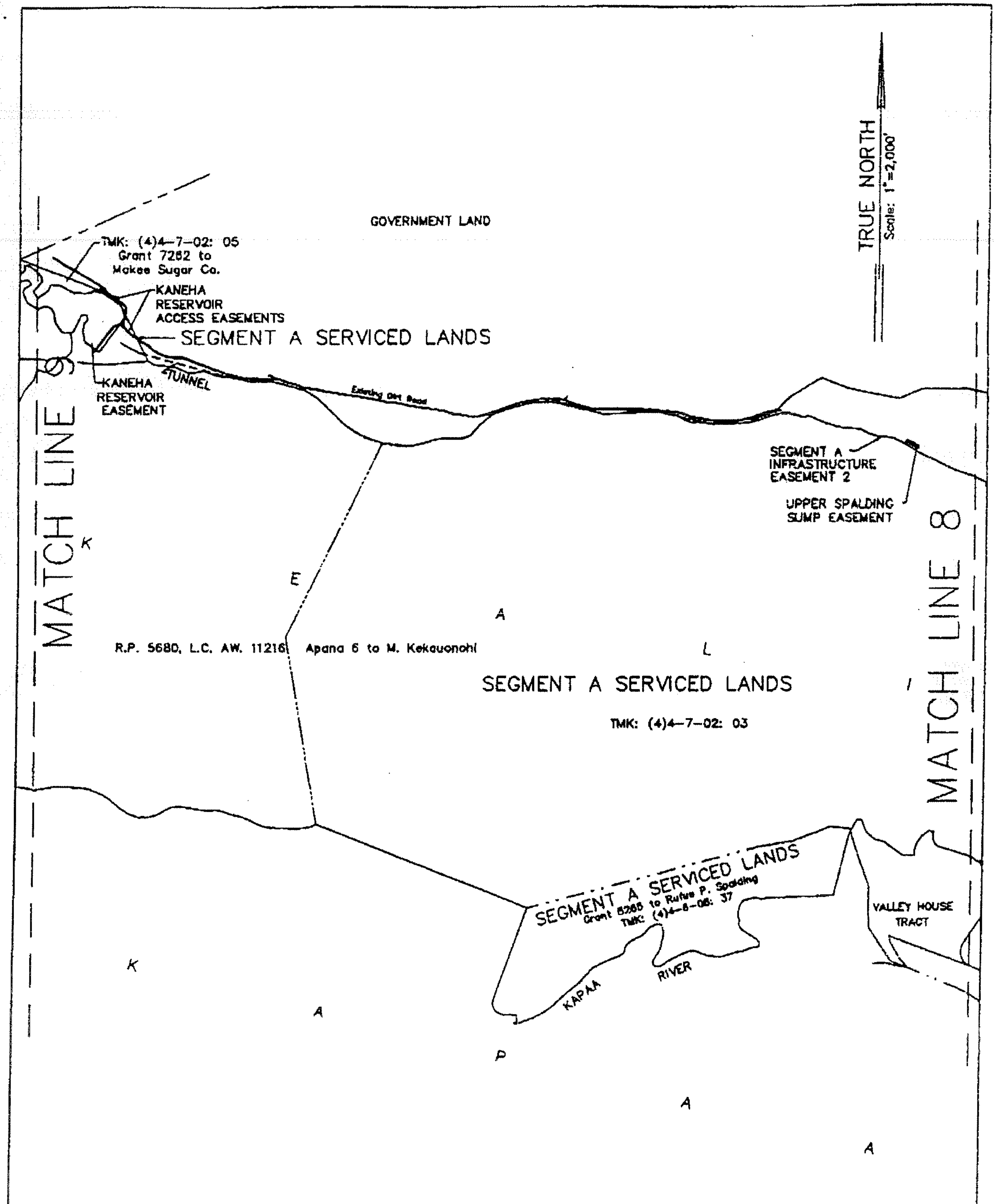
By: ______________________________
Thomas D. McCloskey, Jr.
Manager

EXHIBIT A
TO WATER SERVICE AGREEMENT

EXHIBIT B
TO WATER SERVICE AGREEMENT

MAP


TRUE NORTH
Scale: 1"=2,000'
ANAHOLA
HANALEI
KANEHA RESERVOIR EASEMENT
KEALIA DITCH HEADGATE EASEMENT
SEGMENT A INFRASTRUCTURE EASEMENT 1
SEGMENT A SERVICED LANDS
TMK: (4)4-7-01: 01
MATCH LINE 9
KEALIA FOREST RESERVE
GOVERNMENT LAND



TRUE NORTH
Scale: 1"=2,000'
GOVERNMENT LAND
TMK: (4)4-7-02: 05
Grant 7282 to
Makee Sugar Co.
KANEHA
RESERVOIR
ACCESS EASEMENTS
SEGMENT A SERVICED LANDS
TUNNEL
Existing Dirt Road
KANEHA
RESERVOIR
EASEMENT
SEGMENT A
INFRASTRUCTURE
EASEMENT 2
UPPER SPALDING
SUMP EASEMENT
MATCH LINE 9
MATCH LINE 8
K
E
A
L
I
R.P. 5680, L.C. AW. 11216, Apana 6 to M. Kekauonohi
SEGMENT A SERVICED LANDS
TMK: (4)4-7-02: 03
SEGMENT A SERVICED LANDS
Grant 5265 to Rufus P. Spalding
TMK: (4)4-6-06: 37
VALLEY HOUSE
TRACT
KAPAA
RIVER
K
A
P
A
A

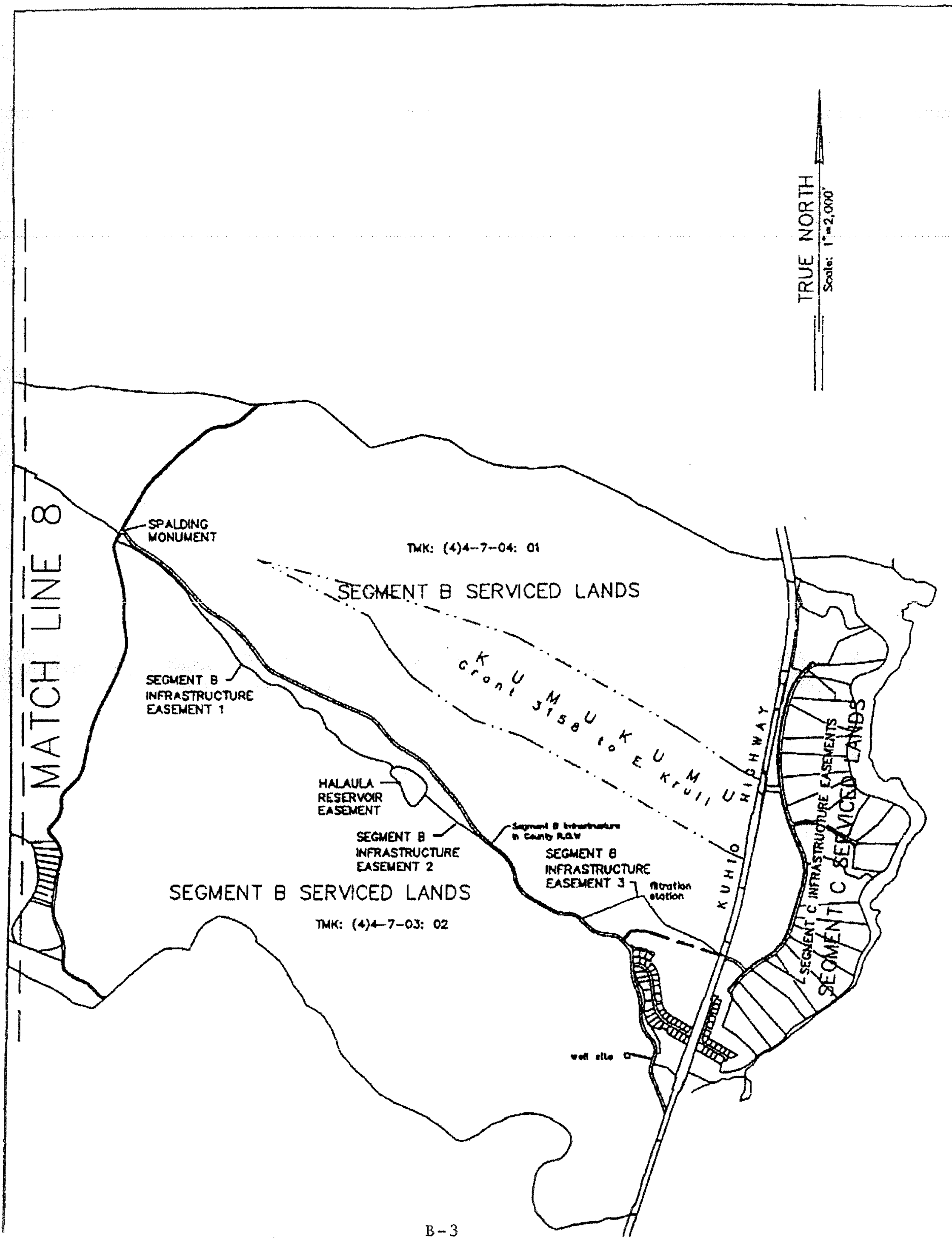
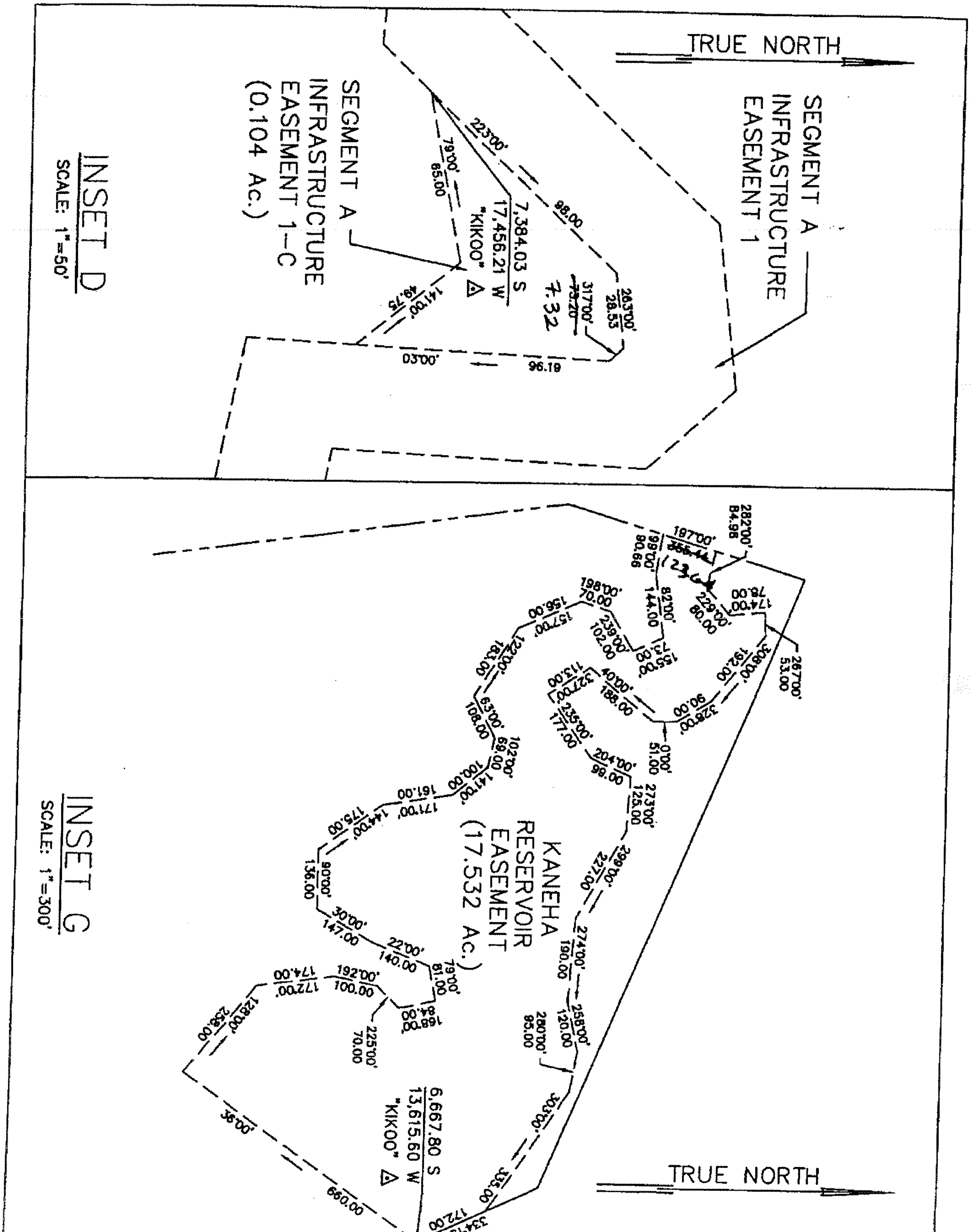
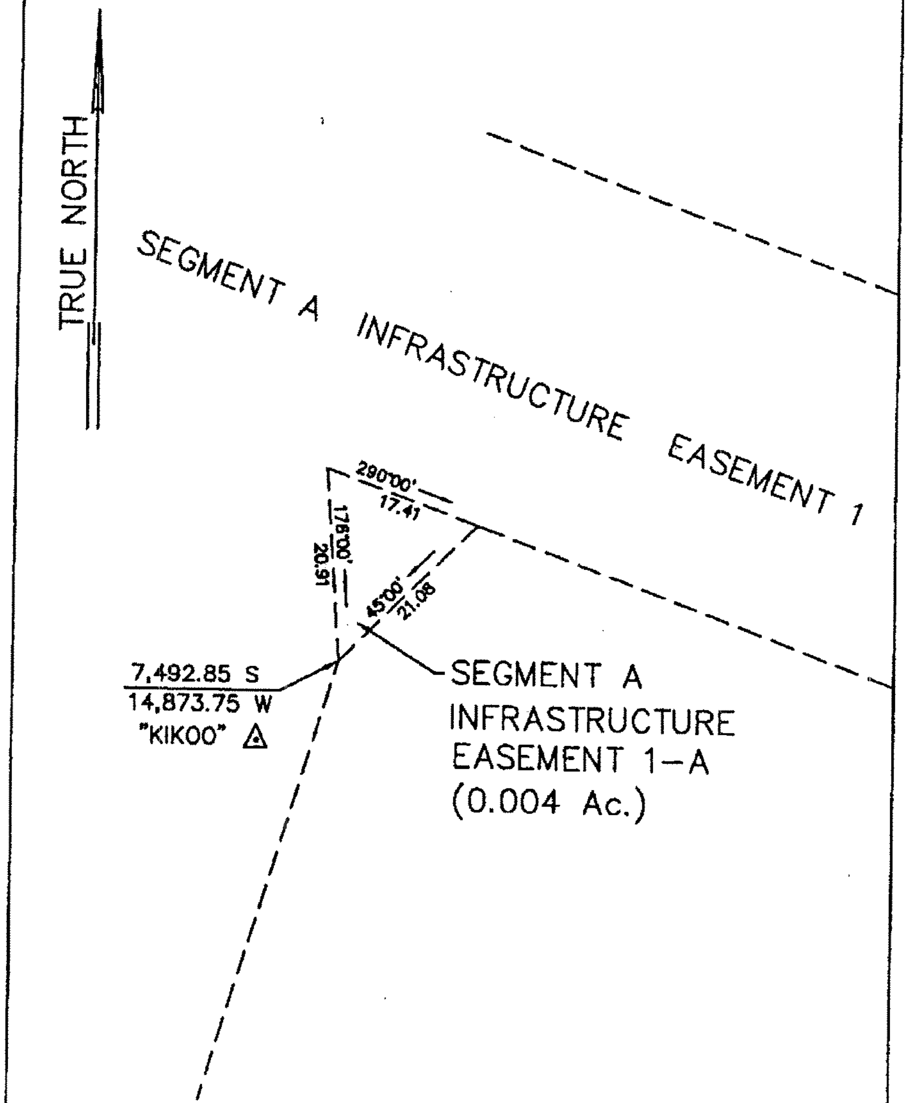

MATCH LINE 8
TRUE NORTH
Scale: 1"=2,000'
SPALDING MONUMENT
TMK: (4)4-7-04: 01
SEGMENT B SERVICED LANDS
KUMUKUMU
Grant 3158 to E. Krull
SEGMENT B INFRASTRUCTURE EASEMENT 1
HALAULA RESERVOIR EASEMENT
SEGMENT B INFRASTRUCTURE EASEMENT 2
Segment B Infrastructure in County R.O.W
SEGMENT B INFRASTRUCTURE EASEMENT 3
filtration station
KUHIO HIGHWAY
SEGMENT C INFRASTRUCTURE EASEMENTS
SEGMENT C SERVICED LANDS
SEGMENT B SERVICED LANDS
TMK: (4)4-7-03: 02
well site

EXHIBIT C
TO WATER SERVICE AGREEMENT

SURVEY OF THE INFRASTRUCTURE

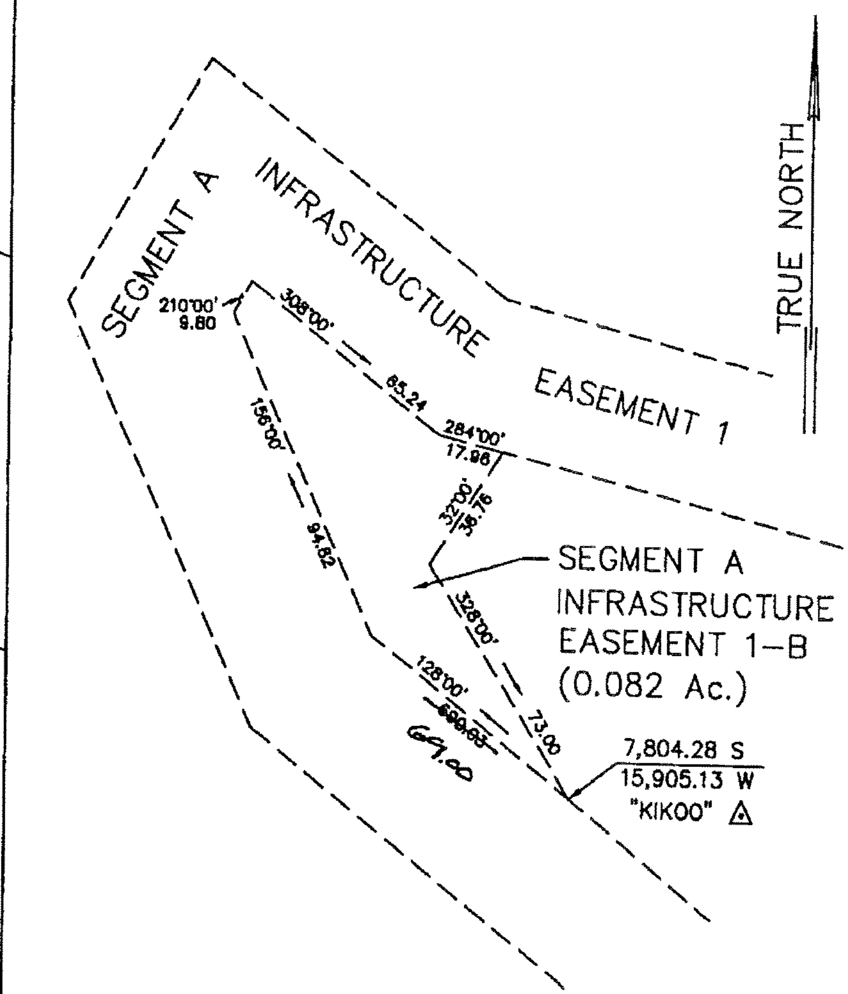

TRUE NORTH
SEGMENT A INFRASTRUCTURE EASEMENT 1
SEGMENT A INFRASTRUCTURE EASEMENT 1-C (0.104 Ac.)
7,384.03 S
17,456.21 W
"KIKOO"
INSET D
SCALE: 1"=50'
KANEHA RESERVOIR EASEMENT (17.532 Ac.)
6,667.80 S
13,615.60 W
"KIKOO"
INSET G
SCALE: 1"=300'
TRUE NORTH

HAF 06333



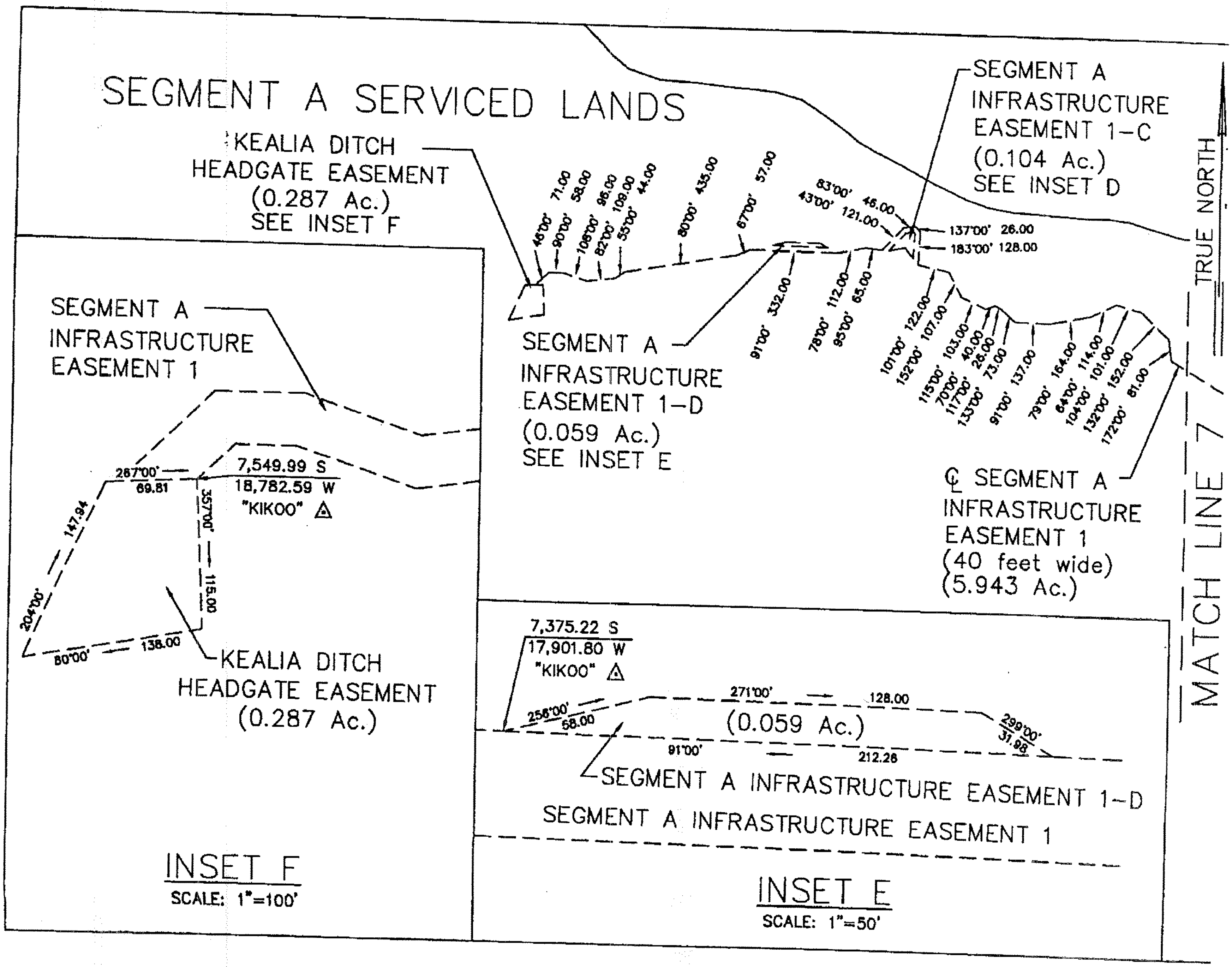
INSET B

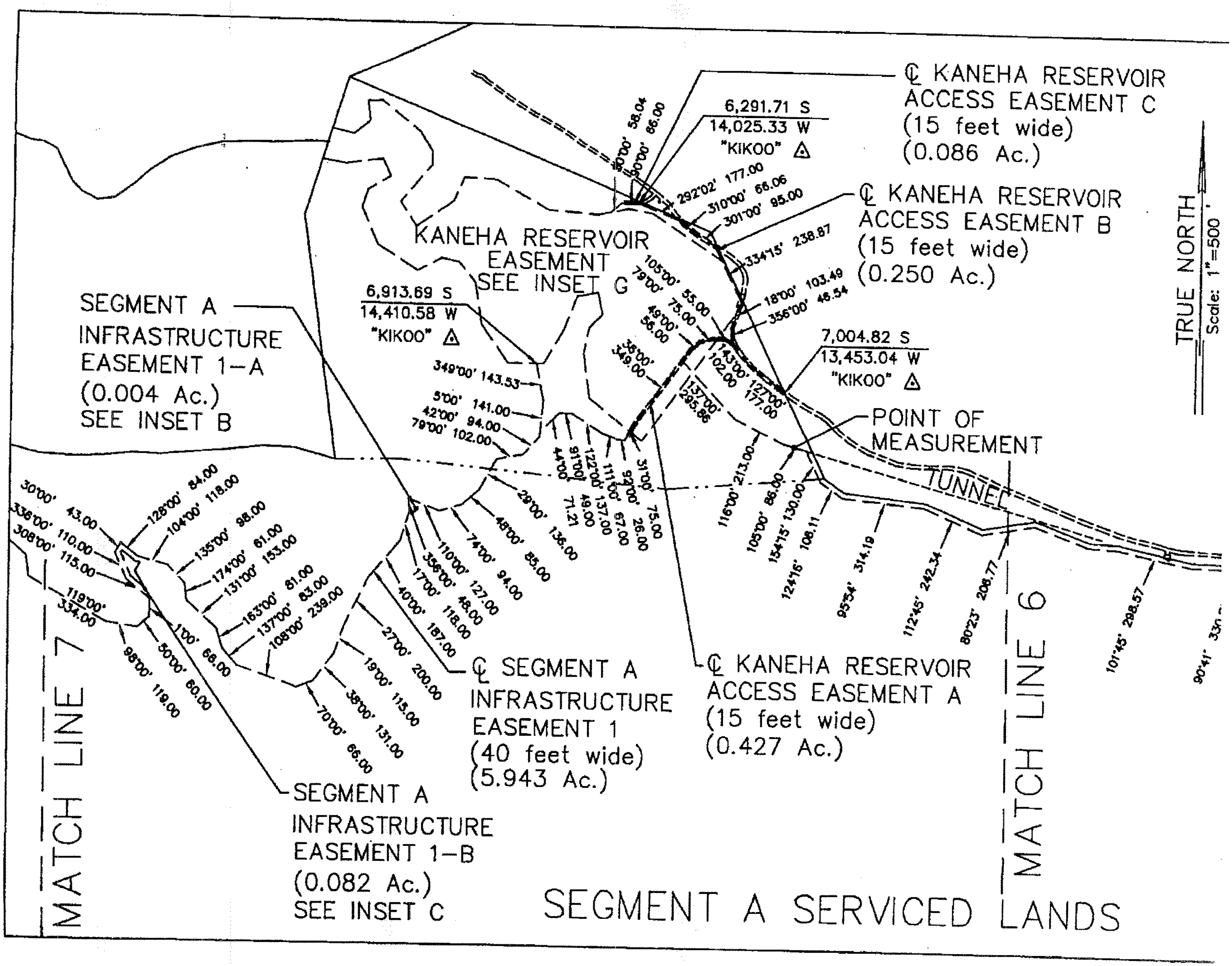
SCALE: 1"=20'



INSET C

SCALE: 1"=50'


SEGMENT A SERVICED LANDS
KEALIA DITCH
HEADGATE EASEMENT
(0.287 Ac.)
SEE INSET F
SEGMENT A
INFRASTRUCTURE
EASEMENT 1-C
(0.104 Ac.)
SEE INSET D
TRUE NORTH
48°00' 71.00
90°00' 58.00
108°00' 96.00
82°00' 109.00
55°00' 44.00
80°00' 435.00
67°00' 57.00
83°00' 46.00
43°00' 121.00
137°00' 26.00
183°00' 128.00
91°00' 332.00
78°00' 112.00
95°00' 65.00
101°00' 122.00
152°00' 107.00
115°00' 103.00
70°00' 40.00
117°00' 26.00
133°00' 73.00
91°00' 137.00
79°00' 164.00
64°00' 114.00
104°00' 101.00
132°00' 152.00
172°00' 81.00
SEGMENT A
INFRASTRUCTURE
EASEMENT 1-D
(0.059 Ac.)
SEE INSET E
℄ SEGMENT A
INFRASTRUCTURE
EASEMENT 1
(40 feet wide)
(5.943 Ac.)
MATCH LINE 7
SEGMENT A
INFRASTRUCTURE
EASEMENT 1
267°00'
69.81
7,549.99 S
18,782.59 W
"KIKOO"
357°00'
115.00
147.94
204°00'
80°00'
138.00
KEALIA DITCH
HEADGATE EASEMENT
(0.287 Ac.)
INSET F
SCALE: 1"=100'
7,375.22 S
17,901.80 W
"KIKOO"
256°00'
58.00
271°00'
128.00
(0.059 Ac.)
299°00'
31.88
91°00'
212.28
SEGMENT A INFRASTRUCTURE EASEMENT 1-D
SEGMENT A INFRASTRUCTURE EASEMENT 1
INSET E
SCALE: 1"=50'



MATCH LINE 7
MATCH LINE 6
SEGMENT A SERVICED LANDS
TRUE NORTH
Scale: 1"=500 '
℄ KANEHA RESERVOIR ACCESS EASEMENT C (15 feet wide) (0.086 Ac.)
℄ KANEHA RESERVOIR ACCESS EASEMENT B (15 feet wide) (0.250 Ac.)
℄ KANEHA RESERVOIR ACCESS EASEMENT A (15 feet wide) (0.427 Ac.)
KANEHA RESERVOIR EASEMENT SEE INSET G
SEGMENT A INFRASTRUCTURE EASEMENT 1–A (0.004 Ac.) SEE INSET B
SEGMENT A INFRASTRUCTURE EASEMENT 1–B (0.082 Ac.) SEE INSET C
℄ SEGMENT A INFRASTRUCTURE EASEMENT 1 (40 feet wide) (5.943 Ac.)
POINT OF MEASUREMENT
TUNNEL
6,291.71 S
14,025.33 W
"KIKOO"
6,913.69 S
14,410.58 W
"KIKOO"
7,004.82 S
13,453.04 W
"KIKOO"
30°00' 58.04
90°00' 86.00
292°02' 177.00
310°00' 66.06
301°00' 95.00
334°15' 238.87
18°00' 103.49
356°00' 46.54
105°00' 55.00
79°00' 75.00
49°00' 56.00
35°00' 349.00
143°00' 102.00
127°00' 177.00
137°00' 295.86
349°00' 143.53
5°00' 141.00
42°00' 94.00
79°00' 102.00
44°00' 71.21
91°00' 49.00
122°00' 137.00
111°00' 67.00
92°00' 26.00
31°00' 75.00
116°00' 213.00
105°00' 86.00
154°15' 130.00
124°16' 108.11
95°54' 314.19
112°45' 242.34
80°23' 206.77
101°45' 298.57
90°41' 330
29°00' 136.00
48°00' 85.00
74°00' 94.00
110°00' 127.00
356°00' 48.00
17°00' 118.00
40°00' 187.00
27°00' 200.00
19°00' 115.00
38°00' 131.00
70°00' 66.00
30°00' 43.00
338°00' 110.00
308°00' 115.00
119°00' 334.00
128°00' 84.00
104°00' 118.00
135°00' 98.00
174°00' 61.00
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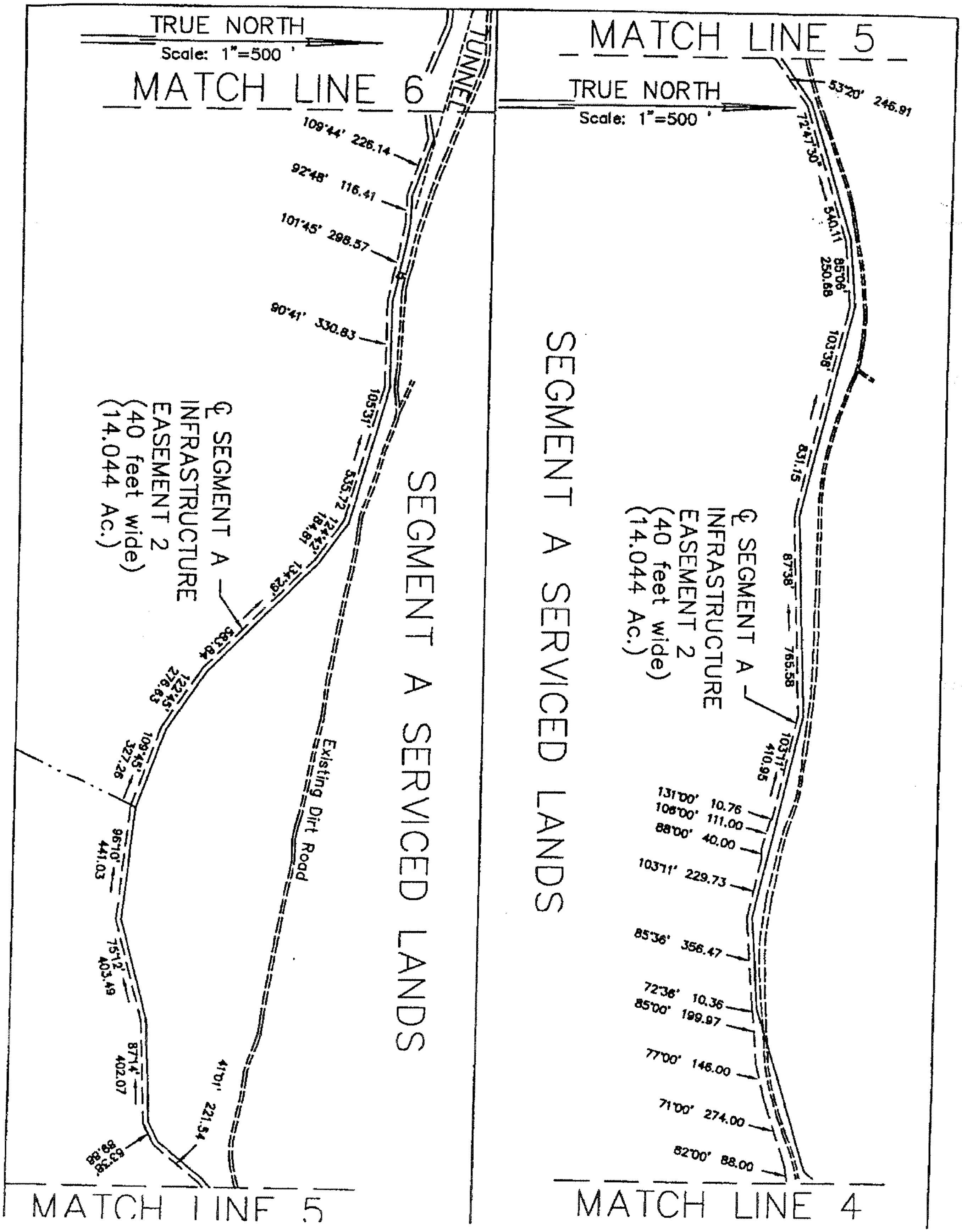
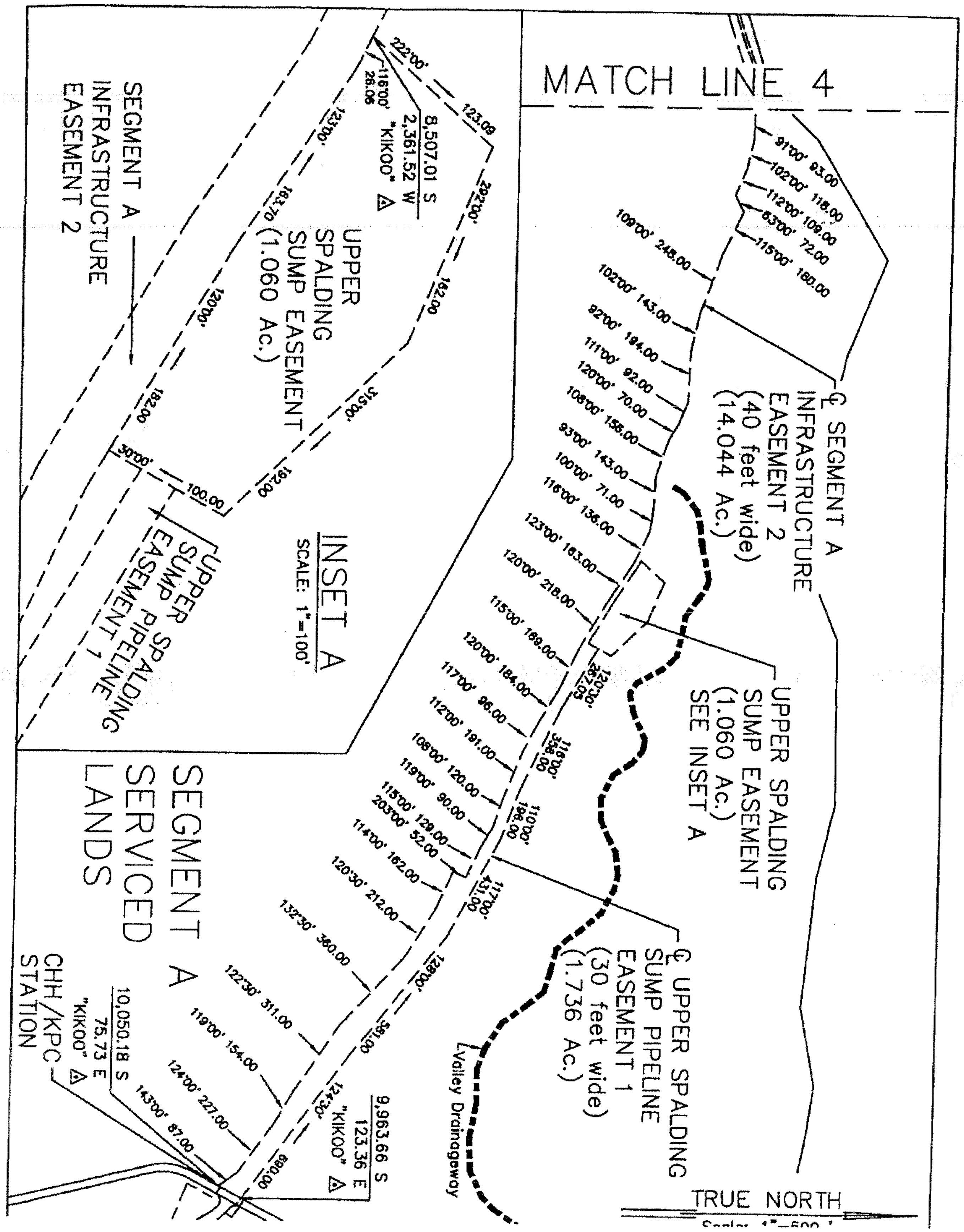
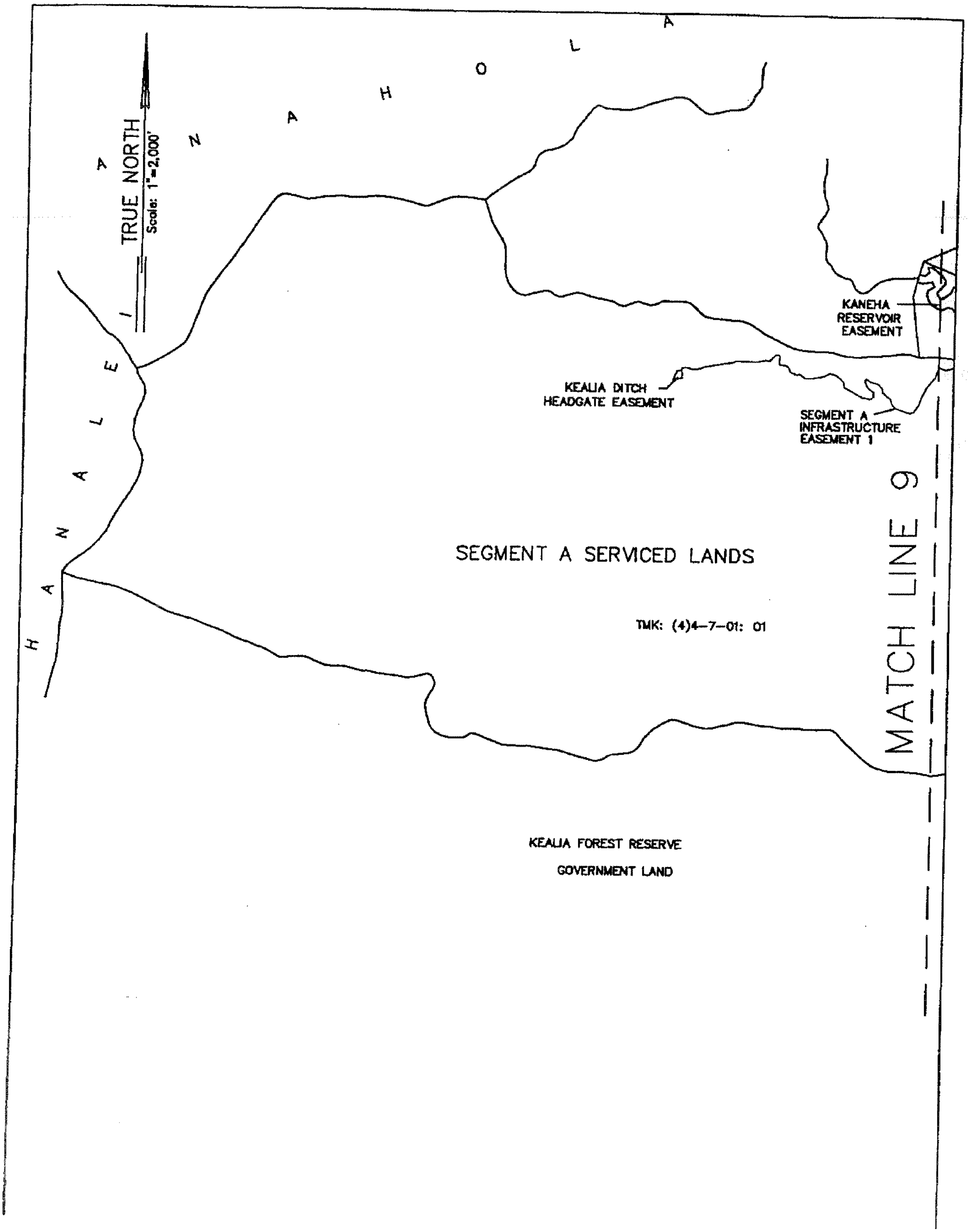
1°00' 66.00
50°00' 60.00
98°00' 119.00

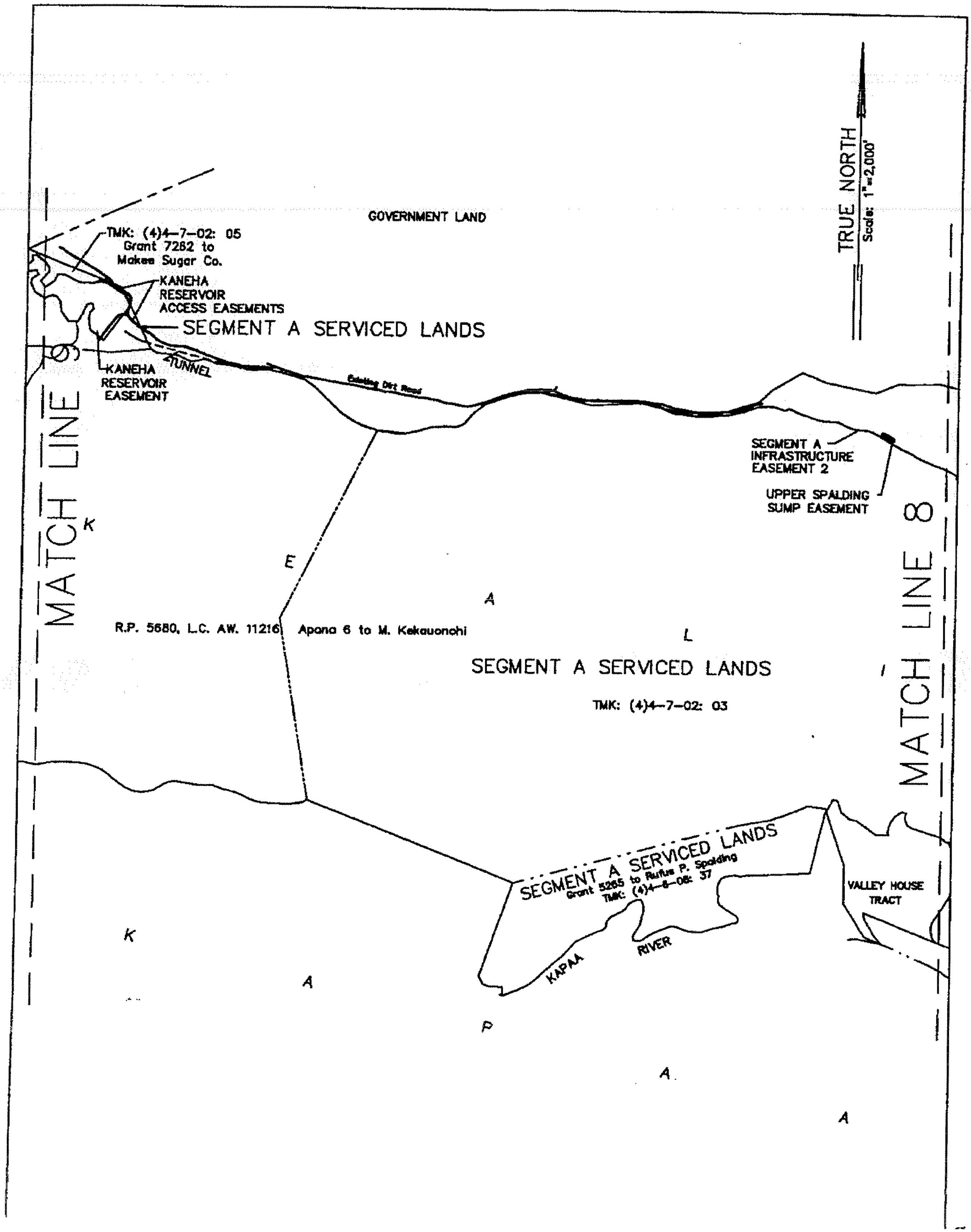

TRUE NORTH
Scale: 1"=500 '
MATCH LINE 6
TUNNEL
109°44' 226.14
92°48' 116.41
101°45' 298.57
90°41' 330.83
105°37'
535.72
124°42'
184.81
134°29'
583.84
122°45'
276.83
109°45'
327.26
96°10'
441.03
75°12'
403.49
87°14'
402.07
63°38'
89.88
41°01'
221.54
℄ SEGMENT A
INFRASTRUCTURE
EASEMENT 2
(40 feet wide)
(14.044 Ac.)
Existing Dirt Road
SEGMENT A SERVICED LANDS
MATCH LINE 5
MATCH LINE 5
TRUE NORTH
Scale: 1"=500 '
53°20' 246.91
72°47'30"
540.11
85°06'
250.68
103°38'
831.15
87°38'
765.58
103°11'
410.95
℄ SEGMENT A
INFRASTRUCTURE
EASEMENT 2
(40 feet wide)
(14.044 Ac.)
SEGMENT A SERVICED LANDS
131°00' 10.76
106°00' 111.00
88°00' 40.00
103°11' 229.73
85°36' 356.47
72°36' 10.36
85°00' 199.97
77°00' 146.00
71°00' 274.00
82°00' 88.00
MATCH LINE 4


MATCH LINE 4
SEGMENT A INFRASTRUCTURE EASEMENT 2
UPPER SPALDING SUMP EASEMENT (1.060 Ac.)
INSET A
SCALE: 1"=100'
UPPER SPALDING SUMP PIPELINE EASEMENT 1
8,507.01 S
2,361.52 W
"KIKOO"
℄ SEGMENT A INFRASTRUCTURE EASEMENT 2 (40 feet wide) (14.044 Ac.)
UPPER SPALDING SUMP EASEMENT (1.060 Ac.) SEE INSET A
℄ UPPER SPALDING SUMP PIPELINE EASEMENT 1 (30 feet wide) (1.736 Ac.)
SEGMENT A SERVICED LANDS
10,050.18 S
75.73 E
"KIKOO"
CHH/KPC STATION
9,963.66 S
123.36 E
"KIKOO"
Valley Drainageway
TRUE NORTH



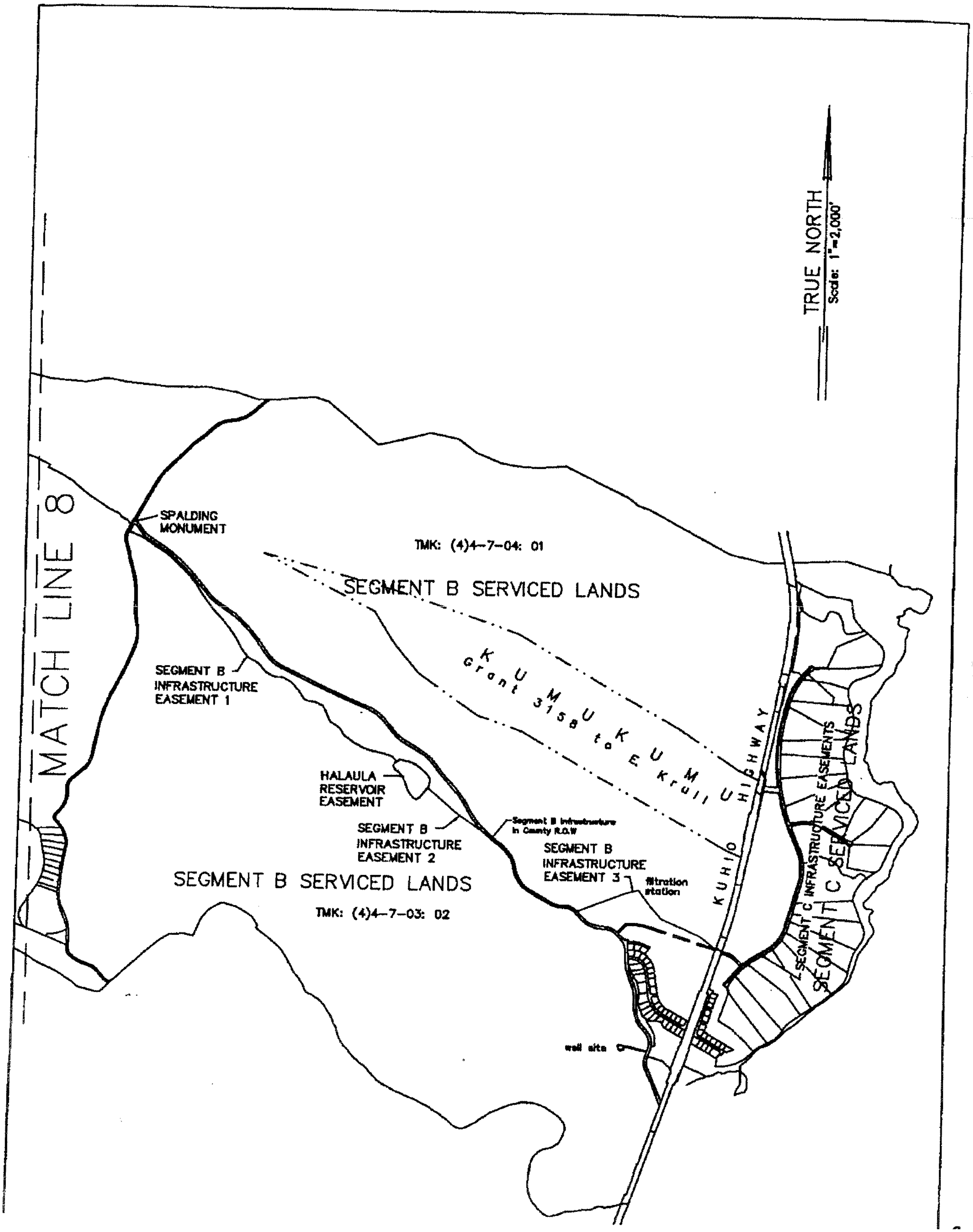
TRUE NORTH
Scale: 1"=2,000'
ANAHOLA
HANALEI
KANEHA RESERVOIR EASEMENT
KEALIA DITCH HEADGATE EASEMENT
SEGMENT A INFRASTRUCTURE EASEMENT 1
SEGMENT A SERVICED LANDS
TMK: (4)4-7-01: 01
MATCH LINE 9
KEALIA FOREST RESERVE
GOVERNMENT LAND

HAF 06339

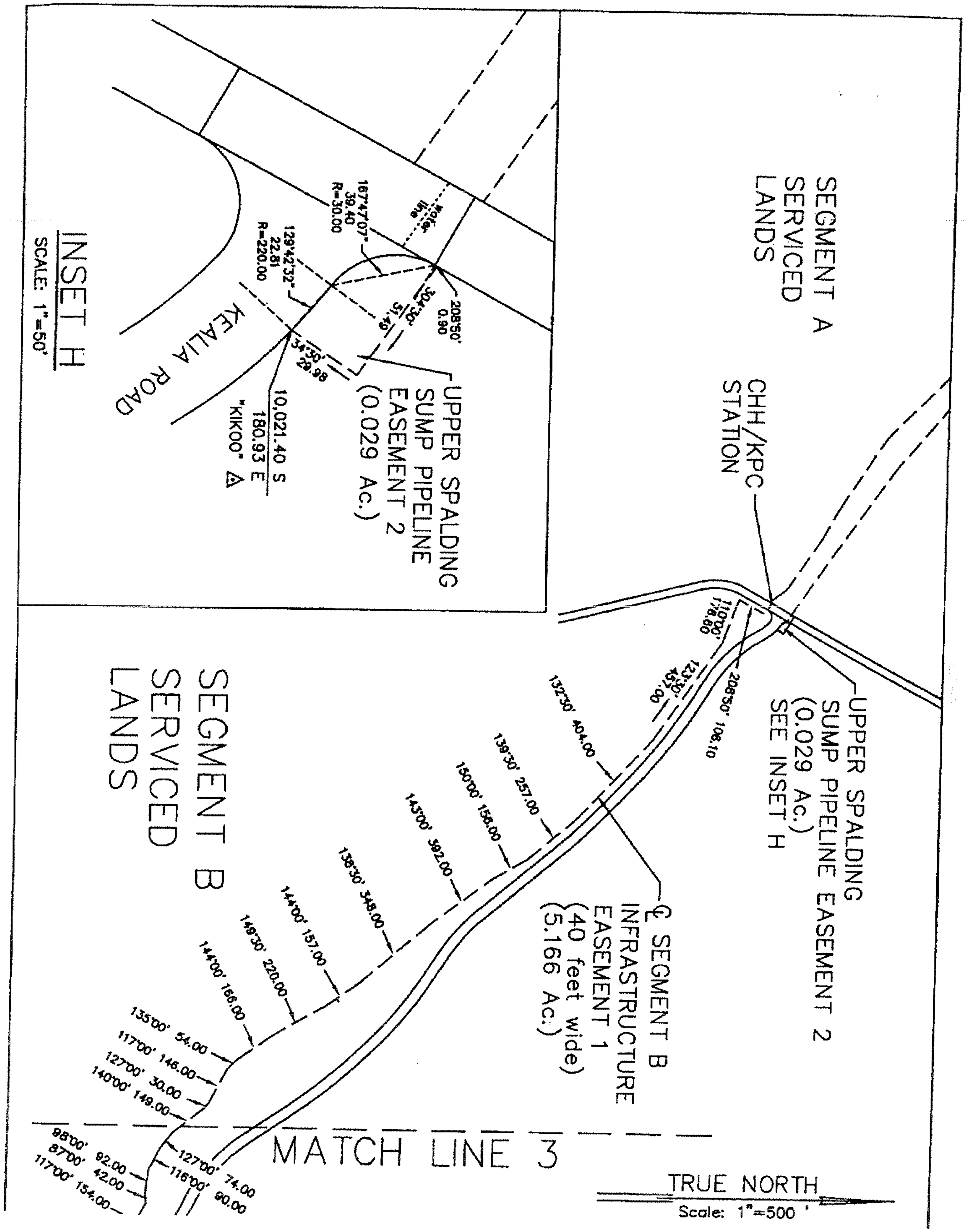


TRUE NORTH
Scale: 1"=2,000'
GOVERNMENT LAND
TMK: (4)4-7-02: 05
Grant 7282 to
Makee Sugar Co.
KANEHA
RESERVOIR
ACCESS EASEMENTS
SEGMENT A SERVICED LANDS
TUNNEL
KANEHA
RESERVOIR
EASEMENT
Existing Dirt Road
MATCH LINE 9
SEGMENT A
INFRASTRUCTURE
EASEMENT 2
UPPER SPALDING
SUMP EASEMENT
MATCH LINE 8
K
E
A
L
I
R.P. 5680, L.C. AW. 11216 Apana 6 to M. Kekauonohi
SEGMENT A SERVICED LANDS
TMK: (4)4-7-02: 03
SEGMENT A SERVICED LANDS
Grant 5265 to Rufus P. Spalding
TMK: (4)4-6-06: 37
VALLEY HOUSE
TRACT
KAPAA
RIVER
K
A
P
A
A

HAF 06340

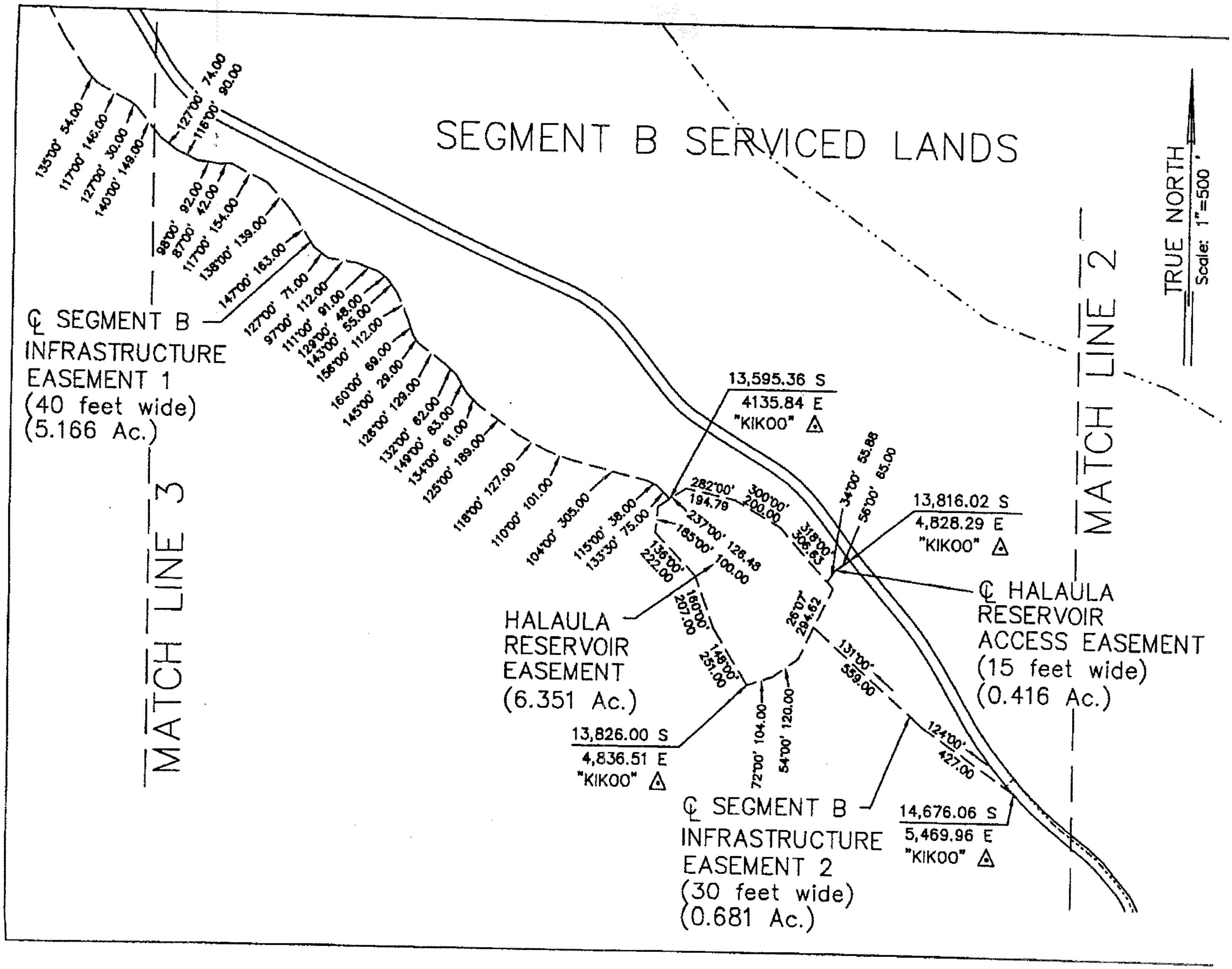


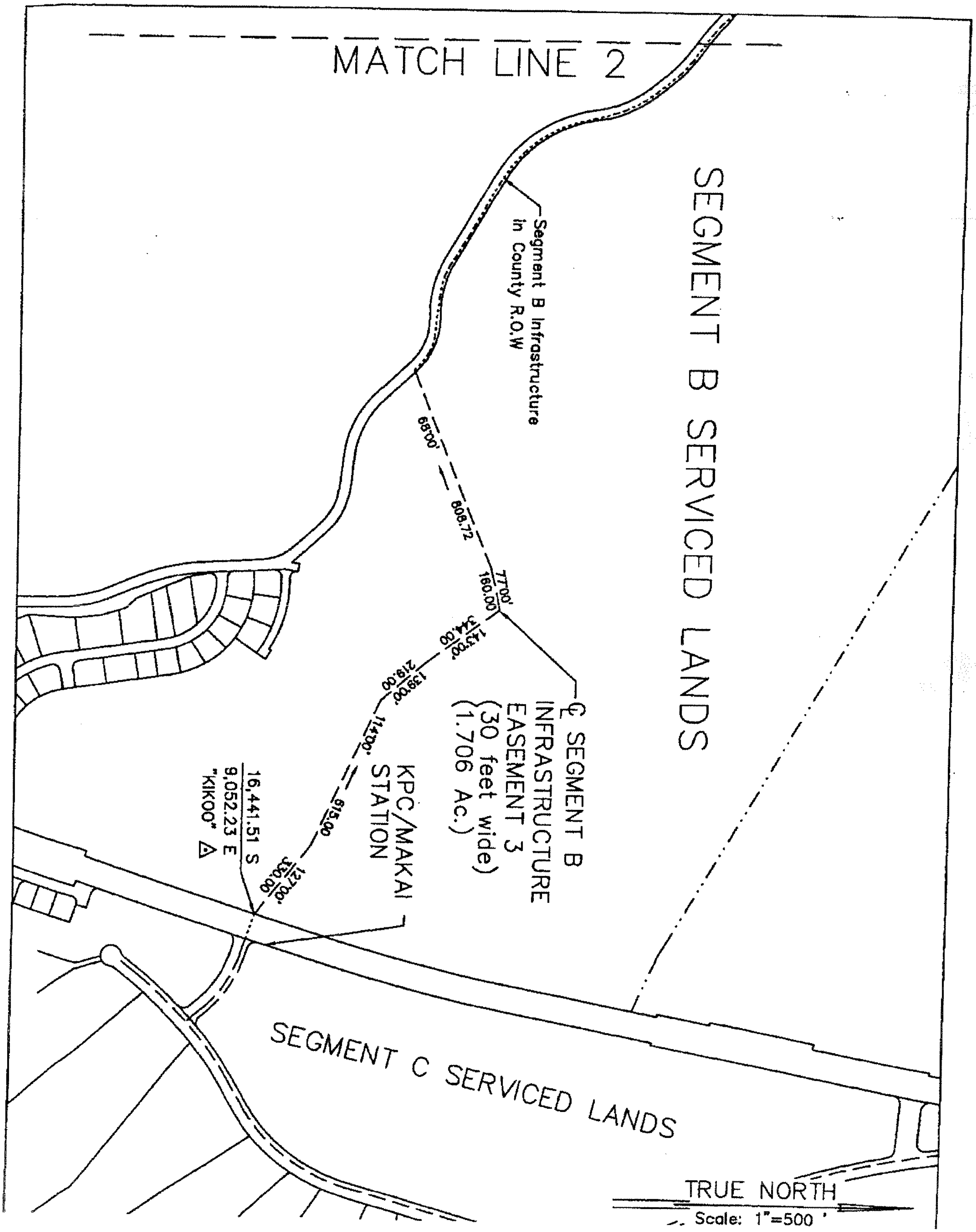
TRUE NORTH
Scale: 1"=2,000'
MATCH LINE 8
SPALDING MONUMENT
TMK: (4)4-7-04: 01
SEGMENT B SERVICED LANDS
KUMUKUMU
Grant 3158 to E Krull
SEGMENT B INFRASTRUCTURE EASEMENT 1
HALAULA RESERVOIR EASEMENT
SEGMENT B INFRASTRUCTURE EASEMENT 2
Segment B Infrastructure in County R.O.W
SEGMENT B INFRASTRUCTURE EASEMENT 3
filtration station
SEGMENT B SERVICED LANDS
TMK: (4)4-7-03: 02
KUHIO HIGHWAY
SEGMENT C SERVICED LANDS
SEGMENT C INFRASTRUCTURE EASEMENTS
SEGMENT C SERVICED LANDS
well site

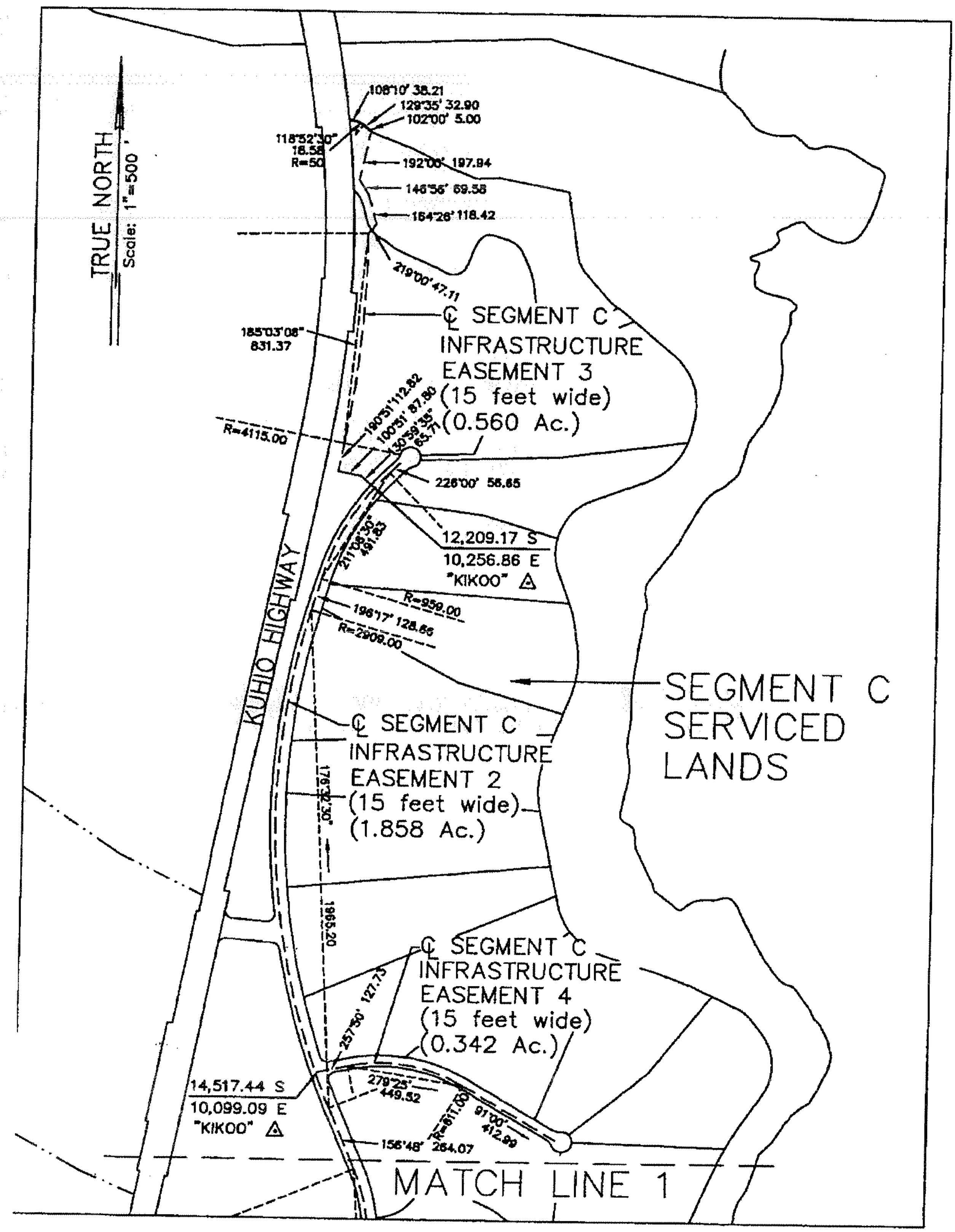


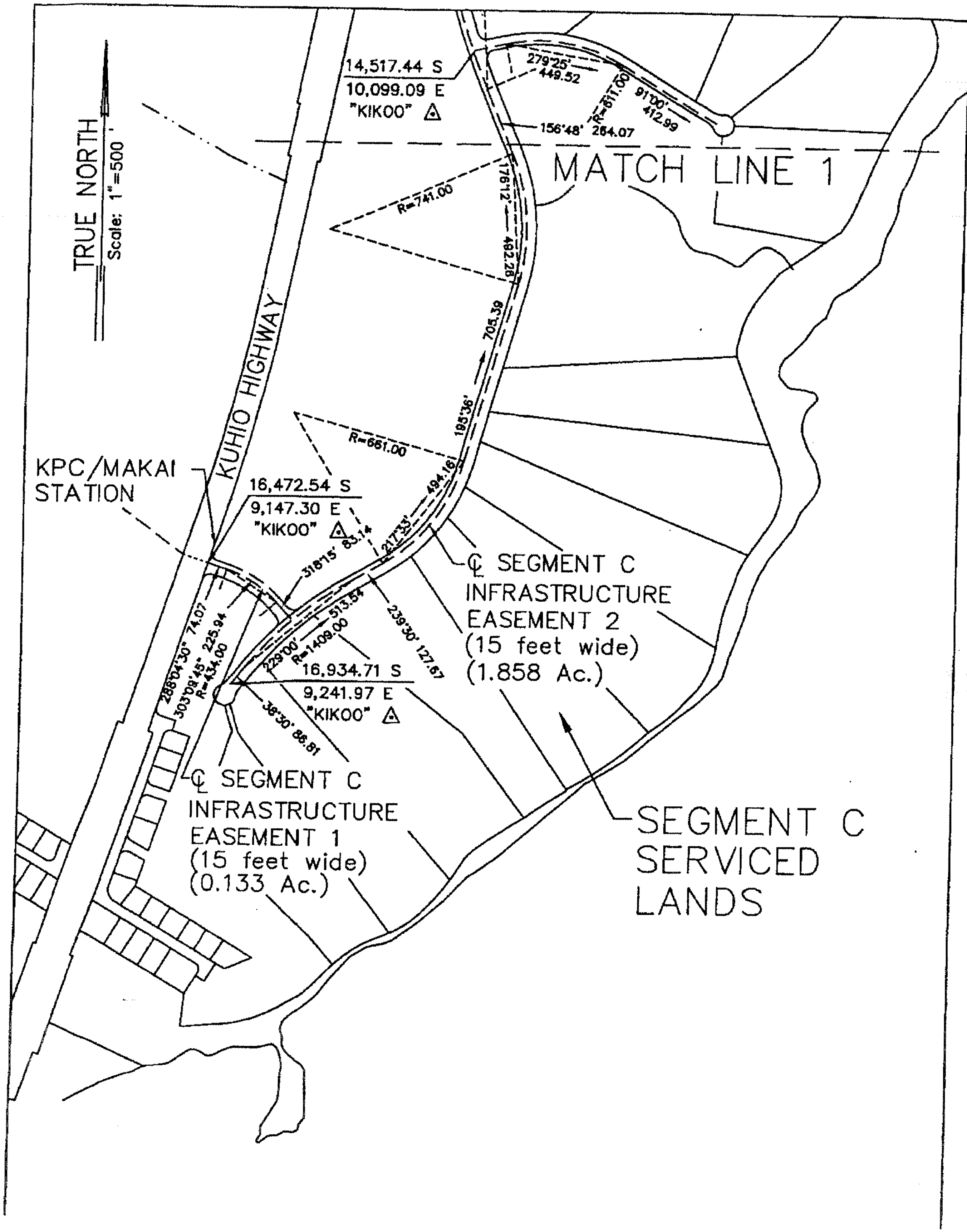
SEGMENT A SERVICED LANDS
CHH/KPC STATION
UPPER SPALDING SUMP PIPELINE EASEMENT 2 (0.029 Ac.) SEE INSET H
℄ SEGMENT B INFRASTRUCTURE EASEMENT 1 (40 feet wide) (5.166 Ac.)
SEGMENT B SERVICED LANDS
110°00' 178.80
208°50' 106.10
123°30' 457.00
132°30' 404.00
139°30' 257.00
150°00' 156.00
143°00' 392.00
138°30' 348.00
144°00' 157.00
149°30' 220.00
144°00' 166.00
135°00' 54.00
117°00' 146.00
127°00' 30.00
140°00' 149.00
98°00' 92.00
87°00' 42.00
117°00' 154.00
127°00' 74.00
116°00' 90.00
MATCH LINE 3
TRUE NORTH
Scale: 1"=500 '
INSET H
SCALE: 1"=50'
KEALIA ROAD
UPPER SPALDING SUMP PIPELINE EASEMENT 2 (0.029 Ac.)
Water line
167°47'07" 39.40 R=30.00
129°42'32" 22.81 R=220.00
208°50' 0.90
30°30' 51.49
34°30' 29.98
10,021.40 S 180.93 E "KIKOO"

HAF 06342


SEGMENT B SERVICED LANDS
℄ SEGMENT B
INFRASTRUCTURE
EASEMENT 1
(40 feet wide)
(5.166 Ac.)
MATCH LINE 3
13,595.36 S
4135.84 E
"KIKOO"
13,816.02 S
4,828.29 E
"KIKOO"
℄ HALAULA
RESERVOIR
ACCESS EASEMENT
(15 feet wide)
(0.416 Ac.)
HALAULA
RESERVOIR
EASEMENT
(6.351 Ac.)
13,826.00 S
4,836.51 E
"KIKOO"
℄ SEGMENT B
INFRASTRUCTURE
EASEMENT 2
(30 feet wide)
(0.681 Ac.)
14,676.06 S
5,469.96 E
"KIKOO"
MATCH LINE 2
TRUE NORTH
Scale: 1"=500'


MATCH LINE 2
SEGMENT B SERVICED LANDS
Segment B Infrastructure in County R.O.W
68°00'
608.72
77°00'
160.00
143°00'
344.00
139°00'
218.00
114°00'
815.00
127°00'
330.00
℄ SEGMENT B INFRASTRUCTURE EASEMENT 3 (30 feet wide) (1.706 Ac.)
KPC/MAKAI STATION
16,441.51 S
9,052.23 E
"KIKOO"
SEGMENT C SERVICED LANDS
TRUE NORTH
Scale: 1"=500'


TRUE NORTH
Scale: 1"=500'
108°10' 38.21
129°35' 32.90
102°00' 5.00
118°52'30"
18.58
R=50
192°00' 197.94
146°56' 69.58
164°26' 118.42
219°00' 47.11
℄ SEGMENT C
INFRASTRUCTURE
EASEMENT 3
(15 feet wide)
(0.560 Ac.)
185°03'08"
831.37
R=4115.00
226°00' 56.65
12,209.17 S
10,256.86 E
"KIKOO"
R=959.00
196°17' 128.86
R=2909.00
KUHIO HIGHWAY
SEGMENT C
SERVICED
LANDS
℄ SEGMENT C
INFRASTRUCTURE
EASEMENT 2
(15 feet wide)
(1.858 Ac.)
1965.20
℄ SEGMENT C
INFRASTRUCTURE
EASEMENT 4
(15 feet wide)
(0.342 Ac.)
257°50' 127.73
14,517.44 S
10,099.09 E
"KIKOO"
279°25'
449.52
91°00'
412.99
156°48' 264.07
MATCH LINE 1



TRUE NORTH
Scale: 1"=500'
KUHIO HIGHWAY
14,517.44 S
10,099.09 E
"KIKOO"
279°25' 449.52
R=811.00
91°00' 412.99
156°48' 264.07
MATCH LINE 1
R=741.00
176°12' 492.28
705.39
195°36'
R=661.00
494.16
KPC/MAKAI STATION
16,472.54 S
9,147.30 E
"KIKOO"
318°15' 83.14
217°33'
513.54
R=1409.00
229°00'
239°30' 127.67
288°04'30" 74.07
303°09'45" 225.94
R=434.00
16,934.71 S
9,241.97 E
"KIKOO"
38°30' 86.81
℄ SEGMENT C INFRASTRUCTURE EASEMENT 2 (15 feet wide) (1.858 Ac.)
℄ SEGMENT C INFRASTRUCTURE EASEMENT 1 (15 feet wide) (0.133 Ac.)
SEGMENT C SERVICED LANDS

HAF 06346

EXHIBIT D
TO WATER SERVICE AGREEMENT

DESCRIPTION OF SEGMENT C SERVICED LANDS / Kealia Kai Subdivision

Appendix H

Traffic Impact Analysis Report
Austin Tsutsumi & Associates

2017

TRAFFIC IMPACT ANALYSIS REPORT
KEALIA MAUKA HOMESITES

Kealia, Kauai, Hawaii

DRAFT FINAL

February 8, 2018

Prepared for:

HHF Planners
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Honolulu, Hawaii 96813

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Honolulu • Wailuku • Hilo, Hawaii

TRAFFIC IMPACT ANALYSIS REPORT
KEALIA MAUKA HOMESITES

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Honolulu • Wailuku • Hilo, Hawai‘i

February 8, 2018

TABLE OF CONTENTS

TABLE OF CONTENTS
Cont'd

Page

TABLE OF CONTENTS
Cont'd

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

TERRANCE S. ARASHIRO, P.E.
ADRIENNE W.L.H. WONG, P.E., LEED AP
DEANNA M.R. HAYASHI, P.E.
PAUL K. ARITA, P.E.
ERIK S. KANESHIRO, L.P.L.S., LEED AP
MATT K. NAKAMOTO, P.E.
GARRETT K. TOKUOKA, P.E.

DRAFT FINAL

TRAFFIC IMPACT ANALYSIS REPORT

KEALIA MAUKA HOMESITES

Kealia, Kauai, Hawaii

1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi & Associates, Inc. (ATA) to evaluate the potential traffic impacts resulting from the proposed Kealia Mauka Homesites in Kealia, Kauai, Hawaii (hereinafter referred to as the "Project"). This Traffic Impact Analysis Report (TIAR) is being prepared for inclusion in an Environmental Impact Study (EIS) with the intent to pursue a State Land Use District Boundary Amendment.

1.1 Location

The Project is located in Kealia on approximately 50 acres of land on the east side of the island of Kauai. The Project is north of Kaao Road and is bounded by Kuhio Highway to the east. See Figure 1.1 for the Project location.

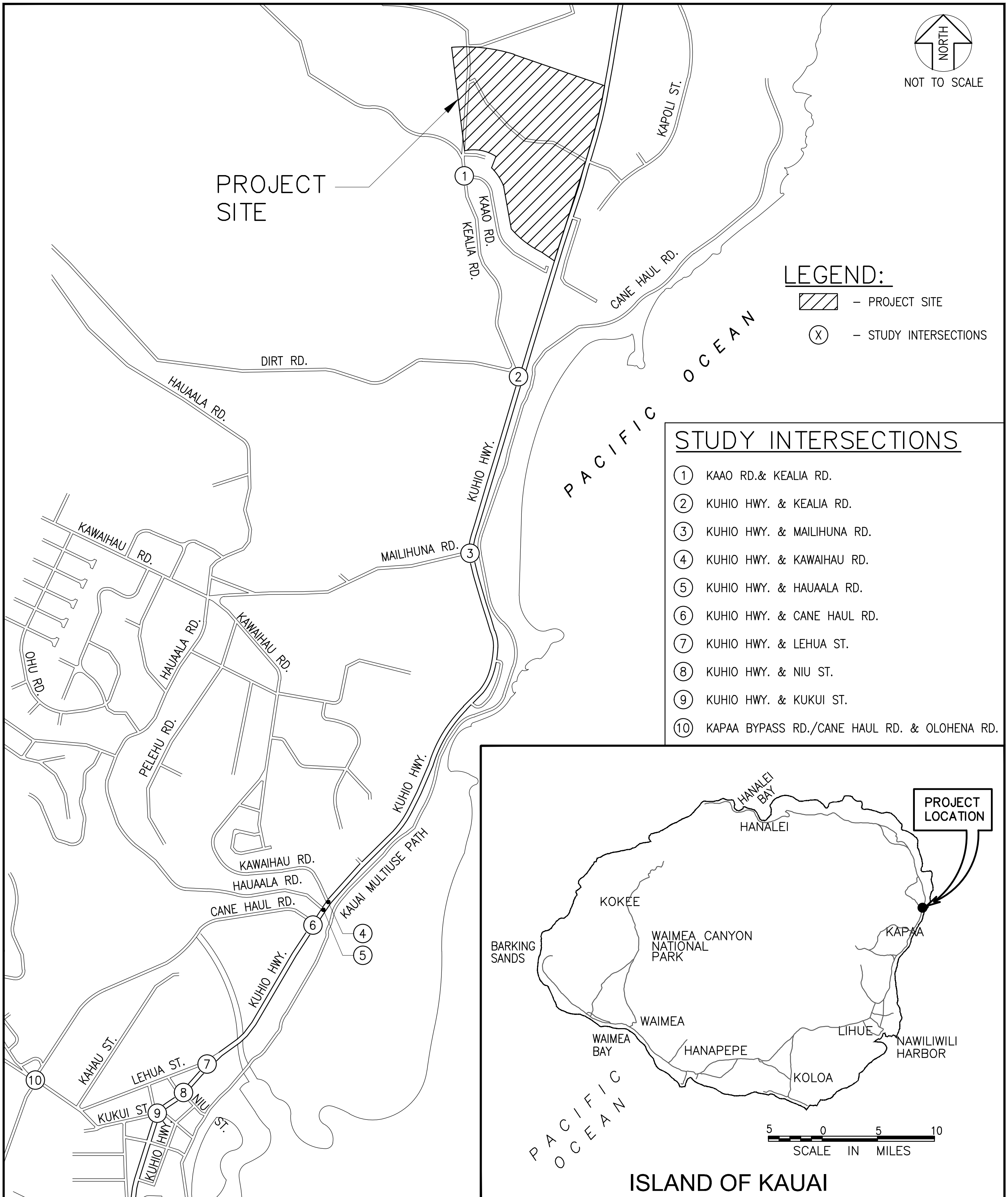
1.2 Project Description

The Project proposes to develop 235 single-family dwellings in the Kealia area. Access to the Project will be provided via Kealia Road from Kuhio Highway. The Project will construct a new four-way, one-lane roundabout north of the Kealia Road/Hopoe Road intersection to connect Kealia Road to the Project site. Both the southern and western approaches of the roundabout will have connections to Kealia Road. Although there is currently a direct access to Kuhio Highway along the Makai side of the Project site, this access will be fully removed during Project construction. Construction and occupancy of homes in the proposed subdivision is anticipated in 2027.

See Figure 1.2 for the proposed Project site plan.

REPLY TO:
501 SUMNER STREET, SUITE 521 • HONOLULU, HAWAII 96817-5031
PHONE (808) 533-3646 • FAX (808) 526-1267
EMAIL : atahnl@atahawaii.com

OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII
HILO, HAWAII



KEALIA MAUKA HOMESITES

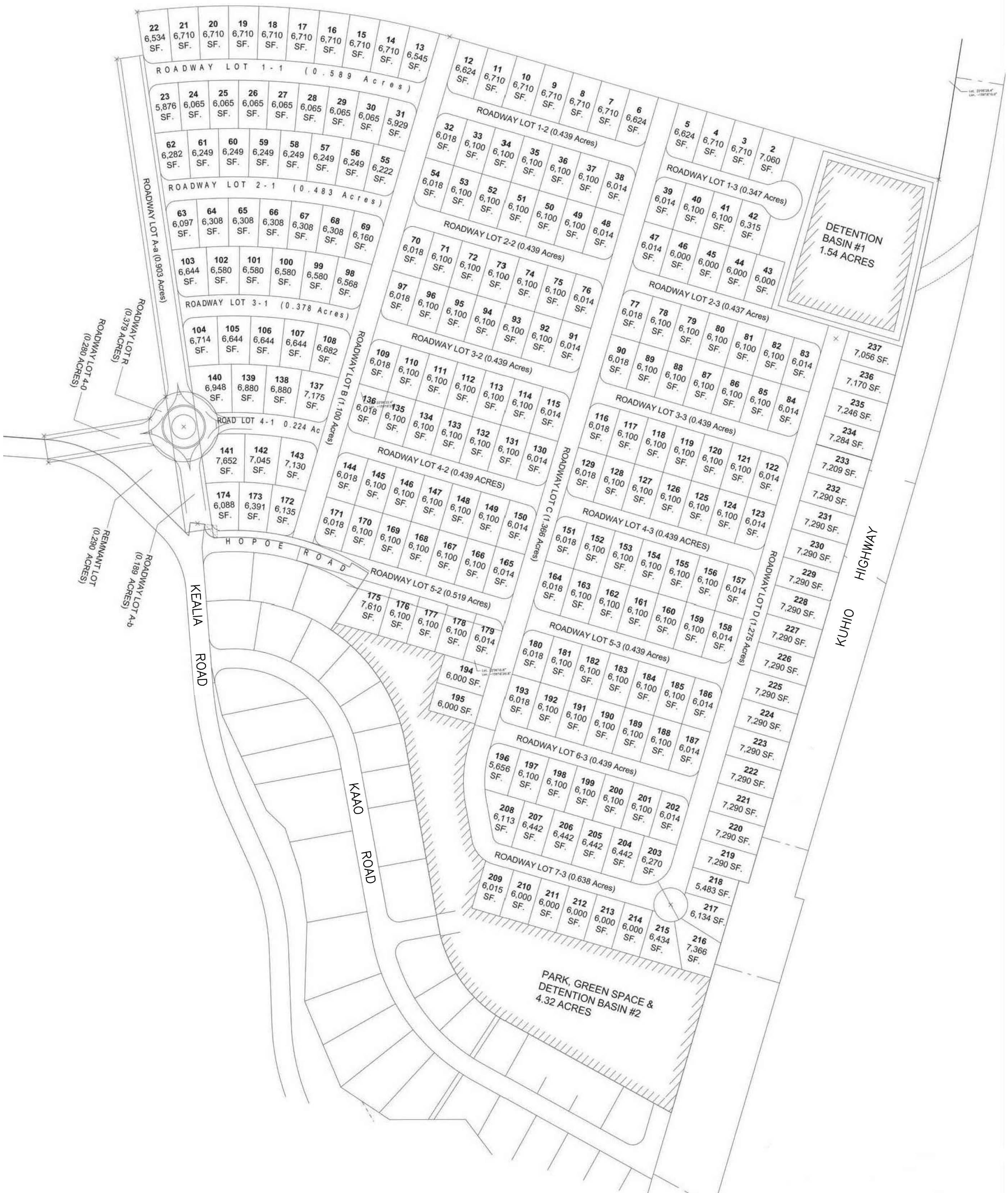
TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

ENGINEERS, SURVEYORS • HONOLULU, HAWAII

LOCATION MAP

FIGURE 1.1



Source: Kodani

KEALIA MAUKA HOMESITES TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	SITE PLAN	1.2

2. METHODOLOGY

2.1 Study Methodology

This study will address the following:

- Assess existing traffic operating conditions and parking at key intersections during the weekday morning (AM) and afternoon (PM) peak hours of traffic within the study area.
- Traffic projections for Base Year 2027 (without the Project) including traffic generated by other known developments in the vicinity of the Project in addition to an ambient growth rate. These other known developments are projects that are currently under construction or known new/future developments that are anticipated to affect traffic demand and operations within the study area.
- Trip generation and traffic assignment characteristics for the proposed Project.
- Traffic projections for Future Year 2027 (with the Project), which includes Base Year traffic volumes in addition to traffic volumes generated by the Project.
- Recommendations for Base Year as well as Future Year roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by known developments in the region or the Project.

2.2 Intersection Analysis

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 (HCM), 6th Edition, dated 2016, includes methods for calculating volume to capacity ratios, delays, and corresponding Levels of Service that were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix B.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results as based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

3. EXISTING CONDITIONS

3.1 Roadway System

The following are brief descriptions of the existing roadways in the vicinity of the Project.

Kuhio Highway – is generally a north-south, two-way, two-lane principal arterial in the vicinity of the Project. The roadway begins in Lihue at its connection with Kaumualii Highway and travels along the coast before terminating at Kee Beach in Haena. Kuhio Highway is a State roadway and is the major thoroughfare in the East Kauai regions. In the vicinity of the Project, Kuhio Highway has a posted speed limit of 25 to 50 miles per hour (mph) depending on the surrounding land uses. In the immediate vicinity of the Project, the highway has a speed limit of 50 mph in the northbound direction and 40 mph in the southbound direction.

Kealia Road – is generally a northwest-southeast, two-way, two-lane roadway in the vicinity of the Project. The roadway begins at its intersection with Kuhio Highway in the east and extends to the northwest to its intersection with Hauaala Road. The roadway then travels to the northeast where it reconnects to Kuhio Highway in Anahola. In the vicinity of the Project, Kealia Road has a posted speed limit of 25 mph.

Kaao Road – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins at its intersection with Kealia Road to the west and travels to the east to provide access to the existing residential neighborhood. In the vicinity of the Project, Kaao Road has a posted speed limit of 15 mph.

Mailihuna Road – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the east at its intersection with Kuhio Highway and terminates to the west at its intersection with Kawaihau Road. Mailihuna Road provides access to Kapaa High School and residential areas. In the vicinity of the Project, Mailihuna Road has a posted speed limit of 25 mph which drops to 15 mph near Kapaa High School.

Kawaihau Road – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the east at its intersection with Kuhio Highway and terminates to the west at its intersection with Kahuna Road and Pililiamoo Road. Kawaihau Road provides access to Kapaa High School, Kapaa Elementary School and residential areas. In the vicinity of the Project, Kawaihau Road has a posted speed limit of 25 mph.

Hauaala Road – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the east at its intersection with Kuhio Highway and terminates to the northwest at its intersection with Kealia Road. Hauaala Road provides access to residential areas. In the vicinity of the Project, Hauaala Road has a posted speed limit of 25 mph.

Cane Haul Road – is generally a north-south, one-way, one-lane roadway in the vicinity of the Project. The roadway begins to the northeast at its intersection with Kuhio Highway and terminates to the south at the roundabout on Olohena Road where it connects to the two-way Kapaa Bypass Road. The roadway provides travel in the southbound direction only. In the vicinity of the Project, Cane Haul Road has a posted speed limit of 25 mph.

Kapaa Bypass Road – is generally a north-south, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the north at the roundabout on Olohena Road where it connects to the one-way Cane Haul Road and terminates to the south at its intersection with Kuhio Highway in Wailua. The approximately three (3) mile long bypass road provides an alternate route to Kuhio Highway for travelers passing through Kapaa and Waipouli. In the vicinity of the Project, Kapaa Bypass Road has a posted speed limit of 25 to 35 mph.

Olohena Road – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the east at its connection with Kukui Street and terminates to the west at its intersection with Waipouli Road and the Moalepe Trail. Olohena Road provides access to Kapaa Middle School. In the vicinity of the Project, Olohena Road has a posted speed limit of 25 mph.

Lehua Street – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the east at its intersection with Kuhio Highway and terminates to the west at its intersection with Olohena Road. In the vicinity of the Project, Lehua Street has a posted speed limit of 25 mph.

Niu Street – is generally a northwest-southeast, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the northwest at its intersection with Lehua Street and terminates to the southeast at the Ke Ala Hele Makalae Multi-Use Path. There is no posted speed limit in the vicinity of the Project.

Kukui Street – is generally an east-west, two-way, two-lane roadway in the vicinity of the Project. The roadway begins to the west at its connection with Olohena Road and terminates to the east at the Ke Ala Hele Makalae Multi-Use Path. In the vicinity of the Project, Kukui Street has a posted speed limit of 15 mph.

Huluili Street – is generally a north-south, one-way, one-lane roadway in the vicinity of the Project. The roadway begins to the south at its intersection with Kuhio Highway and Kukui Street and terminates to the north at its intersection with Lehua Street. The roadway provides travel in the northbound direction only. There is no posted speed limit in the vicinity of the Project.

3.2 Sustainable Transportation

3.2.1 Complete Streets

While transportation planning has traditionally focused on automobile travel, recent "Complete Streets" policies also recognize the numerous benefits of encouraging the use of alternative modes of transportation. "Complete Streets" policies encourage the provision of equitable, accessible and safe transportation for all modes.

Hawaii State Senate Bill 718 (2009) required that the Hawaii Department of Transportation (HDOT) and the County transportation departments:

"…adopt a complete streets policy that seeks to reasonably accommodate convenient access and mobility for all users of the public highways within their respective jurisdictions…"

3.2.2 Pedestrian Accessibility

In the vicinity of the Project, sidewalks are provided on both sides of the road along Kuhio Highway from the Kuhio Highway/Kukui Street intersection to just north of the Kuhio Highway/Lehua Street intersection. The sidewalk continues along the mauka side of Kuhio Highway until the Kuhio Highway/Kawaihau Road intersection. Additionally, the Ke Ala Hele Makalae Multi-Use Path provides a pedestrian and bicycle route as an alternative to travel along Kuhio Highway. The multi-use path begins at Lihi Park in Kapaa and travels north to Kuna Bay in Kealia on the Makai side of Kuhio Highway. The Ke Ala Hele Makalae Multi-Use Path also has a Kawaihau Road spur that provides access from the main pathway to the Mahelona Medical Center, Kapaa Elementary School and Kapaa High School.

Minimal pedestrian activity was observed along Kuhio Highway in the study area. Pedestrian activity was observed to be higher near the Lehua Street, Niu Street and Kukui Street intersections with the highway due to significant amounts of on-street parking and commercial spaces in the area. The majority of pedestrians in the area were observed to travel along the Ke Ala Hele Makalae Multi-Use Path rather than along Kuhio Highway.

3.2.3 Bicycle Accessibility

HDOT currently provides the Bike Plan Hawaii Master Plan, which identifies existing and proposed bicycle routes that could potentially be implemented in the future. In the vicinity of the Project, the Ke Ala Hele Makalae Multi-Use Path provides pedestrian and bicycle accessibility through Kapaa and Kealia as described in the previous section. Additionally, the Kawaihau Bike Path provides a 3.0 mile long shared use path from Kapaa Elementary School to Kapahi Park.

A total of 20 bicycle routes/upgrades are proposed for the Kawaihau region of East Kauai. In the vicinity of the Project, five (5) signed shared roadways and three (3) bicycle paths are proposed.

- Signed Shared Road – Kuhio Highway from the Kealia region to the Anahola region (Priority Level II)
- Signed Shared Road – Kuhio Highway from the Wailua region to the Kealia region (Priority Level II)
- Signed Shared Road – Kealia Road from the Koolau region to Kuhio Highway (Priority Level III)
- Signed Shared Road – Mailihuna Road from Kawaihau Road to Kuhio Highway (Priority Level III)
- Signed Shared Road – Olohena Road/Kukui Street from Kamalu Road to Kuhio Highway (Priority Level III)
- Bike Path – Extension of the Ke Ala Hele Makalae Multi-Use Path from Kuna Bay to the Anahola region (Priority Level I)
- Bike Path – Extension of the Kawaihau Bike Path from Kapaa Elementary School to Kuhio Highway (Priority Level II)
- Bike Path – Upgrade of the Kawaihau Bike Path from Kapaa Elementary School to Kapahi Park

Minimal, if any, bicycle activity was observed along Kuhio Highway in the study area. However, several bicyclists were observed to travel along the Ke Ala Hele Makalae Multi-Use Path.

3.2.4 Public Transit

The Kauai Bus public transit system offers several routes that provide service from Kekaha to Hanalei. Routes 400 and 500 serve Lihue to Hanalei, providing stops at the Kuhio Highway/Kealia Road intersection and at several other locations along Kuhio Highway. Additionally, Route 60 provides service within the Kapaa region. This route has several stops along Kuhio Highway between the Kuhio Highway/Kukui Street and Kuhio Highway/Kawaihau Road intersections and along Kawaihau Road. Buses run every hour throughout the day.

3.3 Existing Traffic Volumes

The hourly turning movement data utilized in this report were collected on April 18-19, 2017. Based on the proximity to the proposed Project site, the following intersections were studied in the existing conditions scenario.

- [1] Kaao Road/Kealia Road (unsignalized)
- [2] Kuhio Highway/Kealia Road (unsignalized)
- [3] Kuhio Highway/Mailihuna Road (unsignalized)
- [4] Kuhio Highway/Kawaihau Road (unsignalized)
- [5] Kuhio Highway/Hauaala Road (unsignalized)
- [6] Kuhio Highway/Cane Haul Road (unsignalized)
- [7] Kuhio Highway/Lehua Street (unsignalized)
- [8] Kuhio Highway/Niu Street (unsignalized)
- [9] Kuhio Highway/Kukui Street (signalized)
- [10] Kapaa Bypass Road/Cane Haul Road/Olohena Road (roundabout)

Note that for intersection [10] Kapaa Bypass Road/Cane Haul Road/Olohena Road, turning movement data was obtained from the 2015 Kapaa Transportation Solutions report and calibrated to collected existing conditions data. Based on the count data, it was determined that the AM peak hour of traffic occurs between 7:15 AM and 8:15 AM and the PM peak hour of traffic occurs between 3:45 PM and 4:45 PM. The turning movement count data is included in Appendix A.

The weekday AM peak hour of traffic generally coincided with the start times of Kapaa Elementary School, Kapaa Middle School and Kapaa High School, which are located in the vicinity of the Project. Although a midday peak hour of traffic was observed from 2:15 PM to 3:15 PM coinciding with the end times of the nearby schools, the midday volumes were generally lower than the AM and PM peak hour volumes and were not included in this report. Table 3.1 shows the start and end times for each of the schools.

Table 3.1: Nearby Schools Start and End Times

	Kapaa Elementary School		Kapaa Middle School		Kapaa High School	
	Start	End	Start	End	Start	End
Monday	7:45 AM	2:00 PM	8:00 AM	2:55 PM	8:00 AM	3:00 PM
Tuesday	7:45 AM	2:00 PM	8:05 AM	2:17 PM	8:00 AM	3:00 PM
Wednesday	7:45 AM	1:15 PM	8:00 AM	2:16 PM	8:00 AM	3:00 PM
Thursday	7:45 AM	2:00 PM	8:00 AM	2:17 PM	8:00 AM	3:00 PM
Friday	7:45 AM	2:00 PM	8:00 AM	2:55 PM	8:00 AM	3:00 PM

3.4 Existing Traffic Conditions Observations and Analysis

Traffic conditions described as current and on-going in this report are based on field observations collected during the data collection period.

3.4.1 Regional Analysis

Kuhio Highway serves as the main thoroughfare for regional traffic in East Kauai. On Monday through Saturday from 7:00 AM to 1:30 PM, Kuhio Highway is contra flowed to provide two (2) southbound lanes and one (1) northbound lane from the Kapaa Bypass south junction to Kapule Highway to serve heavier southbound volumes. Figure 3.1 shows the location of the Kuhio Highway contraflow in the vicinity of the Project.

During the AM and PM peak hours of traffic, volumes along Kuhio Highway are generally balanced in both the northbound and southbound directions within the Project vicinity. During the AM peak hour, southbound traffic is generally higher. However, with approximately one-third of the AM southbound traffic utilizing Kapaa Bypass Road, the traffic volumes along Kuhio Highway are generally balanced during both the AM and PM peaks.

Within the region, queuing along southbound Kuhio Highway was observed to occur during the PM peak hour when contraflow operations were not in place. The queues generally extended approximately 1.25 miles from Kuamoo Road to near Kamoa Road. Occasionally, queues were observed to also form along southbound Kapaa Bypass Road during the PM peak hour. These queues extended approximately 0.4 miles from Kuhio Highway to Pouli Road. Figure 3.2 shows the regional queues observed during existing conditions.

3.4.2 Existing Intersection Analysis

The observations and analysis described below are based on prevailing observations during the time at which the data was collected. Hereinafter, observations that are expressed as ongoing and current shall represent the conditions that prevailed at the time at which the data was collected.

Within Kapaa Town, queuing was observed during both the AM and PM peak hours of traffic. Queues began near the Kuhio Highway/Kawaihau Road intersection and extended in both the northbound and southbound directions. During both peak hours, southbound queues extended to Fire Station 8 (approximately 0.5 miles), and northbound queues extended to Kukui Street (approximately 0.55 miles). Queuing during the AM peak hour was mainly the result of traffic from the nearby Kapaa High School and Kapaa Elementary School.

Study intersections were analyzed using the traffic analysis software Synchro. Because Synchro does not report LOS for uncontrolled movements at unsignalized intersections, LOS is not given for the through movements along Kuhio Highway. Therefore, existing congestion along Kuhio Highway at the study intersections is based solely on observations at the time of the traffic counts.

[1] Kaao Road/Kealia Road

This intersection served 46(62) vehicles during the AM(PM) peak hour of traffic. Because of the low volumes utilizing this intersection, all movements operated at LOS A with minimal delay.

[2] Kuhio Highway/Kealia Road

The eastbound approach of this intersection operated at LOS C(C) and the westbound approach operated at LOS E(F) during the AM(PM) peak hour of traffic. Delay to the westbound approach was mainly caused by the larger percentage of vehicles making a left-turn onto Kuhio Highway. However, the number of vehicles making the left-turn was low (≤ 26 vehicles) and adequate gaps were observed along Kuhio Highway to complete the maneuver. The northbound and southbound left-turn movements from Kuhio Highway onto Kealia Road operated at LOS A during both peak hours and experienced minimal delay. Although minor street movements and major street left-turn movements were able to proceed during gaps in traffic along Kuhio Highway, the high speeds along the highway increased the difficulty of these maneuvers. Along this portion of Kuhio Highway, the posted speed limit is 40 mph in the southbound and 50 mph in the northbound direction. However, southbound speeds were observed to be higher due to a hill on the northbound approach. No congestion along Kuhio Highway was observed at this intersection during either peak hour.

[3] Kuhio Highway/Mailihuna Road

The eastbound approach of this intersection operated at LOS F during both peak hours of traffic and at overcapacity conditions during the AM peak hour because of the high volume of vehicles making the left-turn onto Kuhio Highway. Queues along Mailihuna Road were observed to extend approximately 30 vehicles during the AM peak hour mainly due to the school traffic. The AM congestion on Mailihuna Road was observed to last approximately 50 minutes. Vehicles had difficulty making the eastbound left-turn because of the high speeds of the vehicles on Kuhio Highway. The northbound and left-turn from Kuhio Highway onto Mailihuna Road operated at LOS A during both peak hours and experienced minimal delay. No congestion along Kuhio Highway was observed at this intersection during either peak hour.

[4] Kuhio Highway/Kawaihau Road

The eastbound approach of this intersection operated at LOS F(C) and the northbound left-turn movement operated at LOS B(B) during the AM(PM) peak hour of traffic. Because of the high volume of eastbound right-turns and northbound left-turns, the vehicles heading southbound along Kuhio Highway often stopped to allow these vehicles to proceed, and the intersection was observed to self-regulate and operate similar to an all-way stop controlled intersection during the heaviest periods of congestion. It was observed that on average every four (4) southbound through vehicles would yield to either the northbound left-turn or eastbound left or right-turn. During less congested periods, minor movements were able to use gaps in traffic to proceed. Because of the large number of turning movements at this intersection and the proximity of this intersection to the Kuhio Highway/Hauaala Road intersection, Kuhio Highway became congested in this area in both the northbound and southbound directions.

[5] Kuhio Highway/Hauaala Road

The eastbound approach of this intersection operated at LOS F(D) and the northbound left-turn movement operated at LOS B(B) during the AM(PM) peak hour of traffic. Additionally, the eastbound approach operated under overcapacity conditions during the AM peak hour. Operations at this intersection behaved similarly to the Kuhio Highway/Kawaihau Road intersection.

[6] Kuhio Highway/Cane Haul Road

Because Cane Haul Road is one-way and does not allow traffic to enter Kuhio Highway, minimal delay was observed at this intersection. Many vehicles were observed to make a southbound right-turn onto Cane Haul Road in order to access the Kapaa Bypass Road. The majority of Kuhio Highway congestion in the southbound direction cleared in the vicinity of this intersection. However, congestion in the northbound direction remained due to queues extending from the Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road intersections.

[7] Kuhio Highway/Lehua Street

The eastbound approach of this intersection operated at LOS F and overcapacity during both peak hours of traffic. Because Kapaa Bypass Road terminates at the Olohena Road roundabout, vehicles heading farther north must reenter Kuhio Highway. The majority of these vehicles use Lehua Street to make a left-turn onto Kuhio Highway in order to avoid delay from the signal at Kukui Street. Although a refuge lane is provided for vehicles making the left-turn and there are adequate gaps in the southbound traffic, the high volume of left-turns caused increased delay for the eastbound approach. At this intersection, congestion was observed along Kuhio Highway in the northbound direction due to queues extending from the Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road intersections during both peak hours of traffic.

[8] Kuhio Highway/Niu Street

The eastbound approach of this intersection operated at LOS E(C) and the westbound approach operated at LOS C(C) during the AM(PM) peak hours of traffic. The minor street and major street left-turn movements were observed to experience minimal delay because of adequate gaps in traffic created by the nearby Kukui Street signal. At this intersection, congestion was observed along Kuhio Highway in the northbound direction due to queues extending from the Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road intersections.

[9] Kuhio Highway/Kukui Street

The minor street movements operated at LOS F(D) during the AM(PM) peak hours of traffic. Delay to the minor movements was mainly caused by the long coordinated signal favoring the

Kuhio Highway through movements. All movements were observed to generally clear in one (1) cycle. However, during the most congested AM and PM periods, queues extending from the Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road intersections caused slow-moving traffic in the northbound direction. Although northbound traffic was slow-moving, vehicles were only occasionally unable to proceed through the intersection because of queue spill back. During these events, vehicles were generally still able to clear the intersection in one (1) cycle. Queues reached the Kuhio Highway/Kukui Street intersection sporadically and lasted for a total of approximately 5-10 minutes during each of the peak hours.

[10] Kapaa Bypass Road/Cane Haul Road/Olohena Road

Based on the Kapaa Transportation Solutions calibrated data, the roundabout generally operates smoothly during the PM peak hour of traffic with all approaches operating at LOS C or better. However, during the AM peak hour, the eastbound approach experiences high volumes due to the large number of vehicles entering Kuhio Highway and Kapaa Bypass Road from residential areas and Kapaa Middle School. During the AM peak hour, the eastbound approach operates at LOS E and near overcapacity conditions. According to the Kapaa Transportation Solutions report, significant queuing occurs on the eastbound approach during the AM peak hour with queues reaching approximately 550 feet.

Figure 3.2 illustrates the local queues observed during existing conditions. Figure 3.3 illustrates the existing lane configurations, volumes and LOS. See Table 3.2 for a summary of the existing conditions analysis.

LEGEND

CONTRAFLOW LANE

CONTRAFLOW HOURS

MONDAY – SATURDAY

7:00 AM – 1:30 PM

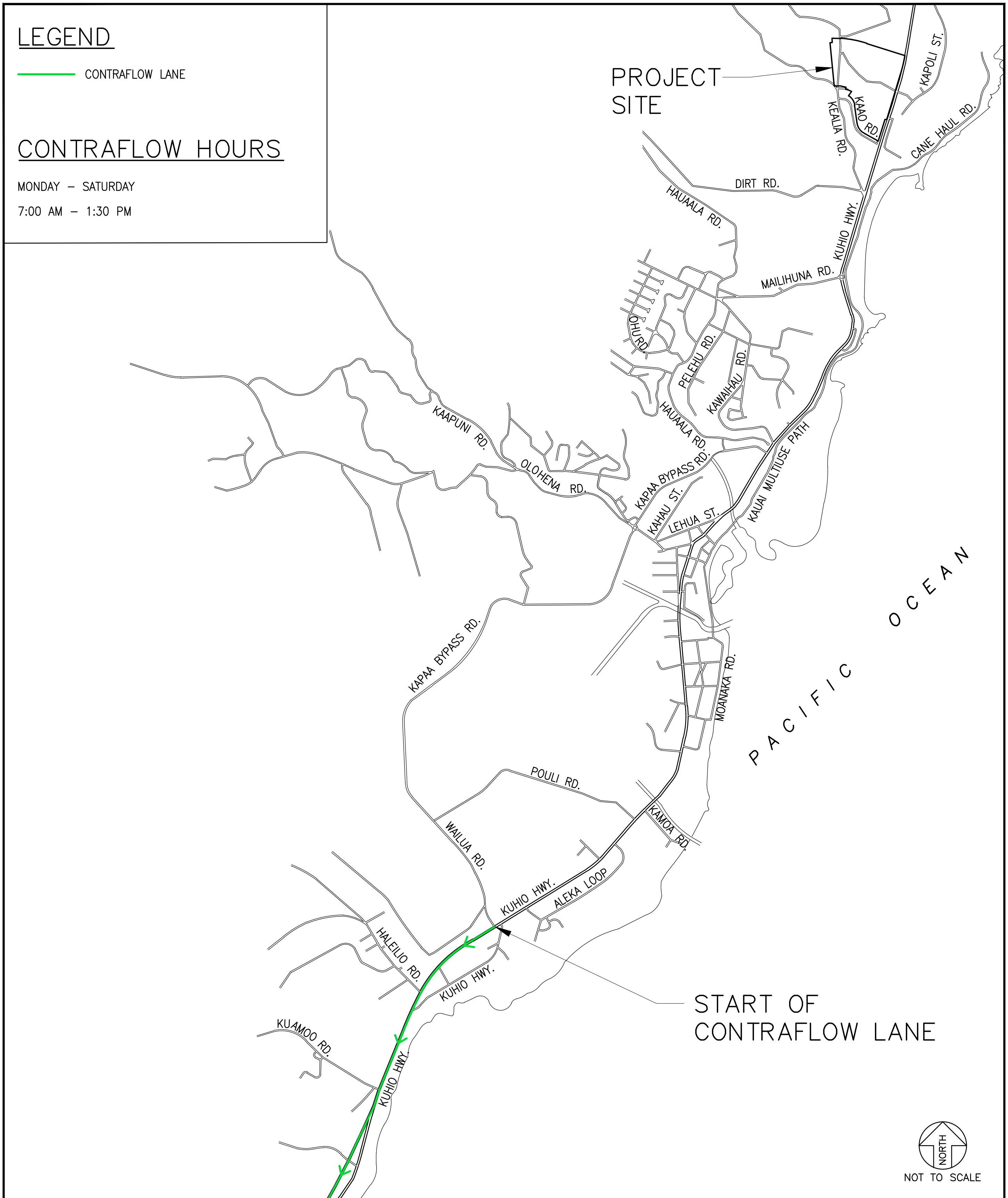


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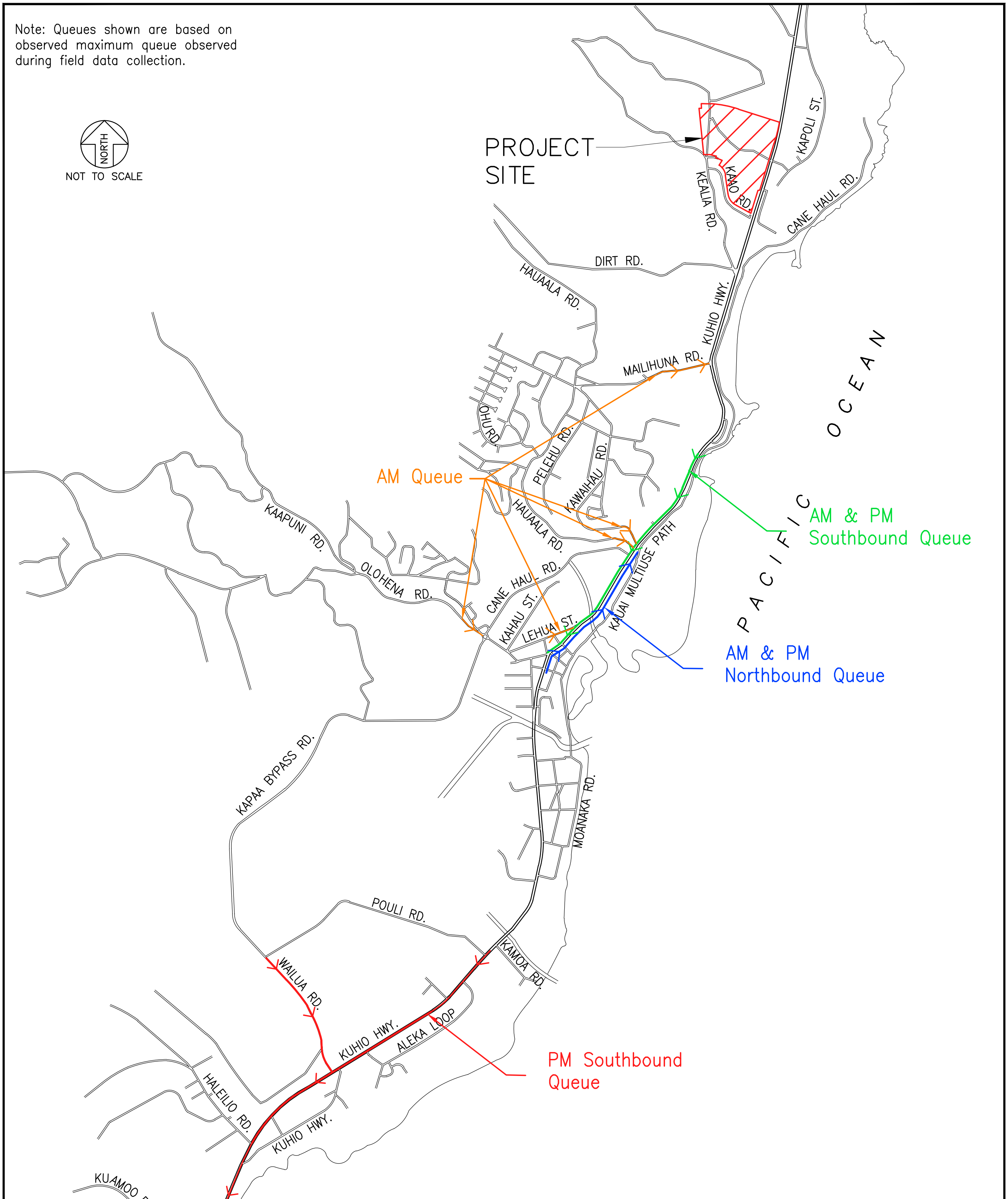
FIGURE 3.1

KUHIO HIGHWAY CONTRAFLOW



KEALIA MAUKA HOMESITES TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII	FIGURE
	EXISTING CONDITION QUEUES	3.2

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EXISTING LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE
3.3

Table 3.2: Existing Conditions Level of Service Summary

Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Kealia Rd & Kaao Rd						
WB LT/RT	9	0.02	A	9	0.01	A
SB LT/TH	7	0.00	A	7	0.00	A
Overall	4	-	-	1	-	-
2: Kuhio Hwy & Kealia Rd						
NB LT	9	0.03	A	10	0.06	A
EB LT/TH/RT	24	0.16	C	20	0.12	C
WB LT/TH/RT	47	0.26	E	77	0.44	F
SB LT	9	0.01	A	9	0.02	A
Overall	2	-	-	3	-	-
3: Kuhio Hwy & Mailihuna Rd						
NB LT/TH	10	0.12	A	10	0.04	A
EB LT/RT	447	1.85	F*	107	0.97	F
Overall	90	-	-	12	-	-
4: Kuhio Hwy & Kawaihau Rd						
NB LT	11	0.38	B	11	0.30	B
EB LT/RT	77	0.98	F	24	0.56	C
Overall	17	-	-	5	-	-
5: Kuhio Hwy & Hauaala Rd						
NB LT	11	0.10	B	11	0.15	B
EB LT/RT	213	1.35	F*	33	0.58	D
Overall	36	-	-	4	-	-
6: Kuhio Hwy & Cane Haul Rd**						
NB LT/TH	1	0.04	A	1	0.02	A
Overall	0	0.72	C	0	0.58	B
7: Kuhio Hwy & Lehua St						
NB LT	10	0.01	A	10	0.02	A
EB LT/RT	98	1.03	F*	87	1.01	F*
Overall	16	-	-	16	-	-
8: Kuhio Hwy & Niu St						
NB LT/TH/RT	9	0.01	A	9	0.02	A
EB LT/TH/RT	46	0.14	E	17	0.08	C
WB LT/TH/RT	23	0.25	C	21	0.33	C
SB LT/TH/RT	10	0.09	A	9	0.05	A
Overall	2	-	-	2	-	-
9: Kuhio Hwy & Kukui St**						
NB LT	2	0.04	A	4	0.06	A
NB TH/RT	33	0.96	C	36	0.95	D
EB LT/TH	96	0.32	F	45	0.15	D
EB RT	92	0.03	F	44	0.03	D
WB RT	92	0.01	F	44	0.02	D
SB LT/TH/RT	11	0.75	B	16	0.75	B
Overall	26	-	C	27	-	C
10: Kapaa Bypass Rd/Cane Haul Rd & Olohena Rd						
NB LT/RT	7	0.10	A	11	0.43	B
EB TH/RT	47	0.95	E	13	0.55	B
WB LT/TH	5	0.18	A	8	0.41	A
SB LT/TH/RT	14	0.62	B	19	0.66	C
Overall	28	-	D	13	-	B

* Denotes overcapacity condition, v/c ≥ 1.

** Intersection analyzed using HCM 2000 methodology due to HCM 6th Edition methodology currently not supporting signalized intersections with a stop-controlled, right-turn only approach or unsignalized intersections without at least one stop-controlled approach.

4. BASE YEAR 2027

Base Year 2027 was selected to reflect the full buildout and occupancy of the Project. The Base Year 2027 scenario represents the traffic conditions within the study area without the Project. Base Year traffic projections were formulated by applying a defacto growth rate to the existing 2017 traffic count volumes and adding trips generated by known future developments in the vicinity of the Project.

4.1 Defacto Growth Rate

Projections for Base Year 2027 traffic were based upon existing traffic counts performed by ATA, HDOT's Kauai Regional Travel Demand Model (KRTDM) growth for forecast years between 2007 and 2035, and nearby developments in the vicinity of the Project. A 1% annual growth rate was applied to Kuhio Highway, Cane Haul Road and Olohena Road, and a 2% annual growth rate was applied to Kukui Street.

4.2 Traffic Forecasts for Known Developments

By Year 2027, traffic in the Project area is expected to experience significant growth due to several residential and commercial developments in the nearby regions. The majority of trips generated from the known developments are accounted for in the KRTDM growth as described in Section 4.1.

The known developments that are projected to be complete by Year 2027 are illustrated in Figure 4.1 and listed below based on the best information available:

1. Piilani Mai Ke Kai – This project is located in Anahola on the makai side of Kuhio Highway on land owned by the Department of Hawaiian Home Lands (DHHL). The project began in 2006 and includes 181 single-family lots. The majority of the lots have already been awarded and were assumed to be fully occupied at the time of the traffic counts. Of the remaining lots, 22 lots were awarded in January 2017 and an additional 51 lots will be awarded by the end of 2017. Full buildout of the 73 lots is expected by 2027. This development is accounted for in the KRTDM growth rates described in Section 4.1 above.
2. Kulana Subdivision – This project is located north of Olohena Road and east of Hauiki Road. The project is an agricultural subdivision that will contain 172 single-family houses at full buildout. There is currently no expected completion date, however, the project is included in KRTDM forecasts. This development is accounted for in the KRTDM growth rates described in Section 4.1 above.
3. Hokua Place – This project is located between Olohena Road and Kapaa Bypass Road near Kapaa Middle School. The project plans to develop 100 single-family units, 700 multi-family units and 8,000 square feet of neighborhood retail. The project also plans to construct a roadway, Road "A", through the subdivision connecting Kapaa Bypass Road to Olohena Road just west of Kapaa Middle School. Once constructed, the roadway is expected to reduce traffic volumes at the Kapaa Bypass Road/Cane Halu Road/Olohena Road roundabout. The Hokua Place project was previously known as Kapaa Highlands Phase II. The Kapaa Highlands TIAR, dated December 2013, assumes a completion year of 2020. The Kapaa Highlands TIAR was used to determine trips generated and rerouted in the study area.

4. Coconut Plantation – This project is located along the makai side of Kuhio Highway between the Courtyard by Marriott Kauai at Coconut Beach Hotel and the Mokihana Lodge. The project proposes to develop 192 resort units. There is currently no expected completion date, however, for the purposes of this TIAR, the project was assumed to be completed by 2027. A summary of the trips generated may be found in Table 4.1 below.
5. Coconut Beach Resort – This project is located along the makai side of Kuhio Highway between the Courtyard by Marriott Kauai at Coconut Beach Hotel and Kauai Coast Resort at the Beachboy. The project proposes to develop 330 condo units as part of a new beachfront timeshare. Completion is anticipated in 2019. A summary of the trips generated may be found in Table 4.1 below.
6. Coco Palms – This project is located along the mauka side of Kuhio Highway north of Kuamoo Road. The project proposes to restore the old Coco Palms hotel into a 350-room resort. Completion is anticipated by the end of 2018. A summary of the trips generated may be found in Table 4.1 below.

Table 4.1: Background Development Trip Generation

Land Use (ITE Code)	Independent Variable	AM Peak Hour			PM Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Coconut Plantation (330)	192 Rooms	26	10	36	35	46	81
Coconut Beach Resort (330)	330 Rooms	66	25	91	60	79	139
Coco Palms (330)	350 Rooms	71	28	99	63	84	147
Total		163	63	226	158	209	367

4.3 Planned Roadway Improvements

Roadway projects that are currently planned and expected to be completed by Year 2027 include:

Kuhio Highway/Mailihuna Road

According to the Final Environmental Impact Statement: Kapaa Stream Bridge & Mailihuna Intersection Improvements, Kuhio Highway (State Route 56), District of Kawaihau, Island of Kauai, "Improvements to the Mailihuna intersection: The existing three-legged intersection on Mailihuna Road, which currently has stop control only, would be reconfigured to improve safety by constructing a roundabout." The roundabout will provide a 130-foot diameter width roundabout with yield-controls on all approaches. Construction at the intersection is expected to begin in mid-2017 and be completed in 2019. For the purposes of this report, it was assumed that the roundabout alternative will be implemented by Base Year 2027 because it was identified as the preferred alternative.

Several roadway projects to relieve congestion along Kuhio Highway in the Wailua and Kapaa regions are currently in the planning stages. These roadway improvements are not expected to be completed by Year 2027 and were not included in Base Year 2027 traffic predictions. These roadway projects include:

Kuhio Highway

- Widening Kuhio Highway from the south junction of Kapaa Bypass Road to Kuamoo Road to include an additional southbound lane.
- Widening Kuhio Highway from Kuamoo Road to Kapule Highway to include an additional southbound lane.
- Optimizing traffic signals along Kuhio Highway.

Kapaa Bypass Road

- Extending the Kapaa Bypass Road from Olohena Road to Kuhio Highway by adding a northbound lane.

Additional roadway improvements are recommended in the 2015 Kapaa Transportation Solutions report but are not currently in the planning stages. These roadway improvements are not expected to be completed by Year 2027 and were not included in Base Year 2027 traffic predictions. These roadway projects include:

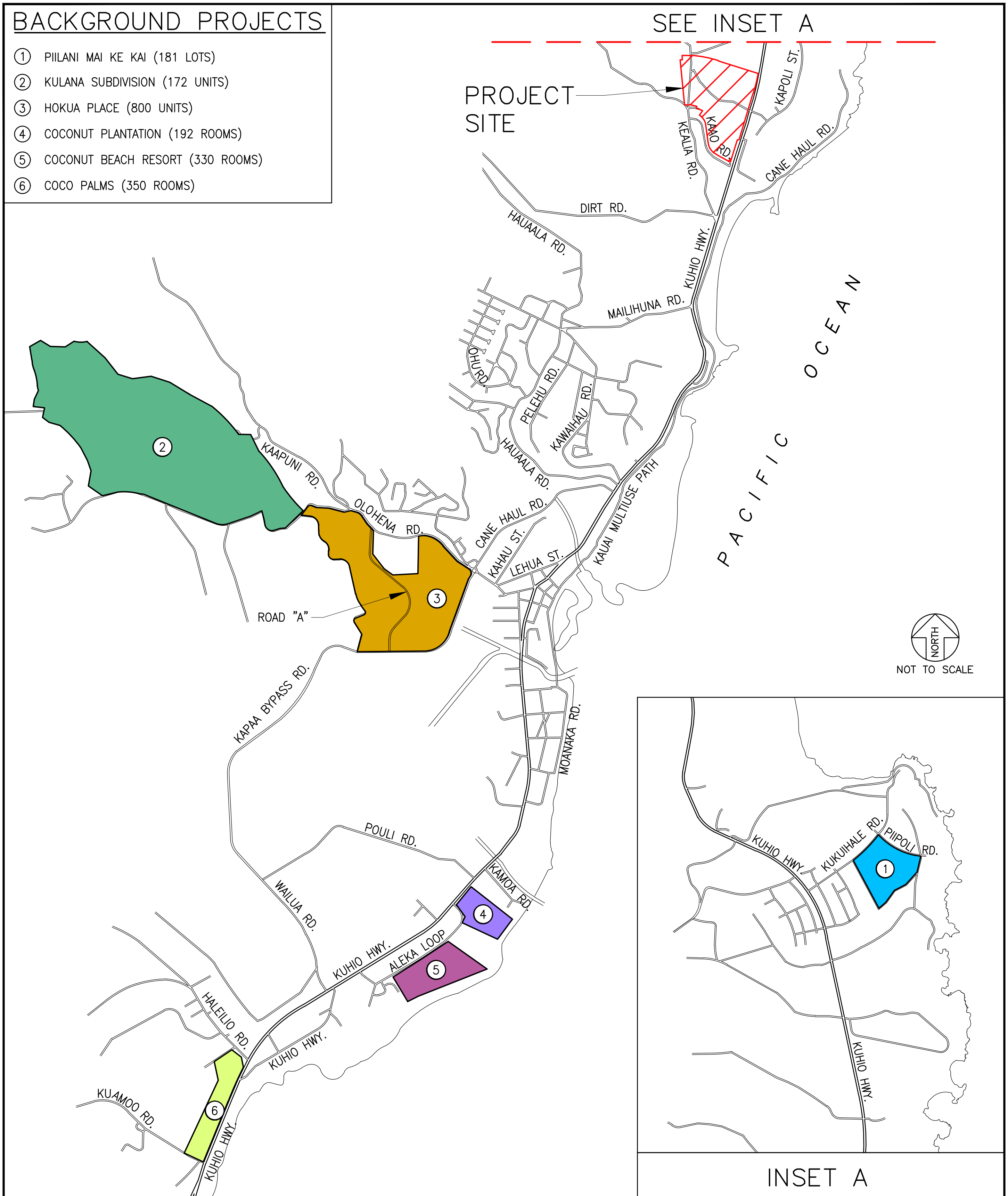
Other roadway improvements

- Closing the east leg of Kukui Street to allocate more green time to movements on Kuhio Highway.
- Improving the Kuhio Highway/Niu Street intersection to alleviate congestion at the Kuhio Highway/Lehua Street intersection.
- Eliminating the connection from Hauaala Road to Kuhio Highway and creating a new connection from Hauaala Road to Kapaa Bypass Road.

Figure 4.2 shows the location of all planned and proposed roadway improvements in the Project area.

BACKGROUND PROJECTS

1. PIILANI MAI KE KAI (181 LOTS)
2. KULANA SUBDIVISION (172 UNITS)
3. HOKUA PLACE (800 UNITS)
4. COCONUT PLANTATION (192 ROOMS)
5. COCONUT BEACH RESORT (330 ROOMS)
6. COCO PALMS (350 ROOMS)



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BACKGROUND DEVELOPMENTS

FIGURE 4.1

FUNDED PROJECTS (COMPLETED BY 2020)

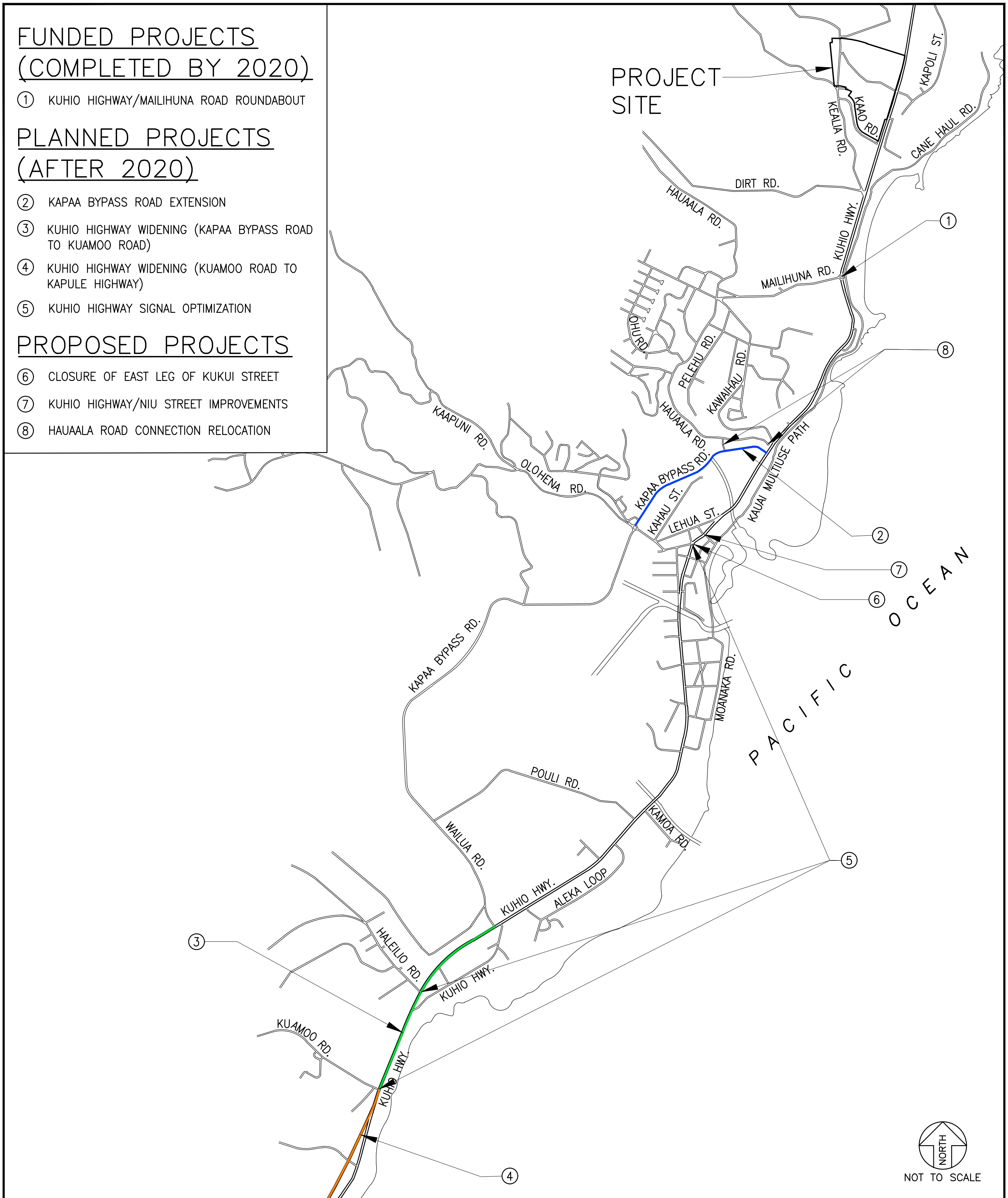
1. KUHIO HIGHWAY/MAILIHUNA ROAD ROUNDABOUT

PLANNED PROJECTS (AFTER 2020)

2. KAPAA BYPASS ROAD EXTENSION
3. KUHIO HIGHWAY WIDENING (KAPAA BYPASS ROAD TO KUAMOO ROAD)
4. KUHIO HIGHWAY WIDENING (KUAMOO ROAD TO KAPULE HIGHWAY)
5. KUHIO HIGHWAY SIGNAL OPTIMIZATION

PROPOSED PROJECTS

6. CLOSURE OF EAST LEG OF KUKUI STREET
7. KUHIO HIGHWAY/NIU STREET IMPROVEMENTS
8. HAUAALA ROAD CONNECTION RELOCATION



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ROADWAY IMPROVEMENT PROJECTS

FIGURE 4.2

4.4 Base Year 2027 Analysis

It is anticipated that by Base Year 2027, traffic will have increased by approximately 18%(24%) along Kuhio Highway and by approximately 9%(14%) along Cane Haul Road/Kapaa Bypass Road during the AM(PM) peak hour over existing conditions due to the development in the surrounding regions. Actual growth within the study region may vary based upon the approval process of the various projects.

Peak hour queuing along Kuhio Highway is expected to operate similarly to existing conditions. Although not expected to be completed by Year 2027, the planned widening of Kuhio Highway from Kapaa Bypass Road to Kuamoo Road would reduce queues along Kuhio Highway south of the study intersections. Queuing along Kuhio Highway near Kawaihau Road is expected to remain in Base Year 2027.

Many minor street movements are expected to experience increases in delay due to the increase in traffic along Kuhio Highway. However, the Kuhio Highway/Mailihuna Rd intersection is expected to operate with all movements at LOS C or better with the construction of the planned roundabout. Note that this LOS reflects conditions where drivers are accustomed to the movements through the roundabout. Initial traffic operations at the roundabout may result in longer delays as drivers become familiar with the maneuvers.

The following intersections are expected to continue operating at or worsen to LOS E/F during Base Year 2027 conditions.

[2] Kuhio Highway/Kealia Road

The eastbound approach is expected to operate at LOS E and the westbound approach is expected to operate at LOS F during both peak hours of traffic. Additionally, the westbound approach will operate at overcapacity during the PM peak hour. Because volumes on both approaches are low (≤ 45 vehicles) and adequate gaps in Kuhio Highway traffic were observed, no mitigation is proposed at this intersection.

[4] Kuhio Highway/Kawaihau Road

The eastbound approach is expected to worsen to overcapacity conditions during the AM peak hour. Section 4.5 below discusses two (2) potential scenarios for mitigation at this intersection.

[5] Kuhio Highway/Hauaala Road

The eastbound approach is expected to continue operating at LOS F and overcapacity conditions during the AM peak hour and worsen to LOS F during the PM peak hour. Section 4.5 below discusses two (2) potential scenarios for mitigation at this intersection.

[7] Kuhio Highway/Lehua Street

The eastbound approach is expected to operate at LOS F and overcapacity conditions during both peak hours of traffic. Section 4.5 below discusses two (2) potential scenarios for mitigation at this intersection.

[8] Kuhio Highway/Niu Street

The eastbound approach is expected to worsen to LOS F(E) during the AM(PM) peak hour, and the westbound approach is expected to worsen to LOS E during the AM peak hour. Because adequate gaps in traffic were observed due the intersection's proximity to the Kukui Street signal, the minor street movements are expected to continue operating adequately, and no mitigation is proposed.

[9] Kuhio Highway/Kukui Street

During both peak hours of traffic, the northbound shared through/right-turn movement is expected to operate at overcapacity due to the increase in traffic along Kuhio Highway. The minor street movements are expected to continue operating at LOS F(E) during the AM(PM) peak hour because of the long coordinated cycle length. Because the minor street movements operate at under capacity conditions, no mitigation is proposed for the minor movements. Section 4.5 below discusses two (2) potential scenarios for mitigation at this intersection for the Kuhio Highway northbound movement.

[10] Kapaa Bypass Road/Cane Haul Road/Olohena Road

Operations at this intersection are anticipated to improve over existing conditions due to the proposed Road "A" through the Hokua Place development. With a portion of traffic expected to utilize Road "A" over traveling through the Kapaa Bypass Road/Cane Haul Road/Olohena Road roundabout, all approaches of the roundabout are anticipated to operate at LOS C or better during both peak hours of traffic.

Figure 4.3 illustrates the Base Year 2027 forecast traffic volumes and LOS for the study intersection movements. Table 4.2 summarizes the Base Year 2027 LOS at the study intersections compared to existing conditions. LOS worksheets are provided in Appendix C.

4.5 Base Year 2027 With Mitigation Analysis

In order to improve Base Year 2027 traffic operations at the study intersections, the Kapaa Bypass Road extension and the relocation of the Hauaala Road connection, as described in Section 4.3, are the preferred mitigations. Although the Kapaa Bypass Road extension is currently planned by HDOT, the project is not expected to be completed by Year 2027. In the event that the bypass extension is completed by Year 2027, Base Year 2027 with Mitigation traffic operations are projected as described in Section 4.5.1 below. If the bypass extension is not completed, alternative mitigations are proposed as described in Section 4.5.2 below.

4.5.1 Base Year 2027 With Mitigation With Kapaa Bypass Road Extension

Kapaa Bypass Road Extension

The Kapaa Bypass Road extension from Olohena Road to Kuhio Highway would add a northbound lane to the existing one-way Cane Haul Road. With the extension, vehicles will be able to head farther north on the bypass road, and the left-turns from Lehua Street onto Kuhio Highway are expected to decrease. The extension has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report and has been acknowledged as a planned improvement by HDOT. With the extension, improvements will also be completed at the northern terminus. However, these improvements are currently not identified.

Hauaala Road Connection

With the Kapaa Bypass Road extension, the existing Hauaala Road connection to Kuhio Highway can be eliminated and replaced with a new connection from Hauaala Road to the Kapaa Bypass Road. Moving the Hauaala Road connection is expected to relieve congestion in the vicinity of the existing Kuhio Highway/Hauaala Road intersection by reducing the number of conflicting turning movements and providing a longer northbound left-turn pocket at the nearby Kuhio Highway/Kawaihau Road intersection. It was assumed that the proposed Kapaa Bypass Road/Hauaala Road intersection will have a stop-controlled left-/right-turn movement on Hauaala Road and shared eastbound left-turn/through and westbound through/right-turn movements on Kapaa Bypass Road. Relocating the Hauaala Road connection has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report.

With the above mitigations, operations at several intersections are expected to improve due to changes in traffic patterns. The following changes in intersection operations are expected.

[3] Kuhio Highway/Mailihuna Road

Although operations at this intersection are not expected to improve with the proposed mitigation, a portion of traffic heading northbound on Kapaa Bypass Road is expected to access Kuhio Highway from this intersection via the proposed Hauaala Road connection. No changes in LOS are anticipated at this intersection.

[4] Kuhio Highway/Kawaihau Road

With the proposed mitigation, a portion of vehicles currently turning onto Kawaihau Road from Kuhio Highway and from Kawaihau Road onto the highway are expected to use the Kapaa Bypass Road and Hauaala Road to access residential areas. Although LOS on the eastbound approach is expected to remain the same at LOS F(D) during the AM(PM) peak hour, the approach is anticipated to operate under capacity with the improvements. The intersection is expected to continue to self-regulate during congested periods.

[5] Kuhio Highway/Hauaala Road

With the proposed mitigation, the Kuhio Highway/Hauaala Road intersection will be replaced with the Kapaa Bypass Road/Hauaala Road intersection. The new Hauaala Road approach is expected to operate under capacity at LOS E(C) during the AM(PM) peak hour of traffic.

[6] Kuhio Highway/Cane Haul Road

With the proposed mitigation, Cane Haul Road will become the two-way Kapaa Bypass Road. Existing intersection configuration is assumed to remain with the addition of a new stop-controlled eastbound left-/right-turn lane. The eastbound approach is expected to operate at LOS F(E) during the AM(PM) peak hour of traffic due to the high volumes along Kuhio Highway. However, with the elimination of the Kuhio Highway/Hauaala Road intersection, the existing left-turn lane can be turned into a refuge lane to reduce conflicts for the left-turn from Kapaa Bypass Road. Additional improvements at this intersection may be completed with the Kapaa Bypass Road extension but are not currently identified and were therefore not included in the Base Year 2027 analysis.

[7] Kuhio Highway/Lehua Street

With the proposed mitigation, the eastbound left-turn volume from Lehua Street onto Kuhio Highway is expected to decrease as vehicles will be able to travel farther north on the Kapaa Bypass Road. The eastbound approach is expected to operate at LOS E during both peak hours of traffic.

[8] Kuhio Highway/Niu Street

With the proposed mitigation, a portion of vehicles currently using Kuhio Highway is expected to utilize the Kapaa Bypass Road instead. As a result, the minor street movements at this intersection are expected to experience a slight decrease in delay.

[9] Kuhio Highway/Kukui Street

With the proposed mitigation, a portion of vehicles currently using Kuhio Highway is expected to utilize the Kapaa Bypass Road instead. Additionally, with the decrease in congestion near the existing Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road intersections, queuing along Kuhio Highway is expected to decrease and improve through progression at this intersection.

[10] Kapaa Bypass Road/Cane Haul Road/Olohena Road

With the proposed mitigation, the Kapaa Bypass Road/Cane Haul Road/Olohena Road roundabout is expected to experience a significant increase in volume. With the northbound extension of the bypass road and new Hauaala Road connection, a larger portion of traffic will be diverted to Kapaa Bypass Road from Kuhio Highway. Due to the increase in volume, the eastbound approach is expected to operate at LOS E during the AM peak hour of traffic similar to existing conditions.

Figure 4.4 illustrates the Base Year 2027 with mitigation, including the Kapaa Bypass Road extension, forecast traffic volumes and LOS for the study intersection movements. Table 4.2 summarizes the Base Year 2027 with the bypass extension LOS at the study intersections compared to Base Year 2027 without mitigation and existing conditions. LOS worksheets are provided in Appendix C.

4.5.2 Base Year 2027 With Mitigation Without Kapaa Bypass Road Extension

The Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) 2009 Edition was used to determine if a traffic signal would be warranted at intersections with movements operating at overcapacity conditions. Based on existing traffic volumes, Warrant 2, Four-Hour Vehicular Volume signal warrant is met[1] at the Kuhio Highway/Lehua Street intersection. However, a signal at Kuhio Highway/Lehua Street may not yield any significant benefits because of existing northbound queues along Kuhio Highway and because vehicles currently allow major street left-turns and minor street movements to proceed during congested periods and adequate gaps in traffic were observed during non-peak hours.

[1] Note that a full signal warrant study was not performed and only available data was used to determine if a signal would be warranted.

Other improvements mentioned in Section 4.3 from the Kapaa Transportation Solutions report may be more appropriate:

- Closing the east leg of Kukui Street to allocate more green time to movements on Kuhio Highway.
- Improving the Kuhio Highway/Niu Street intersection to alleviate congestion at the Kuhio Highway/Lehua Street intersection.

Although not specified in the Kapaa Transportation Solutions report, improving the Kuhio Highway/Niu Street intersection likely consists of providing, similar to the Lehua Street intersection, a northbound refuge lane for eastbound left-turns.

By year 2027 signals may be warranted at the intersections of Kuhio Highway with Kawaihau Road and Hauaala Road. Analysis of traffic signals at these intersections would not provide accurate results as the analysis doesn't take into account the close proximity of the intersections. Based on observations, with a traffic signal, queues are expected to lengthen in the northbound direction due to the delays caused by the signal, the short northbound storage length and the fact that vehicles along Kuhio Highway would be less likely to yield to the minor movements when a signal is installed. Currently, without a signal, vehicles in the southbound through yield to the eastbound approach at a rate of approximately one (1) to two (2) eastbound vehicles to four (4) southbound through; therefore, it is anticipated that this type of behavior would continue. Furthermore, improvements at the Kuhio Highway/Mailihuna Road intersection may provide some relief at the Kawaihau Road and Hauaala Road intersections. Additionally, community input may be a factor in determining the viability of the improvement.

With the above mitigations, the following changes in intersection operations are expected.

[3-5] Kuhio Highway from Mailihuna Road to Hauaala Road

Although these intersections will not be affected by the proposed mitigation, it is anticipated that if the new Hauaala Road connection to Kapaa Bypass Road is not constructed, vehicles will likely modify their travel routes to those with more favorable travel times. Because Mailihuna Road, Kawaihau Road and Hauaala Road all provide access to an interconnected roadway network serving residential areas, it is anticipated that a portion of vehicles will change the roadway they use to access Kuhio Highway.

[7] Kuhio Highway/Lehua Street

With the proposed mitigation, a portion of vehicles currently accessing Kuhio Highway via the Kuhio Highway/Lehua Street intersection are expected to access the highway at either Kuhio Highway/Niu Street or Kuhio Highway/Kukui Street in order to minimize delays. Although the eastbound approach will continue to operate at LOS F during both peak hours of traffic, the movement will operate at under capacity with lower delays than Base Year 2027 without mitigation.

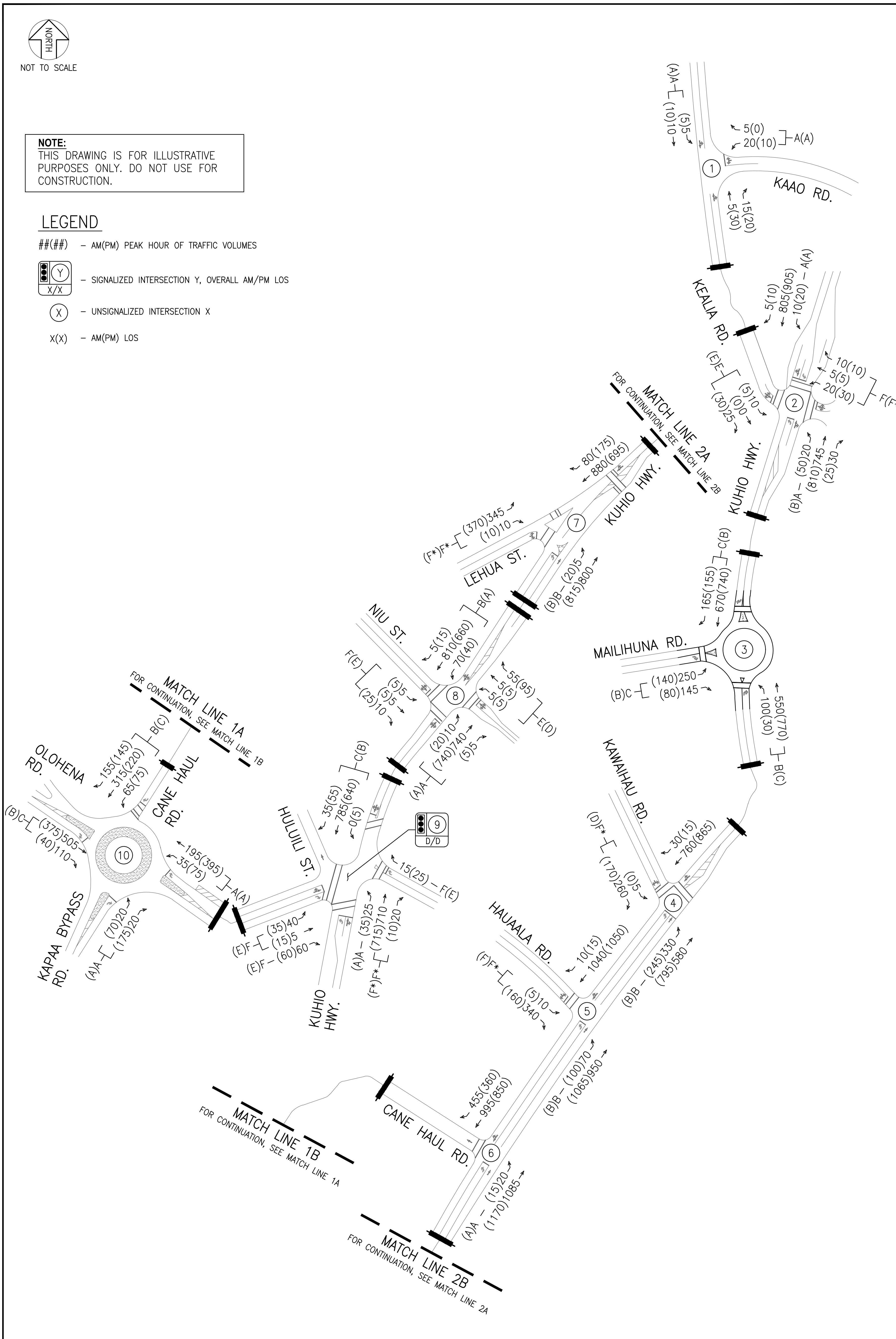
[8] Kuhio Highway/Niu Street

With the proposed mitigation, vehicles will have an easier time making an eastbound left-turn from Niu Street onto Kuhio Highway, and a portion of vehicles will be diverted to this intersection from the Kuhio Highway/Lehua Street intersection. Because larger volumes are expected to utilize this intersection, the eastbound approach is expected to operate at LOS F during both peak hours of traffic and the westbound approach is expected to operate at LOS E during both peak hours. However, all movements are expected to operate at under capacity, and turning movements will likely benefit from the proximity of the Kukui Street signal.

[9] Kuhio Highway/Kukui Street

With the longer delays projected at the Kuhio Highway/Lehua Street intersection, vehicles are expected to utilize the Kuhio Highway/Kukui Street intersection as an alternative route. Because of the larger volume expected at this intersection, the eastbound left-turn movement is expected to continue operating at LOS F during the AM peak hour and worsen from LOS E to LOS F during the PM peak hour. However, the eastbound movement will continue to operate under capacity with delay caused by the long cycle length favoring Kuhio Highway. Despite long green times allotted to Kuhio Highway, the northbound through/right-turn movement will continue to operate at overcapacity conditions.

Figure 4.5 illustrates the Base Year 2027 with mitigation, without the Kapaa Bypass Road extension, forecast traffic volumes and LOS for the study intersection movements. Table 4.2 summarizes the Base Year 2027 mitigation without the bypass extension LOS at the study intersections compared to Base Year 2027 without mitigation and existing conditions. LOS worksheets are provided in Appendix C.



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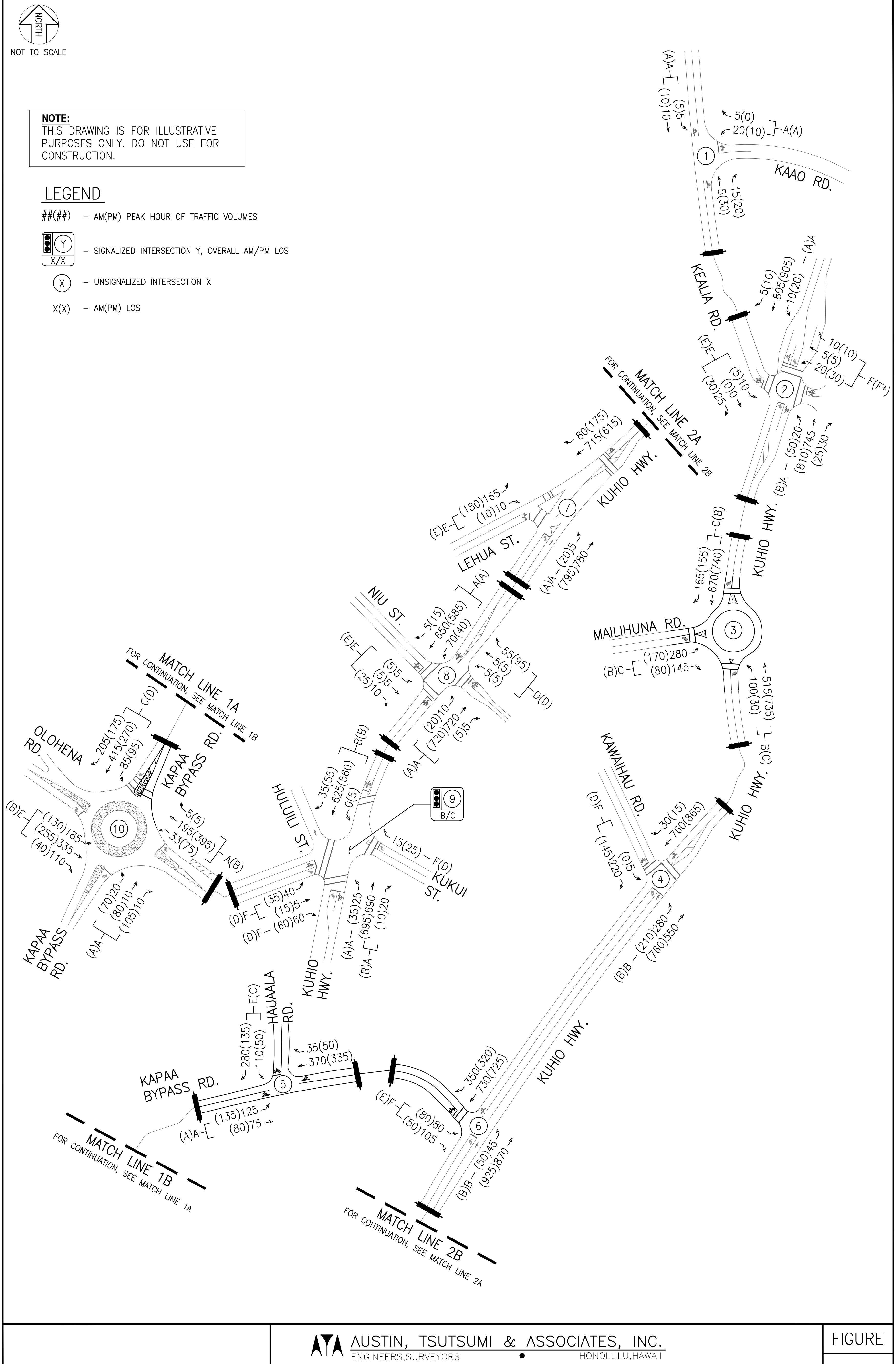
BASE YEAR 2027 LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS

FIGURE
4.3



NOTE:
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LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

Y X/X – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X – UNSIGNALIZED INTERSECTION X

X(X) – AM(PM) LOS

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FIGURE 4.4

BASE YEAR 2027 WITH MITIGATION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS (WITH KAPAA BYPASS ROAD EXTENSION)

NOT TO SCALE

NOTE:
THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

LEGEND

##(##) – AM(PM) PEAK HOUR OF TRAFFIC VOLUMES

Y X/X – SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X – UNSIGNALIZED INTERSECTION X

X(X) – AM(PM) LOS

KEALIA MAUKA HOMESITES TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII **BASE YEAR 2027 WITH MITIGATION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS (WITHOUT KAPAA BYPASS ROAD EXTENSION)**	FIGURE 4.5

Table 4.2: Existing Conditions, Base Year 2027 and Base Year 2027 with Mitigation Level of Service Summary

	Existing Conditions						Base Year 2027						Base Year 2027 with Mitigation (With Kapaa Bypass Extension)						Base Year 2027 with Mitigation (Without Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM			AM			PM		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Kealia Rd & Kaao Rd																								
WB LT/RT	9	0.02	A	9	0.01	A	9	0.03	A	9	0.01	A	**Same as Base Year 2027**						**Same as Base Year 2027**					
SB LT/TH	7	0.00	A	7	0.00	A	7	0.00	A	7	0.00	A												
Overall	4	-	-	1	-	-	4	-	-	2	-	-												
2: Kuhio Hwy & Kealia Rd																								
NB LT	9	0.03	A	10	0.06	A	10	0.03	A	11	0.08	B	**Same as Base Year 2027**						**Same as Base Year 2027**					
EB LT/TH/RT	24	0.16	C	20	0.12	C	40	0.27	E	40	0.27	E												
WB LT/TH/RT	47	0.26	E	77	0.44	F	89	0.49	F	316	1.11	F*												
SB LT	9	0.01	A	9	0.02	A	10	0.01	A	10	0.03	A												
Overall	2	-	-	3	-	-	3	-	-	9	-	-												
3: Kuhio Hwy & Mailihuna Rd																								
NB LT/TH	10	0.12	A	10	0.04	A	15	0.69	B	16	0.75	C	14	0.68	B	16	0.75	C	15	0.69	B	16	0.75	C
EB LT/RT	447	1.85	F*	107	0.97	F	20	0.68	C	12	0.41	B	23	0.73	C	14	0.47	B	28	0.79	D	15	0.52	C
SB TH/RT	-	-	-	-	-	-	15	0.75	C	14	0.74	B	15	0.75	C	14	0.74	B	15	0.75	C	14	0.74	B
Overall	90	-	-	12	-	-	16	-	C	15	-	B	17	-	C	15	-	B	18	-	C	15	-	B
4: Kuhio Hwy & Kawaihau Rd																								
NB LT	11	0.38	B	11	0.30	B	14	0.47	B	13	0.38	B	13	0.40	B	13	0.32	B	15	0.50	B	14	0.40	B
EB LT/RT	77	0.98	F	24	0.56	C	93	1.00	F*	32	0.59	D	55	0.82	F	28	0.51	D	135	1.12	F*	39	0.65	E
Overall	17	-	-	5	-	-	15	-	-	4	-	-	9	-	-	3	-	-	20	-	-	5	-	-
5: Kuhio Hwy & Hauaala Rd* **																								
NB LT	11	0.10	B	11	0.15	B	12	0.13	B	12	0.18	B	-	-	-	-	-	-	12	0.13	B	13	0.19	B
EB LT/TH	-	-	-	-	-	-	-	-	-	-	-	-	9	0.12	A	9	0.13	A	-	-	-	-	-	-
EB LT/RT	213	1.35	F*	33	0.58	D	381	1.72	F*	95	0.92	F	-	-	-	-	-	-	323	1.57	F*	67	0.69	F
SB LT/RT	-	-	-	-	-	-	-	-	-	-	-	-	42	0.86	E	17	0.39	C	-	-	-	-	-	-
Overall	36	-	-	4	-	-	56	-	-	8	-	-	17	-	-	5	-	-	38	-	-	5	-	-
6: Kuhio Hwy & Cane Haul Rd**																								
NB LT	-	-	-	-	-	-	-	-	-	-	-	-	12	0.08	B	11	0.09	B	**Same as Base Year 2027**					
NB LT/TH	1	0.04	A	1	0.02	A	2	0.05	A	1	0.03	A	-	-	-	-	-	-						
EB LT/RT	-	-	-	-	-	-	-	-	-	-	-	-	58	0.80	F	42	0.61	E						
Overall	0	0.72	C	0	0.58	B	0	0.84	E	0	0.70	C	5	-	-	3	-	-						
7: Kuhio Hwy & Lehua St																								
NB LT	10	0.01	A	10	0.02	A	11	0.01	B	10	0.03	B	10	0.01	A	10	0.03	A	11	0.01	B	10	0.03	B
EB LT/RT	98	1.03	F*	87	1.01	F*	273	1.48	F*	296	1.54	F*	36	0.64	E	44	0.72	E	89	0.94	F	90	0.94	F
Overall	16	-	-	16	-	-	46	-	-	54	-	-	4	-	-	5	-	-	9	-	-	9	-	-
8: Kuhio Hwy & Niu St																								
NB LT/TH/RT	9	0.01	A	9	0.02	A	10	0.02	A	10	0.03	A	9	0.01	A	9	0.03	A	10	0.02	A	10	0.03	A
EB LT/TH/RT	46	0.14	E	17	0.08	C	74	0.30	F	43	0.29	E	50	0.21	E	35	0.24	E	120	0.95	F	129	0.95	F
WB LT/TH/RT	23	0.25	C	21	0.33	C	39	0.40	E	34	0.48	D	30	0.33	D	30	0.44	D	41	0.45	E	44	0.60	E
SB LT/TH/RT	10	0.09	A	9	0.05	A	10	0.10	B	10	0.06	A	10	0.09	A	10	0.06	A	10	0.10	B	11	0.06	B
Overall	2	-	-	2	-	-	3	-	-	4	-	-	2	-	-	3	-	-	10	-	-	11	-	-

Table 4.2: Existing Conditions, Base Year 2027 and Base Year 2027 with Mitigation Level of Service Summary Cont'd

Intersection	Existing Conditions						Base Year 2027						Base Year 2027 with Mitigation (With Kapaa Bypass Extension)						Base Year 2027 with Mitigation (Without Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
9: Kuhio Hwy & Kukui St**																								
NB LT	2	0.04	A	4	0.06	A	4	0.05	A	3	0.06	A	2	0.04	A	4	0.07	A	4	0.06	A	5	0.07	A
NB TH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	87	1.13	F*	83	1.11	F*
NB TH/RT	33	0.96	C	36	0.95	D	79	1.11	F*	75	1.09	F*	8	0.74	A	17	0.83	B	-	-	-	-	-	-
EB LT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	0.62	F	112	0.87	F
EB LT/TH	96	0.32	F	45	0.15	D	96	0.41	F	75	0.29	E	96	0.41	F	46	0.22	D	-	-	-	-	-	-
EB RT	92	0.03	F	44	0.03	D	92	0.04	F	73	0.04	E	92	0.04	F	44	0.05	D	76	0.05	E	71	0.06	E
WB RT	92	0.01	F	44	0.02	D	91	0.01	F	72	0.02	E	91	0.01	F	44	0.02	D	-	-	-	-	-	-
SB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	0.93	C	21	0.83	C
SB LT/TH/RT	11	0.75	B	16	0.75	B	22	0.89	C	19	0.82	B	11	0.72	B	20	0.81	B	-	-	-	-	-	-
Overall	26	-	C	27	-	C	51	-	D	48	-	D	16	-	B	20	-	C	57	-	E	58	-	E
10: Kapaa Bypass Rd/Cane Haul Rd & Olohena Rd																								
NB LT/TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	6	0.06	A	9	0.35	A						
NB LT/RT	7	0.10	A	11	0.43	B	6	0.06	A	8	0.33	A	-	-	-	-	-	-						
EB TH/RT	47	0.95	E	13	0.55	B	22	0.79	C	11	0.51	B	-	-	-	-	-	-						
EB LT/TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	41	0.93	E	13	0.56	B	**Same as Base Year 2027**					
WB LT/TH	5	0.18	A	8	0.41	A	4	0.19	A	7	0.41	A	-	-	-	-	-	-						
WB LT/TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	6	0.24	A	10	0.52	B						
SB LT/TH/RT	14	0.62	B	19	0.66	C	11	0.57	B	17	0.65	C	17	0.75	C	25	0.80	D						
Overall	28	-	D	13	-	B	15	-	B	11	-	B	25	-	C	16	-	C						

* Denotes overcapacity condition, v/c ≥ 1.

** Intersection analyzed using HCM 2000 methodology due to HCM 6th Edition methodology currently not supporting signalized intersections with a stop-controlled, right-turn only approach or unsignalized intersections without at least one stop-controlled approach.

*** Values for intersection 5: Kuhio Hwy & Hauaala Rd represent the Kapaa Bypass Road/Hauaala Road intersection for Base Year 2020 with Mitigation.

5. FUTURE YEAR 2027

5.1 Background

The Project proposes to develop 235 single-family dwellings in the Kealia area. Access to the Project will be provided via Kealia Road from Kuhio Highway. The Project will construct a new four-way, one-lane roundabout north of the Kealia Road/Hopoe Road intersection to connect Kealia Road to the Project site. Both the southern and western approaches of the roundabout will have connections to Kealia Road. Although there is currently a direct access to Kuhio Highway along the Makai side of the Project site, this access will be fully removed during Project construction. Construction and occupancy of homes in the proposed subdivision is anticipated in 2027.

5.2 Travel Demand Estimations

The HDOT and Kauai County provide various Transportation Demand Management (TDM) programs that promote the use of transit, walking, biking and alternative modes of transportation to reduce the use of single-occupant vehicles on roadways. These TDM measures have only been identified and conservatively assumed to yield no vehicular reductions for Project generated traffic.

5.2.1 Trip Generation

The Institute of Transportation Engineers (ITE) publishes a book based on empirical data compiled from a body of more than 4,250 trip generation studies submitted by public agencies, developers, consulting firms, and associations. This publication, titled Trip Generation Manual, 10th Edition, provides trip rates and/or formulae based on graphs that correlate vehicular trips with independent variables. The independent variables can range from Dwelling Units (DU) for single-family attached homes to Gross Floor Area (GFA) for commercial or office development. These trip rates/formulae and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the proposed Project. The rates selected were based on the land use description.

See Tables 5.1 and 5.2 for Trip Generation formulae and projections for the Project.

Table 5.1: Trip Generation Rates

Land Use	Independent Variable	AM Peak Hour		PM Peak Hour	
		Trip Rate	% Enter	Trip Rate	% Enter
Single-Family Detached Housing (210)	Dwelling Units (DU)	[a]	25%	[b]	63%

[a] T= 0.7X+4.80
[b] LN(T)= 0.96LN(X)+0.2

Table 5.2: Project-Generated Trips

Land Use	Independent Variable	AM Peak Hour			PM Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Single-Family Detached Housing (210)	235 DU	43	129	172	146	85	231

5.2.2 Trip Distribution and Assignment

Trips generated by the Project were assigned throughout the study area generally based upon existing travel patterns. The traffic generated by the Project was added to the forecast Base Year 2027 traffic volumes to constitute the traffic volumes for Future Year 2027 traffic conditions. Project trips utilizing Kapaa Bypass Road were distributed differently for the scenarios with and without the bypass road extension completion by Year 2027. It was assumed that with the bypass extension and new Hauaala Road connection, volumes along the bypass road would be higher and fewer Project trips would utilize the roadway. However, without the bypass extension and new connection, it was assumed that the bypass would continue to be less congested than Kuhio Highway, and Project trips would favor utilizing the bypass road. Figures 5.1 and 5.4 illustrate the Project-generated trip distributions with and without the bypass road extension, respectively.

5.3 Future Year 2027 Analysis

At full buildout, the Project is projected to generate a total of 172(231) net external trips during the AM(PM) peak hour of traffic. Traffic from the Project is expected to generate growth along major roadways in the study area.

5.3.1 Future Year 2027 With Kapaa Bypass Road Extension

Similar to Base Year 2027, queuing along Kuhio Highway is expected to remain south of the study intersections until the widening of the roadway is completed. However, with Base Year 2027 mitigations, a decrease in queuing is expected in Kapaa town with the extension of the Kapaa Bypass Road and relocation of the Hauaala Road connection. Although queuing is expected to remain due to the high volume of turning movements in the area, queues will likely be reduced due to the diversion of traffic to Kapaa Bypass Road.

The majority of study intersections are forecast to experience increases in delay over Base Year 2027. Intersection movements currently operating at LOS E/F conditions will continue to operate at LOS E/F conditions in Future Year 2027. Below is a description of the intersections with movements that are projected to continue operating at or worsen to LOS E/F during the AM and/or PM peak hours of traffic.

<u>[2] Kuhio Highway/Kealia Road</u>

Because Kuhio Highway/Kealia Road is the only access point to the Project from Kuhio Highway, the intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions during the PM peak hour. Mitigation is proposed in Section 5.4 below.

[4] Kuhio Highway/Kawaihau Road

The eastbound approach is expected to continue operating at LOS F during the AM peak hour. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Because of a lack of feasible alternatives, no mitigation is proposed for this intersection.

[5] Kapaa Bypass Road/Hauaala Road

The southbound approach is expected to continue operating at LOS E during the AM peak hour. Because the approach will continue to operate under capacity as in Base Year 2027 with mitigation conditions, no mitigation is proposed for this intersection.

[6] Kuhio Highway/Kapaa Bypass Road

The eastbound approach is expected to continue operating at or worsen to LOS F during both peak hours of traffic. Although the eastbound approach is expected to experience delays over Base Year 2027 conditions, the proposed refuge lane is anticipated to help minimize delays to the eastbound left-turn movement. Additionally, the approach will continue to operate under capacity, and no mitigation is proposed at this intersection.

[7] Kuhio Highway/Lehua Street

The eastbound approach is expected to continue operating at LOS E during the AM peak hour and worsen to LOS F during the PM peak hour. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. All movements will continue to operate under capacity, and no mitigation is proposed at this intersection.

[8] Kuhio Highway/Niu Street

The eastbound approach is expected to worsen to LOS F during the AM peak hour and continue operating at LOS E during the PM peak hour. As in Base Year 2027 conditions, adequate gaps in traffic are expected due the intersection's proximity to the Kukui Street signal and the minor street movements are expected to continue operating adequately. No mitigation is proposed at this intersection.

[9] Kuhio Highway/Kukui Street

Both minor street approaches are expected to continue operating at LOS F during the AM peak hour of traffic due to a longer green time being allotted to the Kuhio Highway through movements. Because the minor streets will continue to operate under capacity, no mitigation is proposed for this intersection.

Figure 5.2 illustrates the Future Year 2027 forecast traffic volumes and LOS for the study intersection movements. Table 5.3 summarizes the Future Year 2027 LOS at the study intersections compared to Base Year 2027 with mitigation conditions. Both Figure 5.2 and Table 5.3 reflect conditions with the Kapaa Bypass Road extension completed by Year 2027. LOS worksheets are provided in Appendix C.

5.3.2 Future Year 2027 Without Kapaa Bypass Road Extension

Similar to Base Year 2027, queuing along Kuhio Highway within and south of the Project area is expected to remain until congestion relief projects are completed in Kapaa and Wailua. In the Project area, while major through movements are expected to continue allowing other movements to proceed during congested periods to reduce major left-turn and minor movement delay, all movements are expected to experience longer delays over existing conditions.

The majority of study intersections are forecast to experience increases in delay over Base Year 2027. Intersection movements currently operating at LOS E/F conditions will continue to operate at LOS E/F conditions in Future Year 2027. Below is a description of the intersections with movements that are projected to continue operating at or worsen to LOS E/F during the AM and/or PM peak hours of traffic.

<u>[2] Kuhio Highway/Kealia Road</u>

Because Kuhio Highway/Kealia Road is the only access point to the Project from Kuhio Highway, the intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions during the PM peak hour. Mitigation is proposed in Section 5.4 below.

<u>[3] Kuhio Highway/Mailihuna Road</u>

The eastbound approach is expected to worsen to LOS E during the AM peak hour of traffic due to anticipated reroutes of vehicles to this intersection from the congested Kawaihau Road and Hauaala Road. This intersection is expected to continue operating adequately with minimal increases in overall delay. No mitigation is proposed for this intersection.

<u>[4] Kuhio Highway/Kawaihau Road</u>

The eastbound approach is expected to continue operating at LOS F and overcapacity during the AM peak hour and LOS E during the PM peak hour. Similar to Base Year 2027, although a signal may be warranted at this intersection, it may create longer delays. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Additionally, a larger portion of vehicles may use Mailihuna Road to access Kuhio Highway due to the improved conditions at that intersection with the roundabout. No mitigation is proposed for this intersection.

<u>[5] Kuhio Highway/Hauaala Road</u>

The eastbound approach is expected to continue operating at LOS F during both peak hours and at overcapacity during the AM peak hour. Similar to Base Year 2027, although a signal may be warranted at this intersection, it may create longer delays. However, the intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. Additionally, a larger portion of vehicles may use Mailihuna Road to access Kuhio Highway due to the improved conditions at that intersection with the roundabout. No mitigation is proposed for this intersection.

[7] Kuhio Highway/Lehua Street

The eastbound approach is expected to continue operating at LOS F and under capacity during both peak hours of traffic. The intersection is expected to self-regulate as in existing conditions to reduce delay to the eastbound approach. No mitigation is proposed for this intersection.

[8] Kuhio Highway/Niu Street

The minor street approaches are expected to continue operating at or worsen to LOS E(F) during both peak hours of traffic. As in Base Year 2027 conditions, adequate gaps in traffic are expected due the intersection's proximity to the Kukui Street signal, and the minor street movements are expected to continue operating adequately. No mitigation is proposed at this intersection.

[9] Kuhio Highway/Kukui Street

The northbound shared through/right-turn movement will continue operating at overcapacity during both peak hours of traffic with increases in delay. Additionally, both minor street approaches are expected to continue operating at LOS E or F during both peak hours of traffic. Because there is limited ROW to improve capacity along Kuhio Highway and the minor streets will continue to operate under capacity, no mitigation is proposed for this intersection.

Figure 5.5 illustrates the Future Year 2027 forecast traffic volumes and LOS for the study intersection movements. Table 5.4 summarizes the Future Year 2027 LOS at the study intersections compared to Base Year 2027 conditions. Both Figure 5.5 and Table 5.4 reflect conditions without the Kapaa Bypass Road extension. LOS worksheets are provided in Appendix C.

5.4 Future Year 2027 With Mitigation Intersection Analysis

Similar to Base Year 2027 conditions, traffic signals may be warranted at the intersection of Kuhio Highway with Kawaihau Road and Hauaala Road. However, for similar reasons described in section 4.5.2, signals were not assumed.

For both the with Kapaa Bypass Road extension and without Kapaa Bypass Road extension scenarios, the following mitigations were considered at the Kuhio Highway/Kealia Road intersection to improve traffic operations.

- Construct a roundabout: Based on currently planned improvements at the Kuhio Highway/Mailihuna Road intersection, it was assumed that a roundabout would be a viable mitigation for Kuhio Highway/Kealia Road. A roundabout would reduce delay for the minor street movements entering Kuhio Highway by providing yield-controls on all intersection approaches as well as reducing the speed along the highway. However, a roundabout at this location may be problematic from a design standpoint due to the skew of the intersection.

- Install a traffic signal: A traffic signal was also considered at the Kuhio Highway/Kealia Road intersection to improve operations along Kealia Road. Based on projections for Future Year 2027 and the Four-Hour Vehicular Volume signal warrant condition (Warrant 2) in the Manual on Uniform Traffic Control Devices (MUTCD), Federal Highway Administration, dated 2009, a signal will likely be warranted at this intersection with the Project. Although a signal would slow through progression along Kuhio Highway when vehicles actuate the signal along Kealia Road, the signal would be designed to provide Kuhio Highway with the majority of green time. Additionally, because the Kuhio Highway/Kealia Road intersection is relatively isolated, queuing at the signal is not expected to affect traffic operations in the area.

Based on the above considerations, it was assumed that a traffic signal would be the preferred alternative to improve traffic operations for Kealia Road and minimize negative impacts to traffic operations along Kuhio Highway. Mitigation measures required as part of the traffic signal are as follows.

[2] Kuhio Highway/Kealia Road

- Install a traffic signal when warranted.
- Provide a right-turn onto Kealia Road.
- Relocate the existing bus stop/bus bay to south of the intersection.

Figure 3.7 shows the existing intersection configuration at Kuhio Highway/Kealia Road and the proposed mitigation.

With the proposed mitigation, both the eastbound and westbound approaches will operate at LOS C during both peak hours of traffic. Additionally, the intersection will operate with overall LOS B during both peak hours.

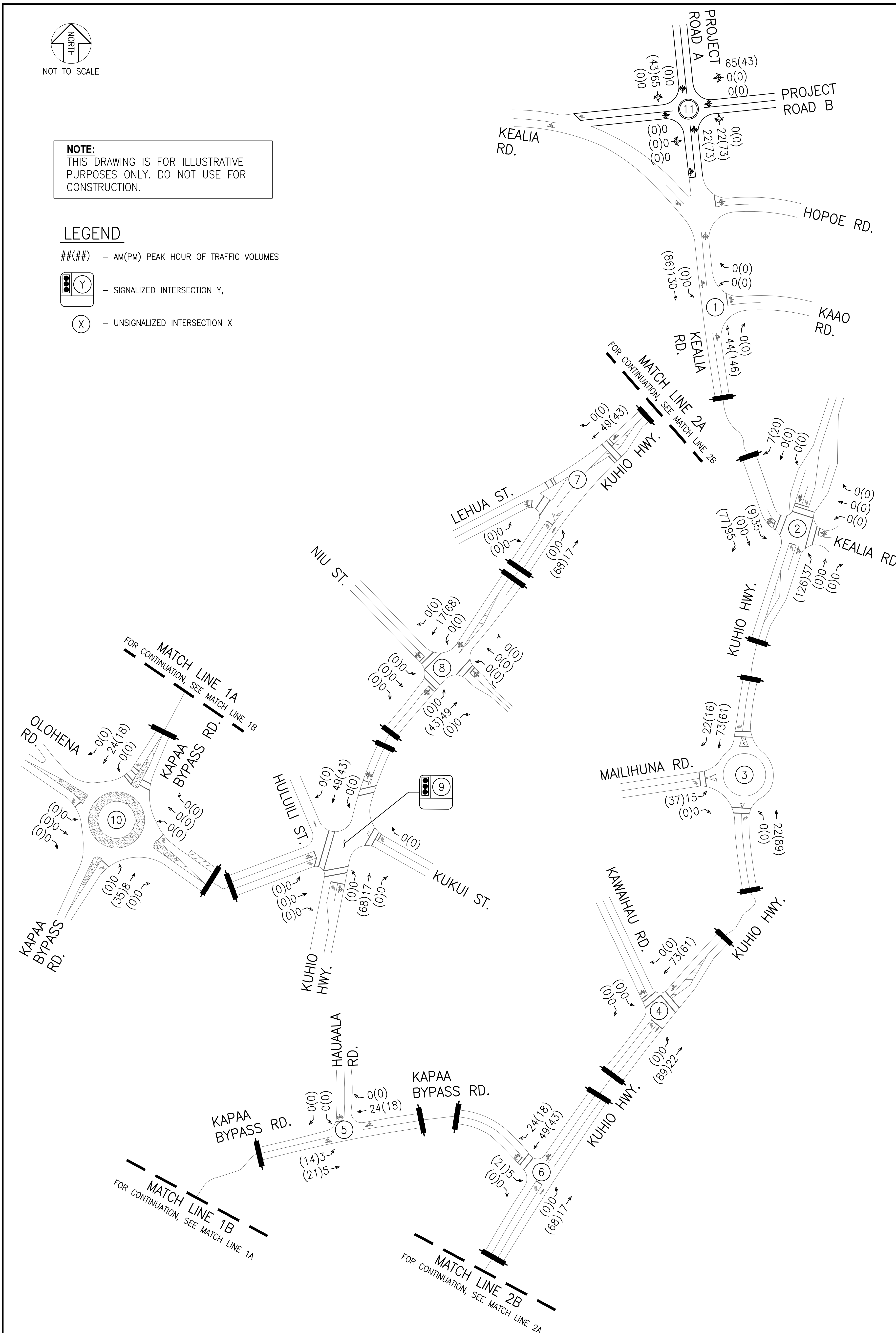
Figures 5.3 and 5.6 illustrate the Future Year 2027 with mitigation forecast traffic volumes and LOS for the study intersection movements. Tables 5.3 and 5.4 summarize the Future Year 2027 with mitigation LOS at the study intersections compared to Future Year 2027 without mitigation. Figure 5.3 and Table 5.3 reflect conditions with the Kapaa Bypass Road extension and Figure 5.6 and Table 5.4 reflect conditions without the Kapaa Bypass Road extension. LOS worksheets are provided in Appendix C.

5.5 Future Year 2027 Sustainable Transportation

The Project proposes to construct improvements to the eastbound approach of Kealia Road, including the addition of a sidewalk providing access between the Project and Kuhio Highway. Further, the recommended installation of a traffic signal at the Kuhio Highway/Kealia Road intersection will provide signalized crossings along the southbound, eastbound and westbound approaches. The existing bus stops at the intersection will continue to be provided, however, the existing bus bay for the southbound approach of Kuhio Highway will be relocated just south of the intersection.

With the proposed and recommended improvements, pedestrians and bicyclists will be able to access bus stops and the Ke Ala Hele Makalae Multi-Use Path, which will allow them to travel further north and south. As discussed in Section 3.2, pedestrians and cyclists were observed to favor the multi-use path over travel along the highway. Pedestrians and cyclists will also be able to access residential areas and schools from the multi-use path via the Kawaihau Road spur or via the Mailihuna Road connection proposed with the construction of the roundabout.

No additional improvements to pedestrian and bicycle facilities are recommended for Future Year 2027.



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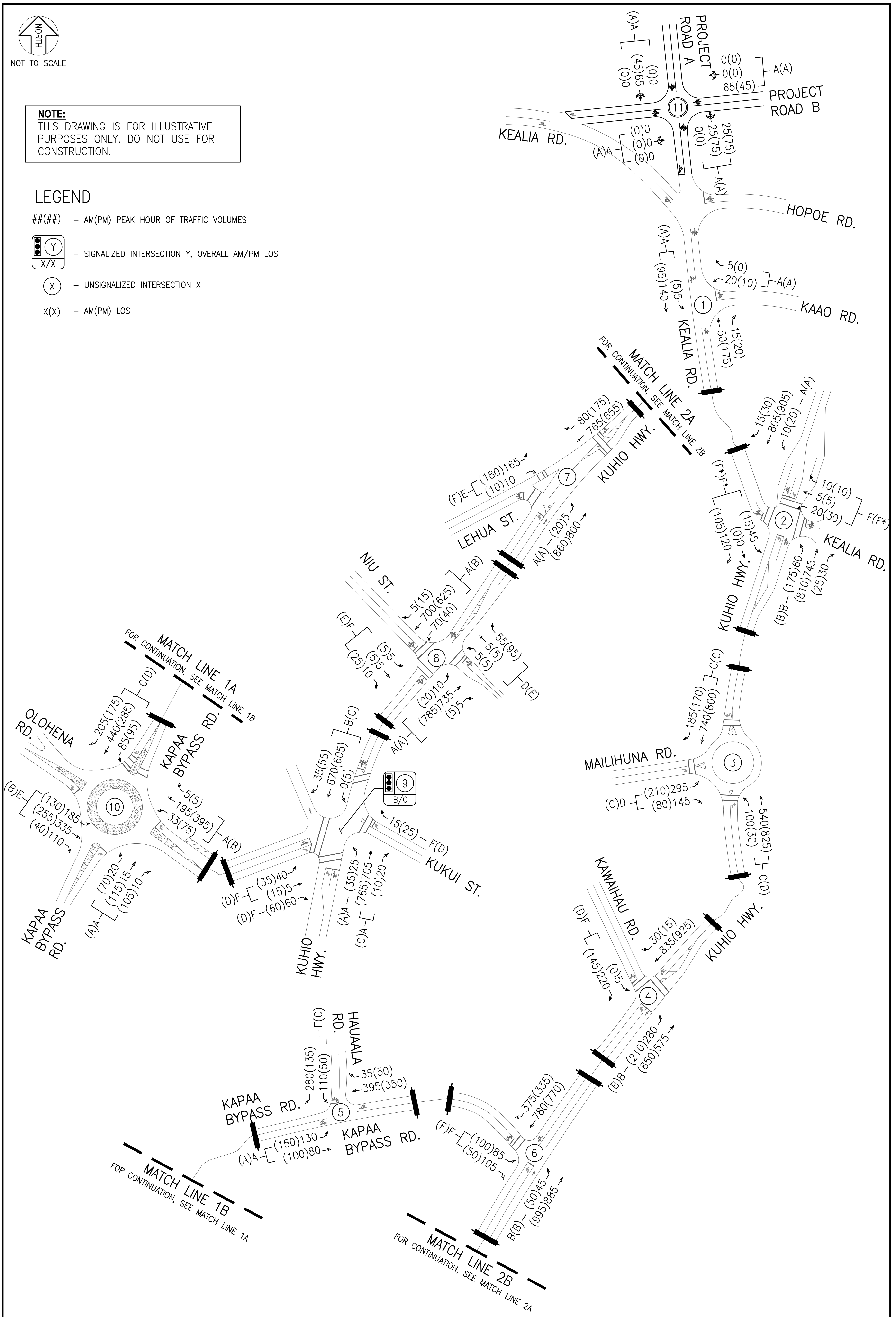
YEAR 2027 PROJECT-GENERATED TRAFFIC
(WITH KAPAA BYPASS ROAD EXTENSION)

FIGURE
5.1



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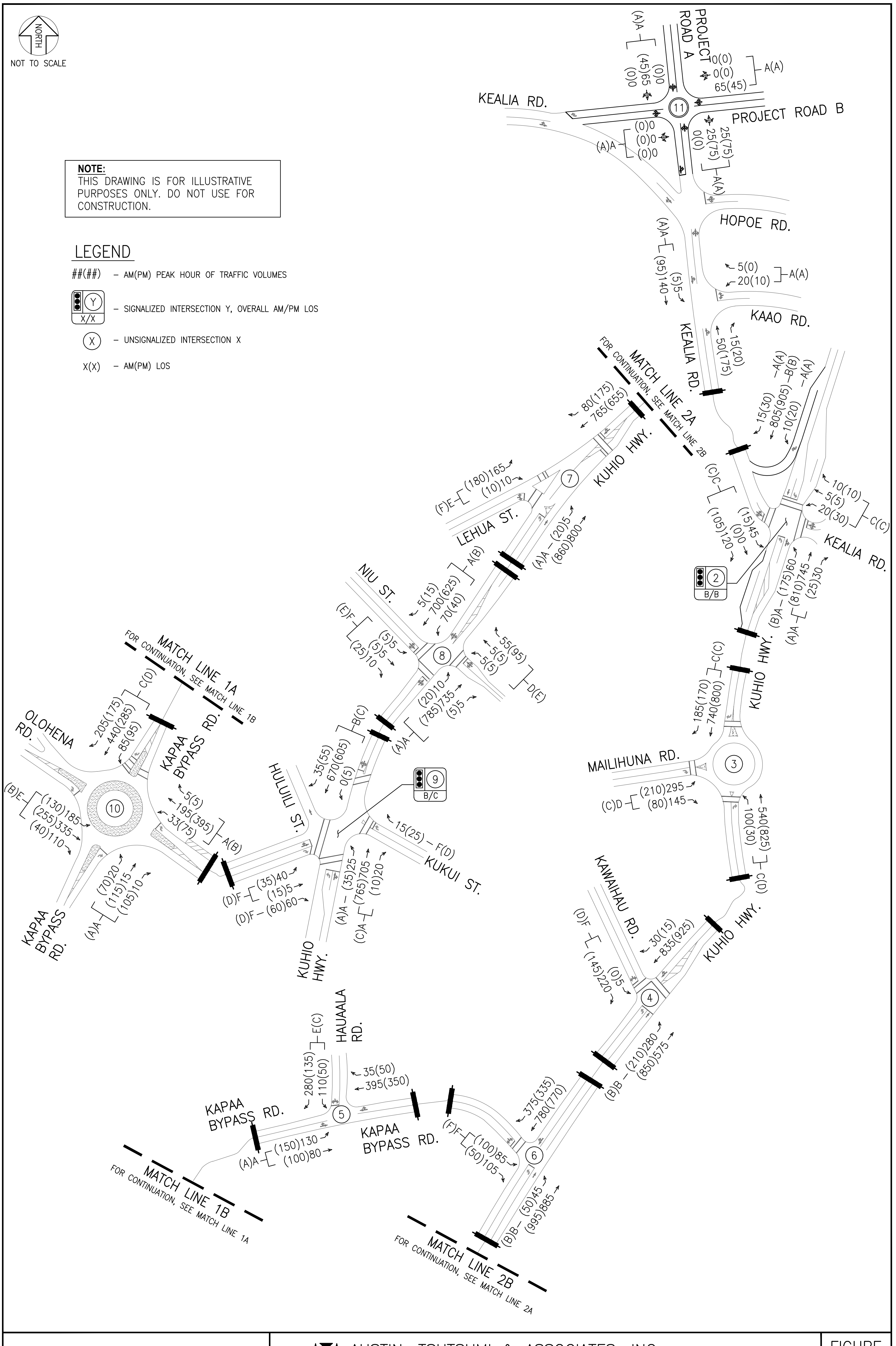
FUTURE YEAR 2027 LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS (WITH KAPAA BYPASS ROAD EXTENSION)

FIGURE 5.2



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FUTURE YEAR 2027 WITH MITIGATION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS (WITH KAPAA BYPASS ROAD EXTENSION)

FIGURE 5.3

Table 5.3: Base Year 2027 with Mitigation, Future Year 2027 and Future Year 2027 with Mitigation Level of Service Summary (With Kapaa Bypass Extension)

Intersection	Base Year 2027 with Mitigation (With Kapaa Bypass Extension)						Future Year 2027 (With Kapaa Bypass Extension)						Future Year 2027 with Mitigation (With Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Kealia Rd & Kaao Rd																		
WB LT/RT	9	0.03	A	9	0.01	A	10	0.03	A	10	0.02	B	**Same as Future Year 2027**					
SB LT/TH	7	0.00	A	7	0.00	A	7	0.00	A	8	0.00	A						
Overall	4	-	-	2	-	-	1	-	-	1	-	-						
2: Kuhio Hwy & Kealia Rd																		
NB LT	10	0.03	A	11	0.08	B	10	0.09	B	12	0.28	B	9	0.17	A	14	0.53	B
NB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	8	0.72	A	8	0.73	A
EB LT/TH/RT	40	0.27	E	40	0.27	E	305	1.45	F*	315	1.40	F*	26	0.57	C	29	0.53	C
WB LT/TH/RT	89	0.49	F	316	1.11	F*	237	0.87	F	1535	3.26	F*	22	0.11	C	26	0.17	C
SB LT	10	0.01	A	10	0.03	A	10	0.01	A	10	0.03	A	7	0.03	A	6	0.06	A
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	13	0.83	B	12	0.85	B
SB RT	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	A	5	0.03	A
Overall	3	-	-	9	-	-	32	-	-	51	-	-	12	-	B	11	-	B
3: Kuhio Hwy & Mailihuna Rd																		
NB LT/TH	14	0.68	B	16	0.75	C	16	0.72	C	25	0.87	D						
EB LT/RT	23	0.73	C	14	0.47	B	32	0.82	D	18	0.58	C	**Same as Future Year 2027**					
SB TH/RT	15	0.75	C	14	0.74	B	20	0.83	C	17	0.81	C						
Overall	17	-	C	15	-	B	21	-	C	21	-	C						
4: Kuhio Hwy & Kawaihau Rd																		
NB LT	13	0.40	B	13	0.32	B	14	0.42	B	13	0.34	B	**Same as Future Year 2027**					
EB LT/RT	55	0.82	F	28	0.51	D	81	0.93	F	32	0.55	D						
Overall	9	-	-	3	-	-	11	-	-	4	-	-						
5: Kapaa Bypass Rd & Hauaala Rd																		
EB LT/TH	9	0.12	A	9	0.13	A	9	0.13	A	9	0.15	A	**Same as Future Year 2027**					
SB LT/RT	42	0.86	E	17	0.39	C	50	0.90	E	18	0.42	C						
Overall	17	-	-	5	-	-	20	-	-	6	-	-						
6: Kuhio Hwy & Kapaa Bypass Rd																		
NB LT	12	0.08	B	11	0.09	B	12	0.09	B	12	0.09	B	**Same as Future Year 2027**					
EB LT/RT	58	0.80	F	42	0.61	E	76	0.88	F	67	0.79	F						
Overall	5	-	-	3	-	-	7	-	-	5	-	-						
7: Kuhio Hwy & Lehua St																		
NB LT	10	0.01	A	10	0.03	A	10	0.01	A	10	0.03	A	**Same as Future Year 2027**					
EB LT/RT	36	0.64	E	44	0.72	E	40	0.67	E	53	0.78	F						
Overall	4	-	-	5	-	-	4	-	-	5	-	-						
8: Kuhio Hwy & Niu St																		
NB LT/TH/RT	9	0.01	A	9	0.03	A	9	0.01	A	9	0.03	A						
EB LT/TH/RT	50	0.21	E	35	0.24	E	57	0.24	F	44	0.30	E	**Same as Future Year 2027**					
WB LT/TH/RT	30	0.33	D	30	0.44	D	33	0.35	D	36	0.51	E						
SB LT/TH/RT	10	0.09	A	10	0.06	A	10	0.10	A	10	0.06	B						
Overall	2	-	-	3	-	-	3	-	-	4	-	-						

Table 5.3: Base Year 2027 with Mitigation, Future Year 2027 and Future Year 2027 with Mitigation Level of Service Summary (With Kapaa Bypass Extension) Cont'd

Intersection	Base Year 2027 with Mitigation (With Kapaa Bypass Extension)						Future Year 2027 (With Kapaa Bypass Extension)						Future Year 2027 with Mitigation (With Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
9: Kuhio Hwy & Kukui St**																		
NB LT	2	0.04	A	4	0.07	A	3	0.05	A	4	0.07	A	**Same as Future Year 2027**					
NB TH/RT	8	0.74	A	17	0.83	B	9	0.75	A	25	0.92	C						
EB LT/TH	96	0.41	F	46	0.22	D	96	0.41	F	46	0.22	D						
EB RT	92	0.04	F	44	0.05	D	92	0.04	F	44	0.05	D						
WB RT	91	0.01	F	44	0.02	D	91	0.01	F	44	0.02	D						
SB LT/TH/RT	11	0.72	B	20	0.81	B	12	0.77	B	25	0.87	C						
Overall	16	-	B	20	-	C	17	-	B	26	-	C						
10: Kapaa Bypass Rd/Cane Haul Rd & Olohena Rd																		
NB LT/TH/RT	6	0.06	A	9	0.35	A	6	0.07	A	10	0.40	A	**Same as Future Year 2027**					
EB LT/TH/RT	41	0.93	E	13	0.56	B	47	0.95	E	13	0.57	B						
WB LT/TH/RT	6	0.24	A	10	0.52	B	6	0.24	A	11	0.55	B						
SB LT/TH/RT	17	0.75	C	25	0.80	D	19	0.78	C	27	0.82	D						
Overall	25	-	C	16	-	C	27	-	D	17	-	C						
11: Project Road A & Project Road B																		
NB LT/TH/RT							3	0.05	A	4	0.13	A	**Same as Future Year 2027**					
EB LT/TH/RT							3	0.01	A	3	0.01	A						
WB LT/TH/RT							3	0.06	A	3	0.05	A						
SB LT/TH/RT							3	0.07	A	3	0.05	A						
Overall							3	-	A	4	-	A						

* Denotes overcapacity condition, v/c ≥ 1.
** Intersection analyzed using HCM 2000 methodology due to HCM 6th Edition methodology currently not supporting signalized intersections with a stop-controlled, right-turn only approach.

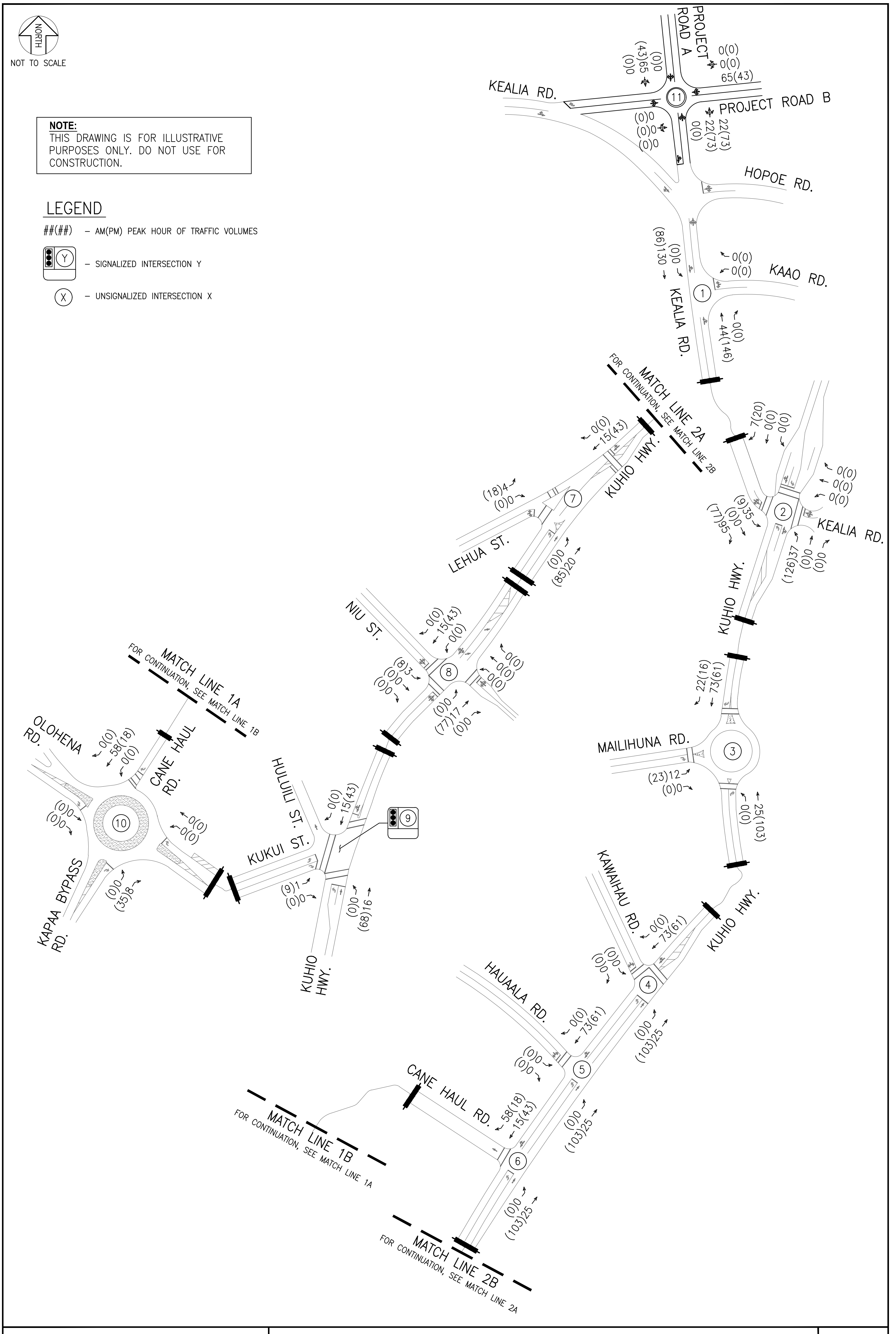

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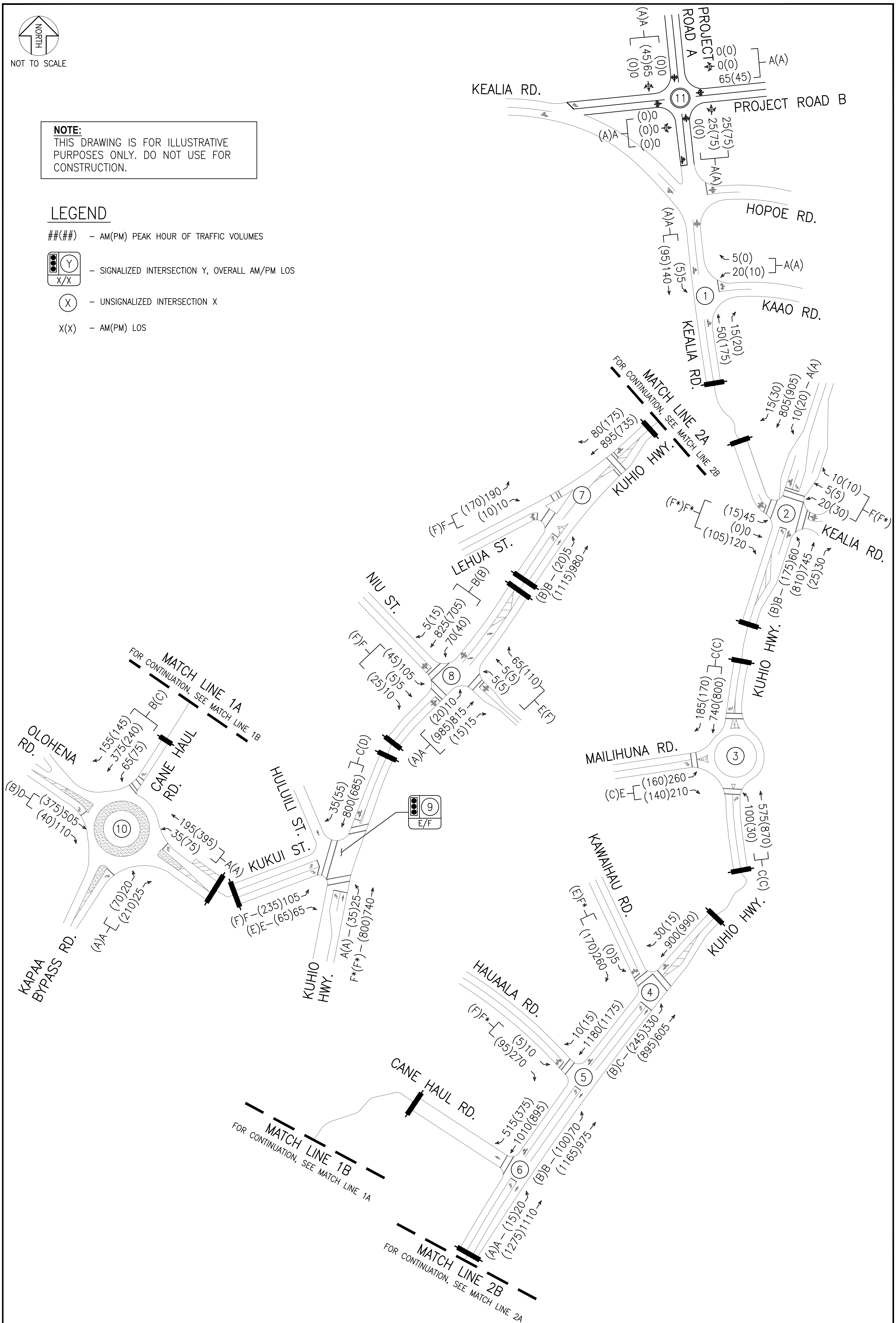
FIGURE 5.4

YEAR 2027 PROJECT-GENERATED TRAFFIC
(WITHOUT KAPAA BYPASS ROAD EXTENSION)



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FUTURE YEAR 2027 LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS (WITHOUT KAPAA BYPASS ROAD EXTENSION)

FIGURE 5.5

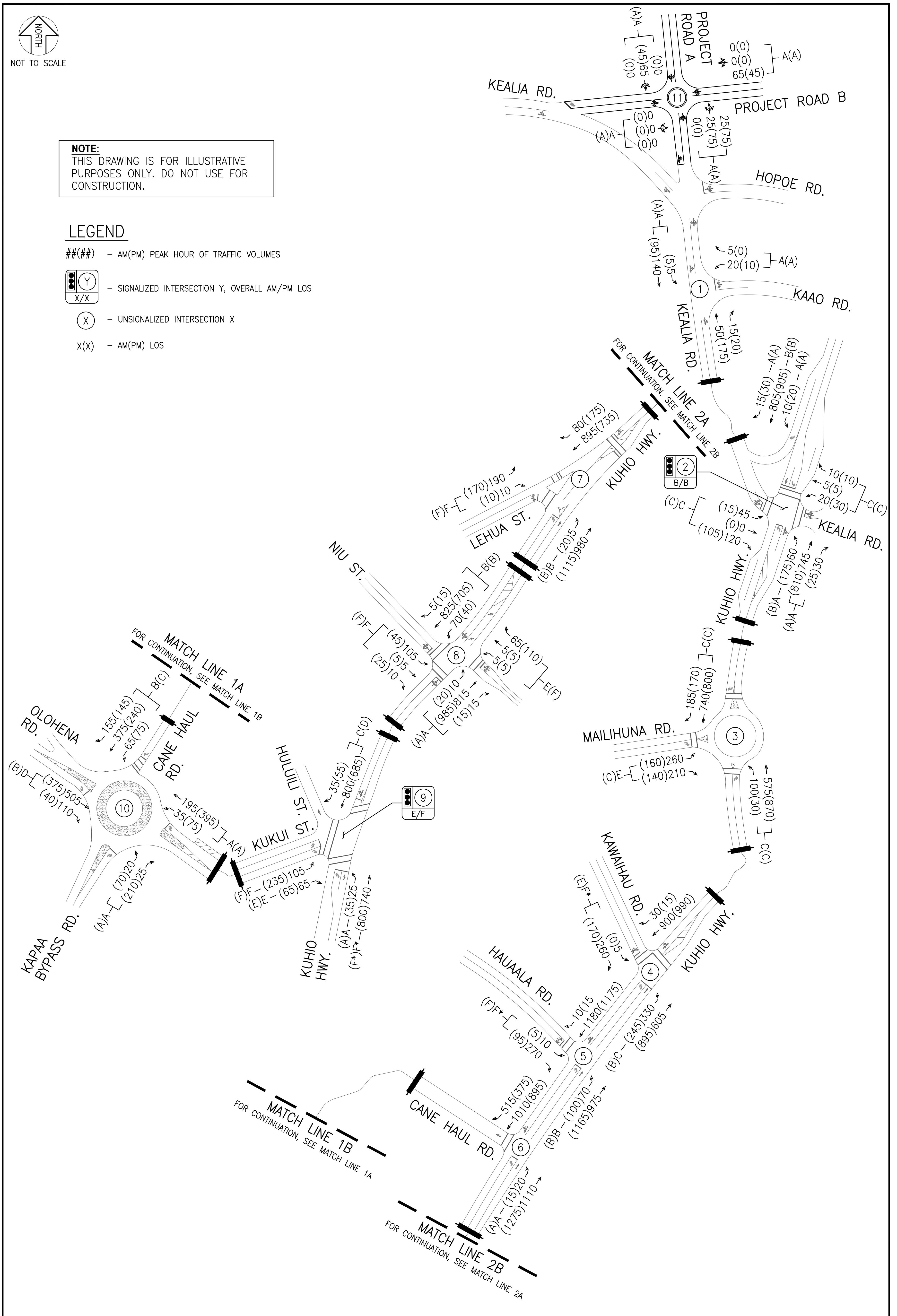

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FIGURE 5.6

FUTURE YEAR 2027 WITH MITIGATION LANE CONFIGURATION, VOLUMES AND MOVEMENT LOS - (WITHOUT KAPAA BYPASS ROAD EXTENSION)

Table 5.4: Base Year 2027, Future Year 2027 and Future Year 2027 with Mitigation Level of Service Summary (Without Kapaa Bypass Extension)

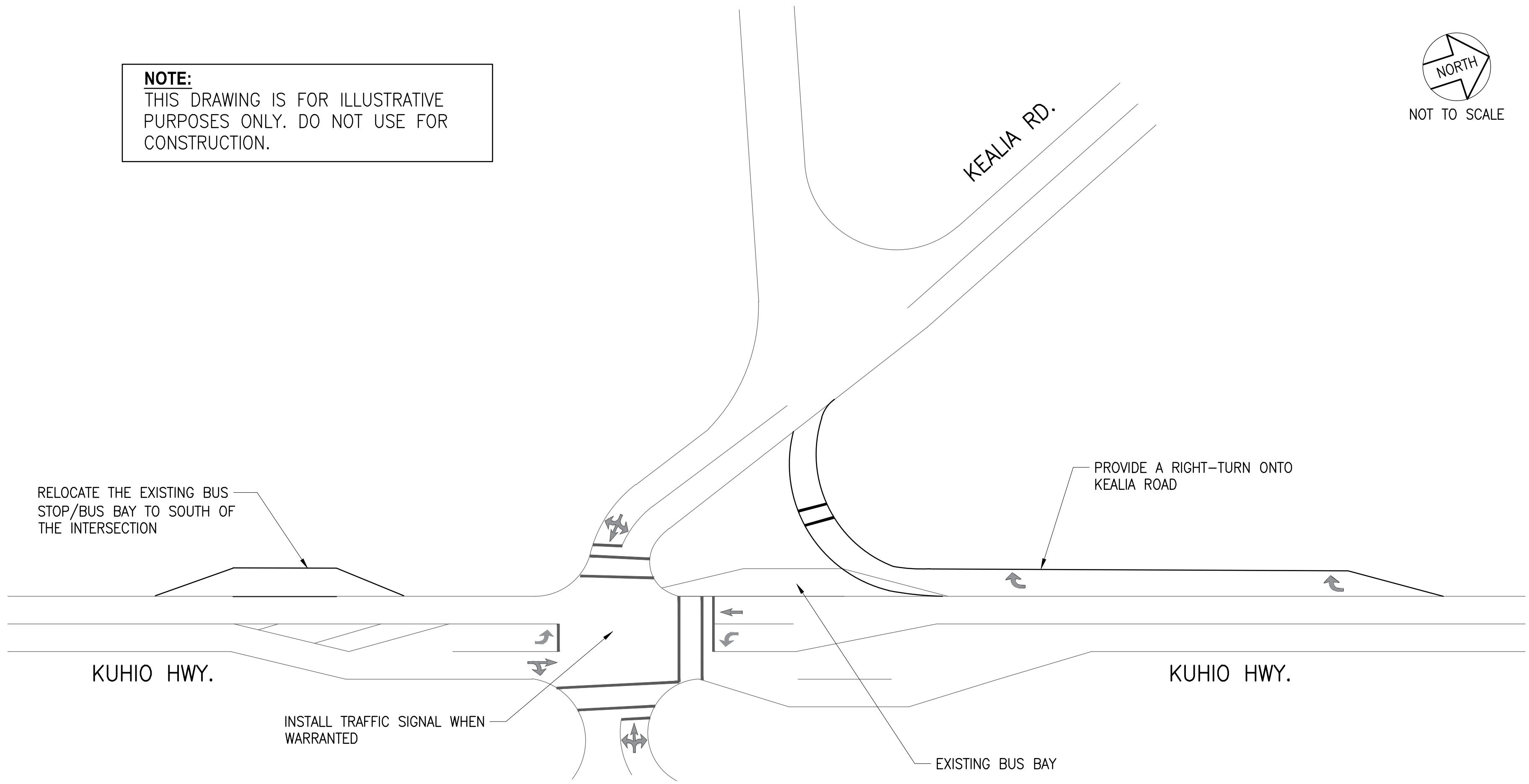
	Base Year 2027 with Mitigation (Without Kapaa Bypass Extension)						Future Year 2027 (Without Kapaa Bypass Extension)						Future Year 2027 with Mitigation (Without Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM		
Intersection	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1: Kealia Rd & Kaao Rd																		
WB LT/RT	9	0.03	A	9	0.01	A	10	0.03	A	10	0.02	B	**Same as Future Year 2027**					
SB LT/TH	7	0.00	A	7	0.00	A	7	0.00	A	8	0.00	A						
Overall	4	-	-	2	-	-	1	-	-	1	-	-						
2: Kuhio Hwy & Kealia Rd																		
NB LT	10	0.03	A	11	0.08	B	10	0.09	B	12	0.28	B	9	0.17	A	14	0.53	B
NB TH/RT	-	-	-	-	-	-	-	-	-	-	-	-	8	0.72	A	8	0.73	A
EB LT/TH/RT	40	0.27	E	40	0.27	E	305	1.45	F*	315	1.40	F*	26	0.57	C	29	0.53	C
WB LT/TH/RT	89	0.49	F	316	1.11	F*	237	0.87	F	1535	3.26	F*	22	0.11	C	26	0.17	C
SB LT	10	0.01	A	10	0.03	A	10	0.01	A	10	0.03	A	7	0.03	A	6	0.06	A
SB TH	-	-	-	-	-	-	-	-	-	-	-	-	13	0.83	B	12	0.85	B
SB RT	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	A	5	0.03	A
Overall	3	-	-	9	-	-	32	-	-	51	-	-	12	-	B	11	-	B
3: Kuhio Hwy & Mailihuna Rd																		
NB LT/TH	15	0.69	B	16	0.75	C	16	0.73	C	24	0.87	C	**Same as Future Year 2027**					
EB LT/RT	28	0.79	D	15	0.52	C	39	0.87	E	19	0.60	C						
SB TH/RT	15	0.75	C	14	0.74	B	20	0.83	C	17	0.81	C						
Overall	18	-	C	15	-	B	23	-	C	20	-	C						
4: Kuhio Hwy & Kawaihau Rd																		
NB LT	15	0.50	B	14	0.40	B	16	0.53	C	15	0.42	B	**Same as Future Year 2027**					
EB LT/RT	135	1.12	F*	39	0.65	E	201	1.29	F*	47	0.71	E						
Overall	20	-	-	5	-	-	28	-	-	5	-	-						
5: Kuhio Hwy & Hauaala Rd																		
NB LT	12	0.13	B	13	0.19	B	13	0.14	B	14	0.21	B	**Same as Future Year 2027**					
EB LT/RT	323	1.57	F*	67	0.69	F	415	1.77	F*	129	0.91	F						
Overall	38	-	-	5	-	-	47	-	-	8	-	-						
6: Kuhio Hwy & Cane Haul Rd**																		
NB LT/TH	2	0.05	A	1	0.03	A	2	0.06	A	1	0.03	A	**Same as Future Year 2027**					
Overall	0	0.84	E	0	0.70	C	0	0.88	E	0	0.73	D						
7: Kuhio Hwy & Lehua St																		
NB LT	11	0.01	B	10	0.03	B	11	0.01	B	10	0.03	B	**Same as Future Year 2027**					
EB LT/RT	89	0.94	F	90	0.94	F	92	0.95	F	101	0.96	F						
Overall	9	-	-	9	-	-	9	-	-	8	-	-						
8: Kuhio Hwy & Niu St																		
NB LT/TH/RT	10	0.02	A	10	0.03	A	10	0.02	A	10	0.03	A	**Same as Future Year 2027**					
EB LT/TH/RT	120	0.95	F	129	0.95	F	130	0.96	F	161	0.93	F						
WB LT/TH/RT	41	0.45	E	44	0.60	E	47	0.50	E	83	0.81	F						
SB LT/TH/RT	10	0.10	B	11	0.06	B	11	0.10	B	11	0.07	B						
Overall	10	-	-	11	-	-	10	-	-	12	-	-						

Table 5.4: Base Year 2027, Future Year 2027 and Future Year 2027 with Mitigation Level of Service Summary (Without Kapaa Bypass Extension) Cont'd

Intersection	Base Year 2027 with Mitigation (Without Kapaa Bypass Extension)						Future Year 2027 (Without Kapaa Bypass Extension)						Future Year 2027 with Mitigation (Without Kapaa Bypass Extension)					
	AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
9: Kuhio Hwy & Kukui St**																		
NB LT	4	0.06	A	5	0.07	A	5	0.06	A	10	0.09	A						
NB TH	87	1.13	F*	83	1.11	F*	103	1.17	F*	208	1.39	F*						
EB LT	88	0.62	F	112	0.87	F	92	0.70	F	125	0.94	F	**Same as Future Year 2027**					
EB RT	76	0.05	E	71	0.06	E	74	0.05	E	72	0.08	E						
SB TH/RT	28	0.93	C	21	0.83	C	34	0.96	C	42	0.94	D						
Overall	57	-	E	58	-	E	67	-	E	124	-	F						
10: Kapaa Bypass Rd/Cane Haul Rd & Olohena Rd																		
NB LT/RT	6	0.06	A	8	0.33	A	6	0.07	A	9	0.38	A						
EB TH/RT	22	0.79	C	11	0.51	B	28	0.85	D	11	0.52	B	**Same as Future Year 2027**					
WB LT/TH	4	0.19	A	7	0.41	A	4	0.19	A	7	0.41	A						
SB LT/TH/RT	11	0.57	B	17	0.65	C	13	0.63	B	18	0.68	C						
Overall	15	-	B	11	-	B	18	-	C	12	-	B						
10: Kapaa Bypass Rd/Cane Haul Rd & Olohena Rd																		
NB LT/TH/RT							3	0.04	A	4	0.12	A						
EB LT/TH/RT							3	0.00	A	3	0.00	A	**Same as Future Year 2027**					
WB LT/TH/RT							3	0.05	A	3	0.04	A						
SB LT/TH/RT							3	0.06	A	3	0.04	A						
Overall							3	-	A	4	-	A						

* Denotes overcapacity condition, v/c ≥ 1.

** Intersection analyzed using HCM 2000 methodology due to HCM 6th Edition methodology currently not supporting signalized intersections with a stop-controlled, right-turn only approach or unsignalized intersections without at least one stop-controlled approach.



KEALIA MAUKA HOMESITES TIAR

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS • HONOLULU,HAWAII

KUHIO HIGHWAY AND KEALIA ROAD MITIGATION

FIGURE 5.7

6. CONCLUSIONS

The Project proposes to develop 235 single-family dwellings in the Kealia area. Access to the Project will be provided via Kealia Road from Kuhio Highway. The Project will construct a new four-way, one-lane roundabout north of the Kealia Road/Hopoe Road intersection to connect Kealia Road to the Project site. Both the southern and western approaches of the roundabout will have connections to Kealia Road. Although there is currently a direct access to Kuhio Highway along the Makai side of the Project site, this access will be fully removed during Project construction. Construction and occupancy of homes in the proposed subdivision is anticipated in 2027.

At full buildout, the Project is projected to generate a total of 172(231) net external trips during the AM(PM) peak hour of traffic.

6.1 Existing Conditions

Kuhio Highway serves as the main thoroughfare for regional traffic in East Kauai. On Monday through Saturday from 7:00 AM to 1:30 PM, Kuhio Highway is contraflowed to provide two (2) southbound lanes and one (1) northbound lane from the Kapaa Bypass south junction to Kapule Highway to serve heavier southbound volumes.

During the AM and PM peak hours of traffic, volumes along Kuhio Highway are generally balanced in both the northbound and southbound directions. During the AM peak hour, southbound traffic is generally higher. However, with approximately one-third of the AM southbound traffic utilizing Kapaa Bypass Road, the traffic volumes along Kuhio Highway are generally balanced during both the AM and PM peaks.

Within the region, queuing along southbound Kuhio Highway was observed to occur during the PM peak hour when contraflow operations were not in place. The queues generally extended approximately 1.25 miles from Kuamoo Road to near Kamoa Road. Occasionally, queues were observed to also form along southbound Kapaa Bypass Road during the PM peak hour. These queues extended approximately 0.4 miles from Kuhio Highway to Pouli Road.

Within Kapaa Town, queuing was observed during both the AM and PM peak hours of traffic. Queues began near the Kuhio Highway/Kawaihau Road intersection and extended in both the northbound and southbound directions. During both peak hours, southbound queues extended to Fire Station 8 (approximately 0.5 miles), and northbound queues extended to Kukui Street (approximately 0.55 miles). Queuing during the AM peak hour was mainly the result of traffic from the nearby Kapaa High School and Kapaa Elementary School.

Several of the study intersections movements operate at LOS F and/or overcapacity during the peak hours of traffic. Eastbound turning movements at Kuhio Highway/Mailihuna Road, Kuhio Highway/Kawaihau Road, Kuhio Highway/Hauaala Road and Kuhio Highway/Lehua Street as well as the eastbound approach of the Kapaa Bypass Road/Cane Haul Road/Olohena Road roundabout experienced lengthy delays due to high turning volumes.

6.2 Base Year 2027

It is anticipated that by Year 2027, traffic will have increased over existing conditions due to various anticipated new developments in the region shown in Figure 4.1. In addition to background development traffic, a 1% annual growth rate was applied to Kuhio Highway, Cane

Haul Road and Olohena Road and a 2% annual growth rate was applied to Kukui Street. By Year 2027, it is assumed that a roundabout will be constructed at Kuhio Highway/Mailihuna Road as shown in Figure 4.2.

It is anticipated that by Base Year 2027, traffic along Kuhio Highway will have increased over existing conditions due to the development in the surrounding regions. Actual growth within the study region may vary based upon the approval process of the various projects.

Peak hour queuing along Kuhio Highway is expected to operate similarly to existing conditions. Although not expected to be completed by Year 2027, the planned widening of Kuhio Highway from Kapaa Bypass Road to Kuamoo Road would reduce queues along Kuhio Highway south of the study intersections. Queuing along Kuhio Highway near Kawaihau Road is expected to remain in Base Year 2027.

Because of continued queuing along Kuhio Highway in Kapaa Town, the northbound through/right-turn movement at the Kuhio Highway/Kukui Street intersection is expected to operate at overcapacity conditions. The overcapacity conditions are expected to result from the increase in traffic volumes and slow northbound progression through Kapaa.

Many minor street movements are expected to experience increases in delay due to the increase in traffic along Kuhio Highway. However, the Kuhio Highway/Mailihuna Rd intersection is expected to operate with all movements at LOS C or better with the construction of the planned roundabout. Note that this LOS reflects conditions where drivers are accustomed to the movements through the roundabout. Initial traffic operations at the roundabout may result in longer delays as drivers become familiar with the maneuvers. Additionally, operations at the Kapaa Bypass Road/Cane Haul Road/Olohena Road roundabout are also expected to improve with the diversion of a portion of traffic through the proposed Hokua Place development.

Eastbound turning movements at Kuhio Highway/Kawaihau Road, Kuhio Highway/Hauaala Road and Kuhio Highway/Lehua Street will continue to experience lengthy delays due to high turning volumes.

6.3 Base Year 2027 With Mitigation

In order to improve Base Year 2027 traffic operations at the study intersections, the Kapaa Bypass Road extension and the relocation of the Hauaala Road connection are the preferred mitigations. Although the Kapaa Bypass Road extension is currently planned by HDOT, the project is not expected to be completed by Year 2027. Base Year 2027 mitigations are proposed for scenarios with and without the bypass extension included.

6.3.1 Base Year 2027 With Mitigation With Kapaa Bypass Road Extension

Kapaa Bypass Road Extension

The Kapaa Bypass Road extension from Olohena Road to Kuhio Highway would add a northbound lane to the existing one-way Cane Haul Road. With the extension, vehicles will be able to head farther north on the bypass road, and the left-turns from Lehua Street onto Kuhio Highway are expected to decrease. The extension has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report and has been acknowledged as a planned improvement by HDOT. With the extension, improvements will also be completed at the northern terminus. However, these improvements are currently not identified.

Hauaala Road Connection

With the Kapaa Bypass Road extension, the existing Hauaala Road connection to Kuhio Highway can be eliminated and replaced with a new connection from Hauaala Road to the Kapaa Bypass Road. Moving the Hauaala Road connection is expected to relieve congestion in the vicinity of the existing Kuhio Highway/Hauaala Road intersection by reducing the number of conflicting turning movements and providing a longer northbound left-turn pocket at the nearby Kuhio Highway/Kawaihau Road intersection. It was assumed that the proposed Kapaa Bypass Road/Hauaala Road intersection will have a stop-controlled left-/right-turn movement on Hauaala Road and shared eastbound left-turn/through and westbound through/right-turn movements on Kapaa Bypass Road. Relocating the Hauaala Road connection has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report.

With the above mitigations, traffic operations at Kuhio Highway/Kawaihau Road and Kuhio Highway/Lehua Street are expected to improve due to a decrease in turning movements. The new Kapaa Bypass Road/Hauaala Road and Kuhio Highway/Kapaa Bypass Road intersections are expected to operate with minor street movements at LOS E or F. However, all movements will operate under capacity and are anticipated to operate adequately.

6.3.2 Base Year 2027 With Mitigation Without Kapaa Bypass Road Extension

Although a traffic signal is warranted at Kuhio Highway/Lehua Street, a signal may not yield any significant benefits because of existing northbound queues along Kuhio Highway and because vehicles currently allow major street left-turns and minor street movements to proceed during congested periods and adequate gaps in traffic were observed during non-peak hours. Other improvements from the Kapaa Transportation Solutions report may be more appropriate:

- Closing the east leg of Kukui Street to allocate more green time to movements on Kuhio Highway.
- Improving the Kuhio Highway/Niu Street intersection to alleviate congestion at the Kuhio Highway/Lehua Street intersection.

Although not specified in the Kapaa Transportation Solutions report, improving the Kuhio Highway/Niu Street intersection likely consists of providing, similar to the Lehua Street intersection, a northbound refuge lane for eastbound left-turns.

By year 2027 signals may be warranted at the intersections of Kuhio Highway with Kawaihau Road and Hauaala Road. Analysis of traffic signals at these intersections would not provide accurate results as the analysis doesn't take into account the close proximity of the intersections. Based on observations, with a traffic signal, queues are expected to lengthen in the northbound direction due to the delays caused by a signal, the short northbound storage length and the fact that vehicles along Kuhio Highway would be less likely to yield to the minor movements when a signal is installed. Currently, without a signal, vehicles in the southbound through yield to the eastbound approach at a rate of approximately one (1) to two (2) eastbound vehicles to four (4) southbound through; therefore, it is anticipated that this type of behavior would continue. Furthermore, improvements at the Kuhio Highway/Mailihuna Road intersection may provide some relief at the Kawaihau Road and Hauaala Road intersections. Additionally, community input may be a factor in determining the viability of the improvement.

With the above mitigations, a portion of vehicles currently accessing Kuhio Highway via the Kuhio Highway/Lehua Street intersection are expected to access the highway at either Kuhio Highway/Niu Street or Kuhio Highway/Kukui Street in order to minimize delays. Although the eastbound approaches of all three (3) intersections are expected to operate at LOS F, all will operate at under capacity conditions. The northbound through/right-turn movement at Kuhio Highway/Kukui Street is expected to continue operating at overcapacity conditions.

6.4 Future Year 2027

At full buildout, the Project is projected to generate a total of 172(231) net external trips during the AM(PM) peak hour of traffic. Traffic from the Project is expected to generate growth along major roadways in the study area.

6.4.1 Future Year 2027 With Kapaa Bypass Road Extension

Similar to Base Year 2027, queuing along Kuhio Highway is expected to remain south of the study intersections until the widening of the roadway is completed. However, with Base Year 2027 mitigations, a decrease in queuing is expected in Kapaa town with the extension of the Kapaa Bypass Road and relocation of the Hauaala Road connection. Although queuing is expected to remain due to the high volume of turning movements in the area, queues will likely be reduced due to the diversion of traffic to Kapaa Bypass Road.

The majority of study intersections are forecast to experience increases in delay over Base Year 2027. However, all movements are expected to operate under capacity with minor street and major left-turn movements operating adequately due to the self-regulating behavior observed in existing conditions.

Because Kuhio Highway/Kealia Road is the only access point to the Project from Kuhio Highway, the intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions during the PM peak hour.

6.4.2 Future Year 2027 Without Kapaa Bypass Road Extension

Similar to Base Year 2027, queuing along Kuhio Highway within and south of the Project area is expected to remain until congestion relief projects are completed in Kapaa and Wailua. While major through movements are expected to continue allowing other movements to proceed during congested periods to reduce major left-turn and minor movement delay, all movements are expected to experience longer delays over existing conditions.

The majority of study intersections are forecast to experience increases in delay over Base Year 2027. The eastbound approaches of Kuhio Highway/Mailihuna Road, Kuhio Highway/Kawaihau Road and Kuhio Highway/Hauaala Road are expected to operate at LOS E/F and/or overcapacity conditions during the AM and PM peak hours with the increase in traffic along Kuhio Highway. Although these movements are expected to experience an increase in delay, the intersections are expected to operate similar to existing conditions with major through movements allowing other movements to proceed during congested periods. The eastbound approaches of Kuhio Highway/Lehua Street, Kuhio Highway/Niu Street and Kuhio Highway/Kukui Street are expected to continue operating at LOS F but under capacity as in Base Year 2027.

Northbound Kuhio Highway is anticipated to continue to operate at overcapacity conditions during both peak hours of traffic due to a lack of feasible alternatives to increase highway capacity in the area.

Because Kuhio Highway/Kealia Road is the only access point to the Project from Kuhio Highway, the intersection is expected to experience a significant increase in traffic. During both peak hours of traffic, the eastbound approach is expected to worsen to LOS F and overcapacity conditions. The westbound approach is also expected to operate at overcapacity conditions during the PM peak hour.

6.5 Future Year 2027 With Mitigation

For both the with Kapaa Bypass Road extension and without Kapaa Bypass Road extension scenarios, the following mitigations were considered at the Kuhio Highway/Kealia Road intersection to improve traffic operations.

- Construct a roundabout
- Install a traffic signal

Although a roundabout is being considered at Kuhio Highway/Mailihuna Road, it was determined that a traffic signal would be more appropriate for Kealia Road to minimize negative impacts to traffic operations along Kuhio Highway. Mitigation measures required as part of the traffic signal are as follows.

[2] Kuhio Highway/Kealia Road

- Install a traffic signal when warranted
- Provide a right-turn onto Kealia Road
- Relocate the existing bus stop/bus bay to south of the intersection

With the proposed mitigation, both the eastbound and westbound approaches will operate at LOS C during both peak hours of traffic. Additionally, the intersection will operate with overall LOS B during both peak hours.

7. RECOMMENDATIONS

7.1 Base Year 2027

The following roadway improvement was assumed to be completed by Base Year 2027:

- Construct a roundabout at the Kuhio Highway/Mailihuna Road intersection

7.2 Base Year 2027 With Mitigation

The following mitigations were proposed for Base Year 2027 for scenarios with and without the Kapaa Bypass Road extension.

7.2.1 Base Year 2027 With Mitigation With Kapaa Bypass Road Extension

Kapaa Bypass Road Extension

The Kapaa Bypass Road extension from Olohena Road to Kuhio Highway would add a northbound lane to the existing one-way Cane Haul Road. With the extension, vehicles will be able to head farther north on the bypass road, and the left-turns from Lehua Street onto Kuhio Highway are expected to decrease. The extension has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report and has been acknowledged as a planned improvement by HDOT. With the extension, improvements will also be completed at the northern terminus. However, these improvements are currently not identified.

Hauaala Road Connection

With the Kapaa Bypass Road extension, the existing Hauaala Road connection to Kuhio Highway can be eliminated and replaced with a new connection from Hauaala Road to the Kapaa Bypass Road. Moving the Hauaala Road connection is expected to relieve congestion in the vicinity of the existing Kuhio Highway/Hauaala Road intersection by reducing the number of conflicting turning movements and providing a longer northbound left-turn pocket at the nearby Kuhio Highway/Kawaihau Road intersection. It was assumed that the proposed Kapaa Bypass Road/Hauaala Road intersection will have a stop-controlled left-/right-turn movement on Hauaala Road and shared eastbound left-turn/through and westbound through/right-turn movements on Kapaa Bypass Road. Relocating the Hauaala Road connection has been identified as a proposed roadway improvement in the 2015 Kapaa Transportation Solutions report.

7.2.2 Base Year 2027 With Mitigation Without Kapaa Bypass Road Extension

As proposed in the Kapaa Transportation Solutions report:

- Closing the east leg of Kukui Street to allocate more green time to movements on Kuhio Highway.
- Improving the Kuhio Highway/Niu Street intersection to alleviate congestion at the Kuhio Highway/Lehua Street intersection.
    - Although not specified in the Kapaa Transportation Solutions report, improving the Kuhio Highway/Niu Street intersection likely consists of providing, similar to the Lehua Street intersection, a northbound refuge lane for eastbound left-turns.

7.3 Future Year 2027 With Mitigation

The following mitigation is proposed for Future Year 2027 for both scenarios with and without the Kapaa Bypass Road extension.

[2] Kuhio Highway/Kealia Road

- Install a traffic signal when warranted
- Provide a right-turn onto Kealia Road
- Relocate the existing bus stop/bus bay to south of the intersection

8. REFERENCES

1. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 2011.
2. Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009.
3. Institute of Transportation Engineers, Trip Generation, 10th Edition, 2017.
4. State of Hawaii, Department of Transportation, Final Environmental Assessment Kapaa Stream Bridge, Kuhio Highway, and Mailihuna Road Intersection Project Kawaihau District, Island of Kauai, Hawaii, 2017.
5. State of Hawaii, Department of Transportation, Kapaa Transportation Solutions, 2015.
6. Transportation Research Board, Highway Capacity Manual, 6th Edition, 2016.

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APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

Austin Tsutsumi & Associates

501 Sumner Street, Suite 521
Honolulu, HI 96817-5031
Phone: 533-3646 Fax: 526-1267

File Name : AM_Kealia Rd - Kaao Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KEALIA RD Southbound			KAAO RD Westbound			KEALIA RD Northbound				
Start Time	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:15	1	0	0	0	4	0	1	1	0	0	7
07:30	2	1	0	2	4	0	2	0	0	1	12
07:45	3	0	0	0	6	0	8	1	0	0	18
Total	6	1	0	2	14	0	11	2	0	1	37
08:00	2	1	0	1	3	0	2	1	0	0	10
Grand Total	8	2	0	3	17	0	13	3	0	1	47
Apprch %	80	20	0	15	85	0	76.5	17.6	0	5.9	
Total %	17	4.3	0	6.4	36.2	0	27.7	6.4	0	2.1	
Motorcycles	0	0	0	0	0	0	0	0	0	0	0
% Motorcycles	0	0	0	0	0	0	0	0	0	0	0
Cars	4	2	0	3	10	0	8	2	0	0	29
% Cars	50	100	0	100	58.8	0	61.5	66.7	0	0	61.7
Light Goods Vehicles	4	0	0	0	7	0	4	1	0	0	16
% Light Goods Vehicles	50	0	0	0	41.2	0	30.8	33.3	0	0	34
Buses	0	0	0	0	0	0	1	0	0	0	1
% Buses	0	0	0	0	0	0	7.7	0	0	0	2.1
Single-Unit Trucks	0	0	0	0	0	0	0	0	0	0	0
% Single-Unit Trucks	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	1	1
% Pedestrians	0	0	0	0	0	0	0	0	0	100	2.1

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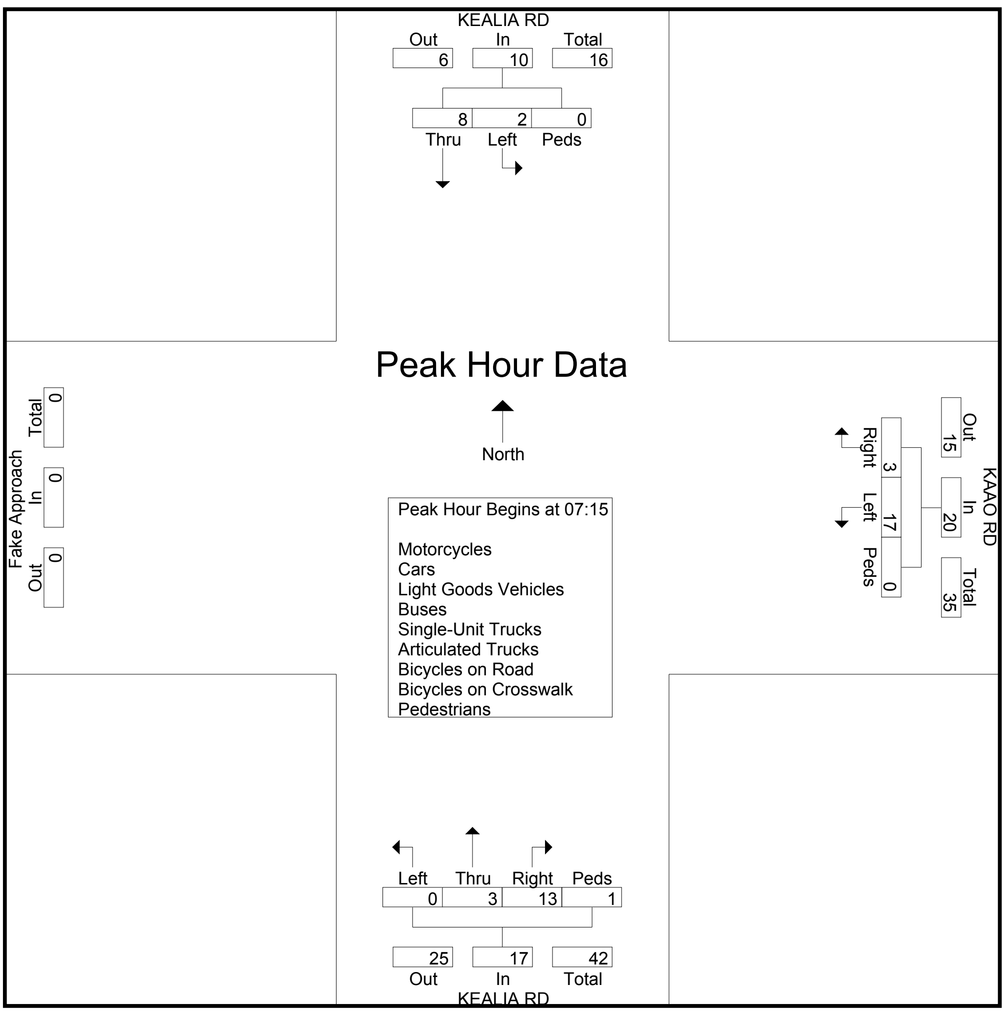
File Name : AM_Kealia Rd - Kaao Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017

	KEALIA RD Southbound				KAAO RD Westbound				KEALIA RD Northbound					
Start Time	Thru	Left	Peds	App. Total	Right	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	0	0	1	0	4	0	4	1	**1**	0	0	2	7
07:30	2	**1**	0	**3**	**2**	4	0	**6**	2	0	0	**1**	3	12
07:45	**3**	0	0	3	0	**6**	0	6	**8**	1	0	0	**9**	**18**
08:00	2	1	0	3	1	3	0	4	2	1	0	0	3	10
Total Volume	8	2	0	10	3	17	0	20	13	3	0	1	17	47
% App. Total	80	20	0		15	85	0		76.5	17.6	0	5.9		
PHF	.667	.500	.000	.833	.375	.708	.000	.833	.406	.750	.000	.250	.472	.653



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File Name : AM_Kuhio Hwy - Kealia Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Pedestrians

	KUHIO HWY Southbound				KEALIA RD Westbound				KUHIO HWY Northbound				KEALIA RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	0	85	2	0	2	0	6	0	3	121	4	0	4	0	2	0	229
06:45	2	134	0	3	0	0	3	0	3	125	5	0	6	0	2	0	283
Total	2	219	2	3	2	0	9	0	6	246	9	0	10	0	4	0	512
07:00	0	136	0	0	0	0	2	0	1	134	5	0	7	0	3	0	288
07:15	1	168	2	0	2	0	3	0	5	162	3	0	5	0	5	0	356
07:30	0	176	1	0	0	0	8	0	4	158	3	0	7	0	1	0	358
07:45	0	173	4	0	3	1	2	0	14	153	11	0	6	0	0	0	367
Total	1	653	7	0	5	1	15	0	24	607	22	0	25	0	9	0	1369
08:00	3	138	2	0	1	0	7	0	7	153	3	0	6	0	3	0	323
08:15	2	126	1	0	2	0	4	0	4	134	5	0	9	0	0	0	287
Grand Total	8	1136	12	3	10	1	35	0	41	1140	39	0	50	0	16	0	2491
Apprch %	0.7	98	1	0.3	21.7	2.2	76.1	0	3.4	93.4	3.2	0	75.8	0	24.2	0	
Total %	0.3	45.6	0.5	0.1	0.4	0	1.4	0	1.6	45.8	1.6	0	2	0	0.6	0	
Motorcycles	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	4
% Motorcycles	0	0.1	0	0	0	0	0	0	2.4	0.2	0	0	0	0	0	0	0.2
Cars	5	742	9	0	4	0	23	0	23	673	20	0	34	0	4	0	1537
% Cars	62.5	65.3	75	0	40	0	65.7	0	56.1	59	51.3	0	68	0	25	0	61.7
Light Goods Vehicles	2	364	3	0	6	1	12	0	17	422	19	0	15	0	12	0	873
% Light Goods Vehicles	25	32	25	0	60	100	34.3	0	41.5	37	48.7	0	30	0	75	0	35
Buses	1	18	0	0	0	0	0	0	0	13	0	0	1	0	0	0	33
% Buses	12.5	1.6	0	0	0	0	0	0	0	1.1	0	0	2	0	0	0	1.3
Single-Unit Trucks	0	10	0	0	0	0	0	0	0	27	0	0	0	0	0	0	37
% Single-Unit Trucks	0	0.9	0	0	0	0	0	0	0	2.4	0	0	0	0	0	0	1.5
Articulated Trucks	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.2
Pedestrians	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
% Pedestrians	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0.1

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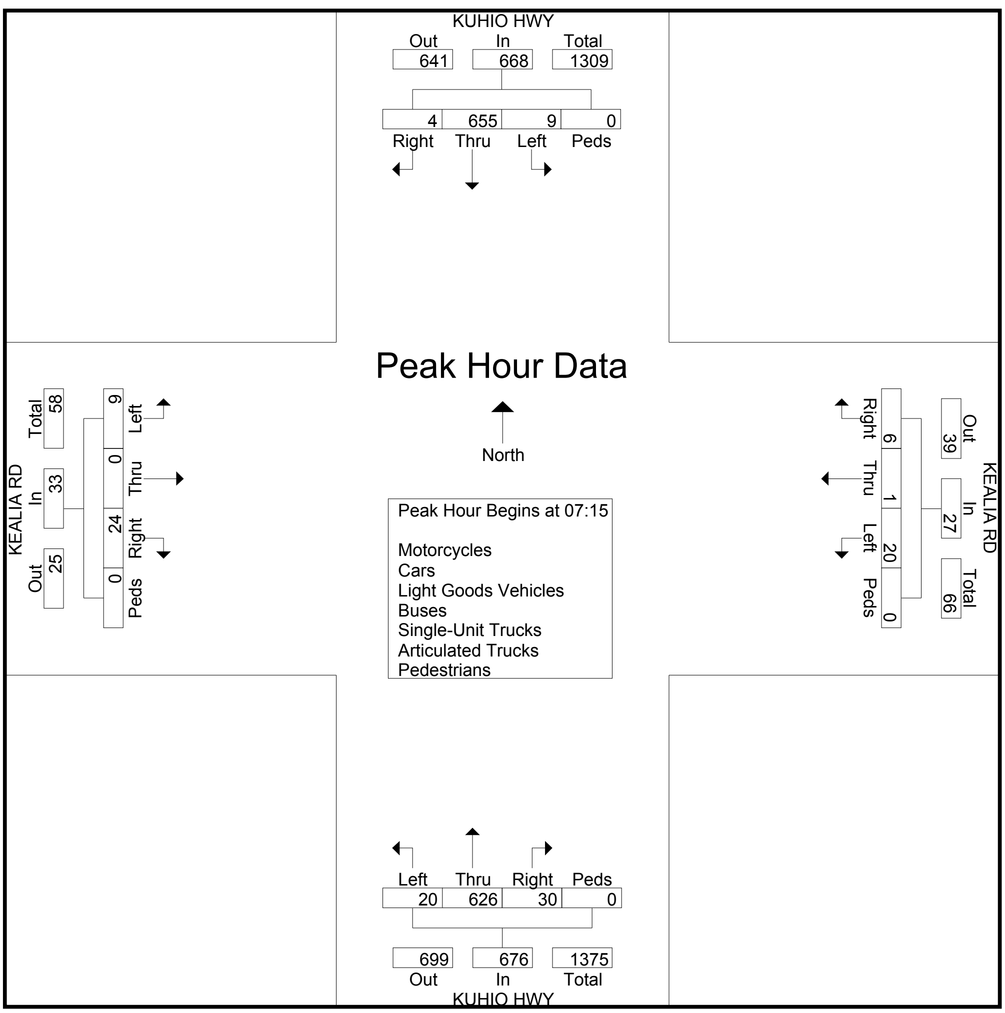
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017
Page No : 2

	KUHIO HWY Southbound					KEALIA RD Westbound					KUHIO HWY Northbound					KEALIA RD Eastbound					
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 06:30 to 08:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	1	168	2	0	171	2	0	3	0	5	5	**162**	3	0	170	5	0	**5**	0	**10**	356
07:30	0	**176**	1	0	**177**	0	0	**8**	0	**8**	4	158	3	0	165	**7**	0	1	0	8	358
07:45	0	173	**4**	0	177	**3**	**1**	2	0	6	**14**	153	**11**	0	**178**	6	0	0	0	6	**367**
08:00	**3**	138	2	0	143	1	0	7	0	8	7	153	3	0	163	6	0	3	0	9	323
Total Volume	4	655	9	0	668	6	1	20	0	27	30	626	20	0	676	24	0	9	0	33	1404
% App. Total	0.6	98.1	1.3	0		22.2	3.7	74.1	0		4.4	92.6	3	0		72.7	0	27.3	0		
PHF	.333	.930	.563	.000	.944	.500	.250	.625	.000	.844	.536	.966	.455	.000	.949	.857	.000	.450	.000	.825	.956



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Start Date : 4/19/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				MAILIHUNA RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	21	100	0	0	0	0	0	0	0	78	0	0	10	0	45	0	254
06:45	27	108	0	0	0	0	0	0	0	84	5	0	12	0	47	0	283
Total	48	208	0	0	0	0	0	0	0	162	5	0	22	0	92	0	537
07:00	21	125	0	0	0	0	0	0	0	98	11	0	13	0	44	0	312
07:15	31	134	0	0	0	0	0	0	0	106	9	0	18	0	71	0	369
07:30	42	149	0	0	0	0	0	0	0	116	24	0	11	0	56	0	398
07:45	49	130	0	0	0	0	0	0	0	120	38	0	22	0	58	0	417
Total	143	538	0	0	0	0	0	0	0	440	82	0	64	0	229	0	1496
08:00	41	121	0	0	0	0	0	0	0	117	25	0	27	0	49	0	380
08:15	17	115	0	0	0	0	0	0	0	115	10	0	10	0	36	0	303
Grand Total	249	982	0	0	0	0	0	0	0	834	122	0	123	0	406	0	2716
Apprch %	20.2	79.8	0	0	0	0	0	0	0	87.2	12.8	0	23.3	0	76.7	0	
Total %	9.2	36.2	0	0	0	0	0	0	0	30.7	4.5	0	4.5	0	14.9	0	

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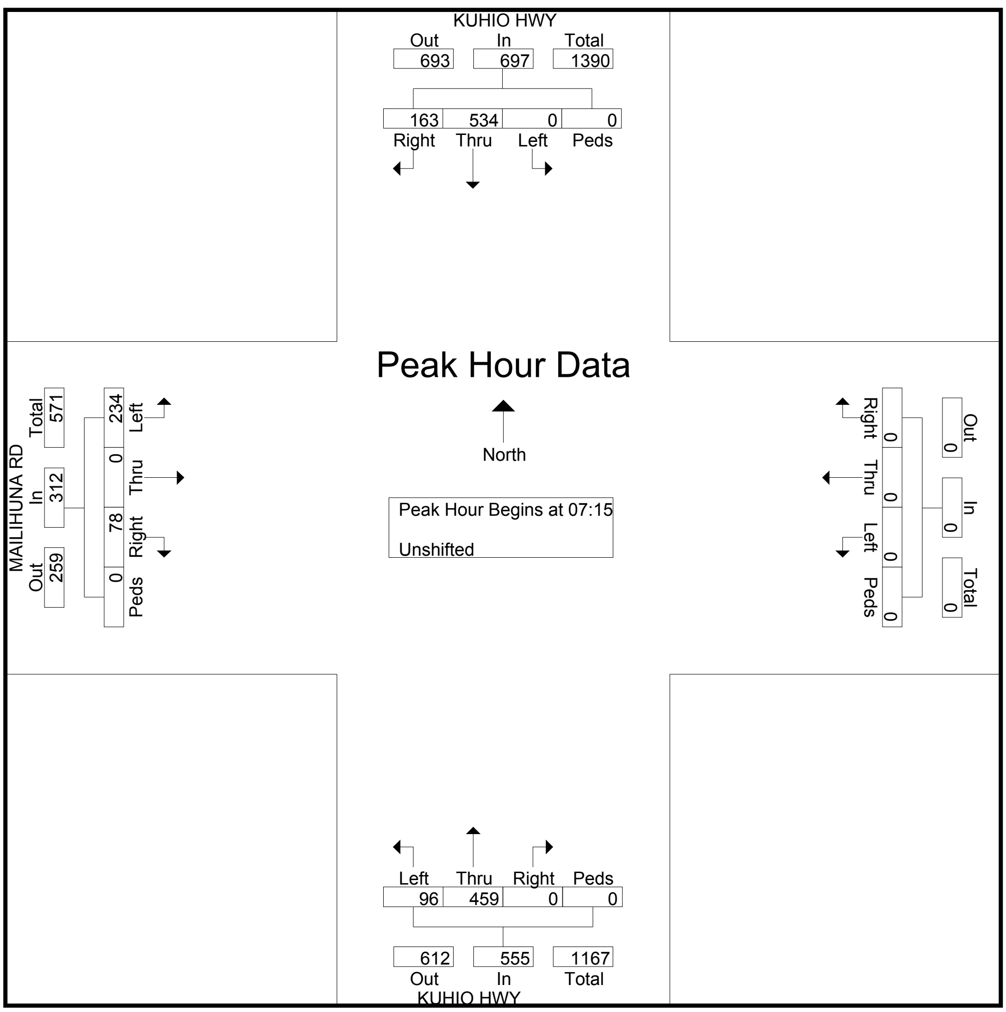
File Name : AM_Kuhio Hwy - Mailihuna Rd
Site Code : 00000000
Start Date : 4/19/2017
Page No : 2

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					MAILIHUNA RD Eastbound					
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 06:30 to 08:00 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	31	134	0	0	165	0	0	0	0	0	0	106	9	0	115	18	0	**71**	0	**89**	369
07:30	42	**149**	0	0	**191**	0	0	0	0	0	0	116	24	0	140	11	0	56	0	67	398
07:45	**49**	130	0	0	179	0	0	0	0	0	0	**120**	**38**	0	**158**	22	0	58	0	80	**417**
08:00	41	121	0	0	162	0	0	0	0	0	0	117	25	0	142	**27**	0	49	0	76	380
Total Volume	163	534	0	0	697	0	0	0	0	0	0	459	96	0	555	78	0	234	0	312	1564
% App. Total	23.4	76.6	0	0		0	0	0	0		0	82.7	17.3	0		25	0	75	0		
PHF	.832	.896	.000	.000	.912	.000	.000	.000	.000	.000	.000	.956	.632	.000	.878	.722	.000	.824	.000	.876	.938



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File Name : AM_Kuhio Hwy - Kawaihau Rd
Site Code : 00000000
Start Date : 4/19/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				KAWAIHAU RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:15	3	132	0	3	0	0	0	0	0	117	98	0	92	0	1	4	450
07:30	13	144	0	2	0	0	0	0	0	136	93	0	69	0	3	0	460
07:45	7	123	0	2	0	0	0	0	0	116	80	0	91	0	3	4	426
Total	23	399	0	7	0	0	0	0	0	369	271	0	252	0	7	8	1336
08:00	3	160	0	2	0	0	0	0	0	115	59	0	69	0	4	0	412
Grand Total	26	559	0	9	0	0	0	0	0	484	330	0	321	0	11	8	1748
Apprch %	4.4	94.1	0	1.5	0	0	0	0	0	59.5	40.5	0	94.4	0	3.2	2.4	
Total %	1.5	32	0	0.5	0	0	0	0	0	27.7	18.9	0	18.4	0	0.6	0.5	

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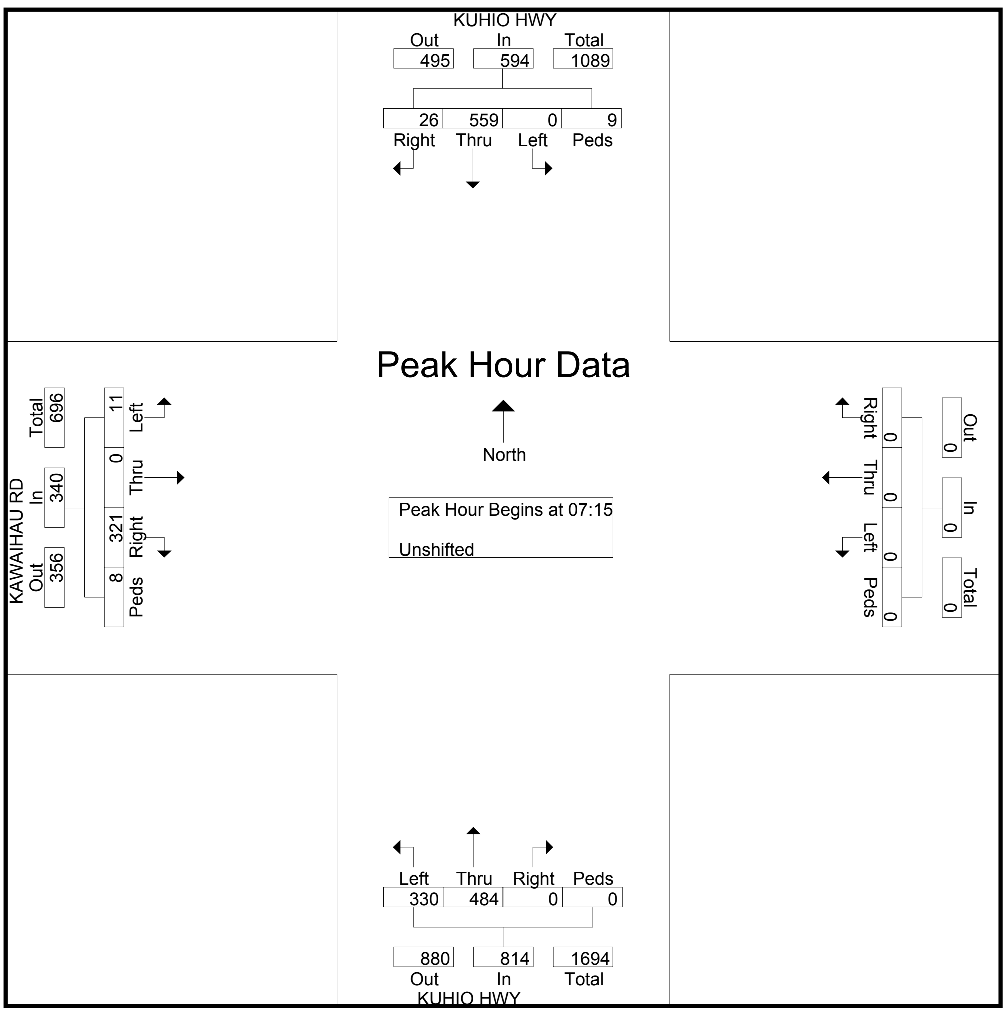
File Name : AM_Kuhio Hwy - Kawaihau Rd
Site Code : 00000000
Start Date : 4/19/2017
Page No : 2

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					KAWAIHAU RD Eastbound					
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	3	132	0	**3**	138	0	0	0	0	0	0	117	**98**	0	215	**92**	0	1	**4**	97	450
07:30	**13**	144	0	2	159	0	0	0	0	0	0	**136**	93	0	**229**	69	0	3	0	72	**460**
07:45	7	123	0	2	132	0	0	0	0	0	0	116	80	0	196	91	0	3	4	**98**	426
08:00	3	**160**	0	2	**165**	0	0	0	0	0	0	115	59	0	174	69	0	**4**	0	73	412
Total Volume	26	559	0	9	594	0	0	0	0	0	0	484	330	0	814	321	0	11	8	340	1748
% App. Total	4.4	94.1	0	1.5		0	0	0	0		0	59.5	40.5	0		94.4	0	3.2	2.4		
PHF	.500	.873	.000	.750	.900	.000	.000	.000	.000	.000	.000	.890	.842	.000	.889	.872	.000	.688	.500	.867	.950



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File Name : AM_Kuhio Hwy - Hauaala Rd
Site Code : 00000000
Start Date : 4/19/2017

Groups Printed- Unshifted

	KUHIO HWY SOUTHBOUND				HAUAALA RD WESTBOUND				KUHIO HWY NORTHBOUND				HAUAALA RD EASBOUND				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	1	152	0	2	0	0	0	0	0	127	12	0	65	0	1	0	360
06:45	0	180	0	6	0	0	0	0	0	144	9	0	77	0	0	2	418
Total	1	332	0	8	0	0	0	0	0	271	21	0	142	0	1	2	778
07:00	0	249	0	1	0	0	0	0	0	153	14	0	87	0	0	0	504
07:15	3	221	0	3	0	0	0	0	0	215	15	0	99	0	2	2	560
07:30	0	213	0	2	0	0	0	0	0	229	10	0	92	0	9	0	555
07:45	3	212	0	2	0	0	0	0	0	194	24	0	80	0	3	1	519
Total	6	895	0	8	0	0	0	0	0	791	63	0	358	0	14	3	2138
08:00	4	224	0	2	0	0	0	0	0	175	17	0	67	0	0	1	490
08:15	5	193	0	2	0	0	0	0	0	159	11	0	76	0	2	0	448
Grand Total	16	1644	0	20	0	0	0	0	0	1396	112	0	643	0	17	6	3854
Apprch %	1	97.9	0	1.2	0	0	0	0	0	92.6	7.4	0	96.5	0	2.6	0.9	
Total %	0.4	42.7	0	0.5	0	0	0	0	0	36.2	2.9	0	16.7	0	0.4	0.2	

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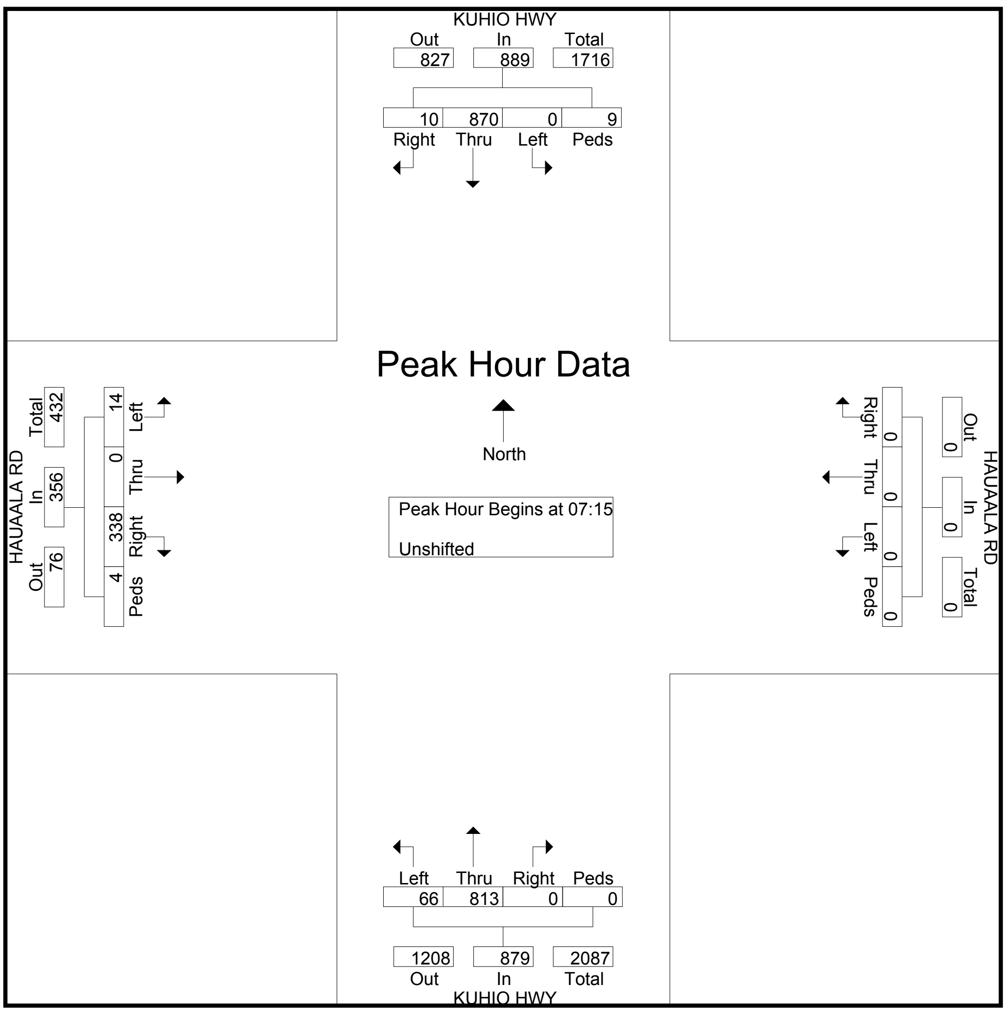
File Name : AM_Kuhio Hwy - Hauaala Rd
Site Code : 00000000
Start Date : 4/19/2017
Page No : 2

	KUHIO HWY SOUTHBOUND					HAUAALA RD WESTBOUND					KUHIO HWY NORTHBOUND					HAUAALA RD EASBOUND					
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	3	221	0	**3**	227	0	0	0	0	0	0	215	15	0	230	**99**	0	2	**2**	**103**	**560**
07:30	0	213	0	2	215	0	0	0	0	0	0	**229**	10	0	**239**	92	0	**9**	0	101	555
07:45	3	212	0	2	217	0	0	0	0	0	0	194	**24**	0	218	80	0	3	1	84	519
08:00	**4**	**224**	0	2	**230**	0	0	0	0	0	0	175	17	0	192	67	0	0	1	68	490
Total Volume	10	870	0	9	889	0	0	0	0	0	0	813	66	0	879	338	0	14	4	356	2124
% App. Total	1.1	97.9	0	1		0	0	0	0		0	92.5	7.5	0		94.9	0	3.9	1.1		
PHF	.625	.971	.000	.750	.966	.000	.000	.000	.000	.000	.000	.888	.688	.000	.919	.854	.000	.389	.500	.864	.948



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File Name : AM_Kuhio Hwy - Cane Haul Rd
Site Code : 00000000
Start Date : 4/19/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				CANE HAUL RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
06:30	42	178	0	2	0	0	0	0	0	143	0	0	0	0	0	2	367
06:45	60	194	0	6	0	0	0	0	0	154	0	0	0	0	0	3	417
Total	102	372	0	8	0	0	0	0	0	297	0	0	0	0	0	5	784
07:00	98	236	0	1	0	0	0	0	0	177	0	0	0	0	0	1	513
07:15	101	205	0	3	0	0	0	0	0	223	3	0	0	0	0	3	538
07:30	104	208	0	2	0	0	0	0	0	254	3	0	0	0	0	1	572
07:45	102	210	0	2	0	0	0	0	0	252	3	0	0	0	0	0	569
Total	405	859	0	8	0	0	0	0	0	906	9	0	0	0	0	5	2192
08:00	94	216	0	2	0	0	0	0	0	206	8	0	0	0	0	0	526
08:15	103	203	0	2	0	0	0	0	0	174	4	0	0	0	0	0	486
Grand Total	704	1650	0	20	0	0	0	0	0	1583	21	0	0	0	0	10	3988
Apprch %	29.7	69.5	0	0.8	0	0	0	0	0	98.7	1.3	0	0	0	0	100	
Total %	17.7	41.4	0	0.5	0	0	0	0	0	39.7	0.5	0	0	0	0	0.3	

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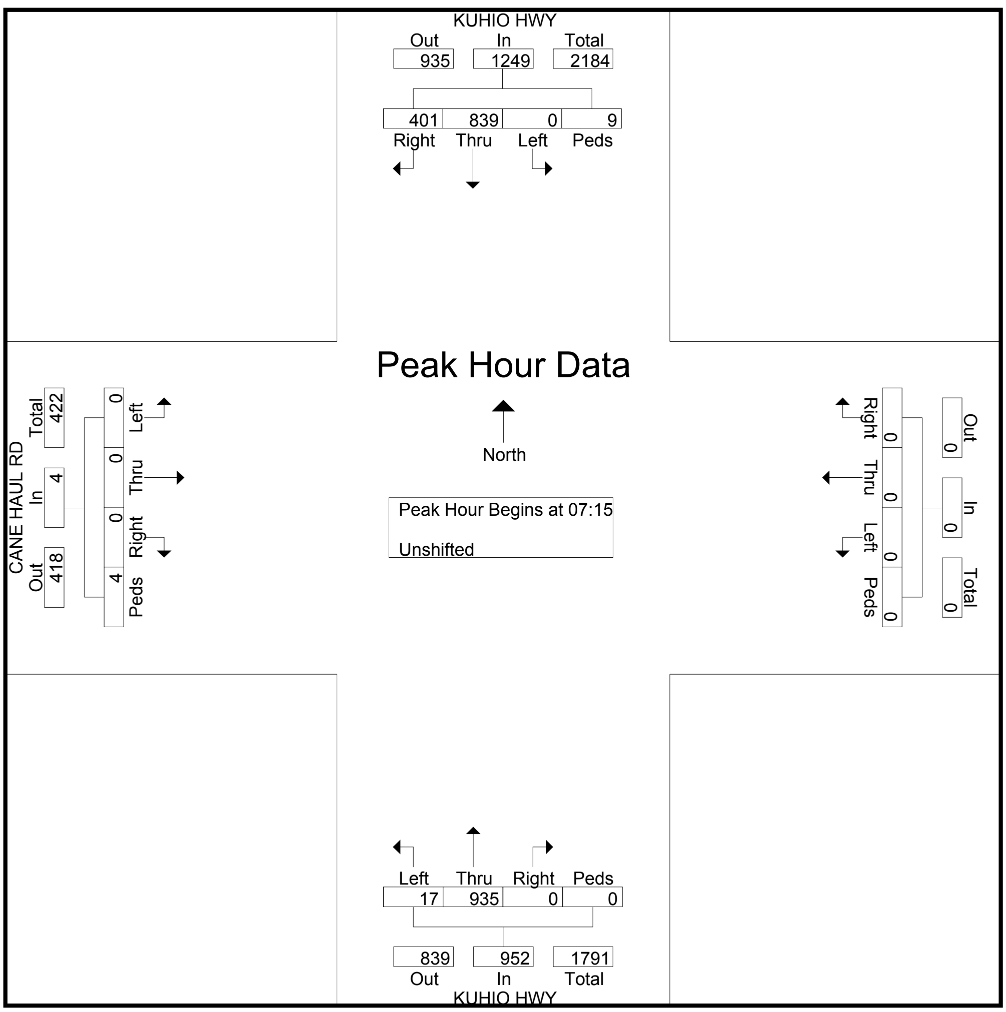
File Name : AM_Kuhio Hwy - Cane Haul Rd
Site Code : 00000000
Start Date : 4/19/2017

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					CANE HAUL RD Eastbound					
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 06:30 to 08:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15																					
07:15	101	205	0	**3**	309	0	0	0	0	0	0	223	3	0	226	0	0	0	**3**	**3**	538
07:30	**104**	208	0	2	**314**	0	0	0	0	0	0	**254**	3	0	**257**	0	0	0	1	1	**572**
07:45	102	210	0	2	314	0	0	0	0	0	0	252	3	0	255	0	0	0	0	0	569
08:00	94	**216**	0	2	312	0	0	0	0	0	0	206	**8**	0	214	0	0	0	0	0	526
Total Volume	401	839	0	9	1249	0	0	0	0	0	0	935	17	0	952	0	0	0	4	4	2205
% App. Total	32.1	67.2	0	0.7		0	0	0	0		0	98.2	1.8	0		0	0	0	100		
PHF	.964	.971	.000	.750	.994	.000	.000	.000	.000	.000	.000	.920	.531	.000	.926	.000	.000	.000	.333	.333	.964



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File Name : AM_Kuhio Hwy - Lehua St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound			KUHIO HWY Northbound			LEHUA ST Eastbound			
Start Time	Right	Thru	Peds	Thru	Left	Peds	Right	Left	Peds	Int. Total
06:30	10	153	0	123	3	0	1	31	0	321
06:45	8	185	0	117	0	0	1	44	0	355
Total	18	338	0	240	3	0	2	75	0	676
07:00	12	219	0	131	0	0	2	55	2	421
07:15	17	195	0	168	0	0	1	80	1	462
07:30	14	179	0	176	1	0	4	87	3	464
07:45	20	183	0	183	1	0	3	77	0	467
Total	63	776	0	658	2	0	10	299	6	1814
08:00	20	183	0	174	2	0	2	41	1	423
08:15	18	188	0	159	3	0	1	44	2	415
Grand Total	119	1485	0	1231	10	0	15	459	9	3328
Apprch %	7.4	92.6	0	99.2	0.8	0	3.1	95	1.9	
Total %	3.6	44.6	0	37	0.3	0	0.5	13.8	0.3	
Motorcycles	0	4	0	2	0	0	0	2	0	8
% Motorcycles	0	0.3	0	0.2	0	0	0	0.4	0	0.2
Cars	67	978	0	744	9	0	12	297	0	2107
% Cars	56.3	65.9	0	60.4	90	0	80	64.7	0	63.3
Light Goods Vehicles	37	475	0	431	1	0	3	147	0	1094
% Light Goods Vehicles	31.1	32	0	35	10	0	20	32	0	32.9
Buses	15	11	0	18	0	0	0	10	0	54
% Buses	12.6	0.7	0	1.5	0	0	0	2.2	0	1.6
Single-Unit Trucks	0	13	0	34	0	0	0	3	0	50
% Single-Unit Trucks	0	0.9	0	2.8	0	0	0	0.7	0	1.5
Articulated Trucks	0	2	0	1	0	0	0	0	0	3
% Articulated Trucks	0	0.1	0	0.1	0	0	0	0	0	0.1
Bicycles on Road	0	2	0	1	0	0	0	0	0	3
% Bicycles on Road	0	0.1	0	0.1	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	9	9
% Pedestrians	0	0	0	0	0	0	0	0	100	0.3

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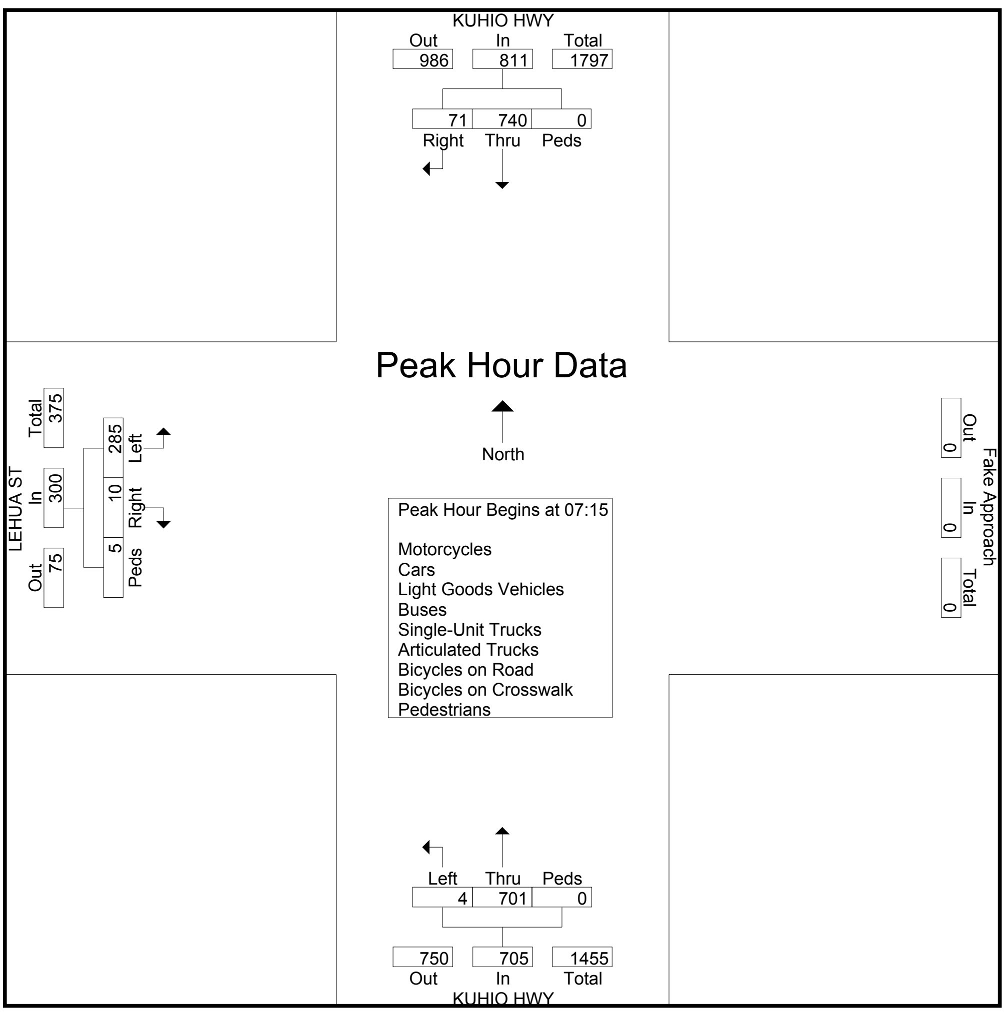
File Name : AM_Kuhio Hwy - Lehua St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017

	KUHIO HWY Southbound				KUHIO HWY Northbound				LEHUA ST Eastbound				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 08:15 - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15													
07:15	17	**195**	0	**212**	168	0	0	168	1	80	1	82	462
07:30	14	179	0	193	176	1	0	177	**4**	**87**	**3**	**94**	464
07:45	**20**	183	0	203	**183**	1	0	**184**	3	77	0	80	**467**
08:00	20	183	0	203	174	**2**	0	176	2	41	1	44	423
Total Volume	71	740	0	811	701	4	0	705	10	285	5	300	1816
% App. Total	8.8	91.2	0		99.4	0.6	0		3.3	95	1.7		
PHF	.888	.949	.000	.956	.958	.500	.000	.958	.625	.819	.417	.798	.972



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File Name : AM_Kuhio Hwy - Niu St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound				NIU ST Westbound				KUHIO HWY Northbound				NIU ST Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:15	0	185	12	0	14	0	1	5	2	160	0	5	1	1	1	5	392
07:30	0	164	20	0	9	0	2	2	0	165	1	4	2	1	1	7	378
07:45	2	168	18	0	17	2	1	5	1	165	5	1	1	0	3	0	389
Total	2	517	50	0	40	2	4	12	3	490	6	10	4	2	5	12	1159
08:00	2	162	19	0	15	0	1	2	2	154	2	3	2	0	0	0	364
Grand Total	4	679	69	0	55	2	5	14	5	644	8	13	6	2	5	12	1523
Apprch %	0.5	90.3	9.2	0	72.4	2.6	6.6	18.4	0.7	96.1	1.2	1.9	24	8	20	48	
Total %	0.3	44.6	4.5	0	3.6	0.1	0.3	0.9	0.3	42.3	0.5	0.9	0.4	0.1	0.3	0.8	
Motorcycles	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	4
% Motorcycles	0	0.1	1.4	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.3
Cars	1	459	51	0	33	1	5	0	2	394	5	0	1	1	4	0	957
% Cars	25	67.6	73.9	0	60	50	100	0	40	61.2	62.5	0	16.7	50	80	0	62.8
Light Goods Vehicles	3	197	16	0	22	1	0	0	3	221	3	0	5	0	1	0	472
% Light Goods Vehicles	75	29	23.2	0	40	50	0	0	60	34.3	37.5	0	83.3	0	20	0	31
Buses	0	10	1	0	0	0	0	0	0	4	0	0	0	0	0	0	15
% Buses	0	1.5	1.4	0	0	0	0	0	0	0.6	0	0	0	0	0	0	1
Single-Unit Trucks	0	10	0	0	0	0	0	0	0	19	0	0	0	0	0	0	29
% Single-Unit Trucks	0	1.5	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1.9
Articulated Trucks	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4
% Articulated Trucks	0	0.1	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.3
Bicycles on Road	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	3
% Bicycles on Road	0	0.1	0	0	0	0	0	0	0	0.2	0	0	0	50	0	0	0.2
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	3
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	15.4	0	0	0	8.3	0.2
Pedestrians	0	0	0	0	0	0	0	14	0	0	0	11	0	0	0	11	36
% Pedestrians	0	0	0	0	0	0	0	100	0	0	0	84.6	0	0	0	91.7	2.4

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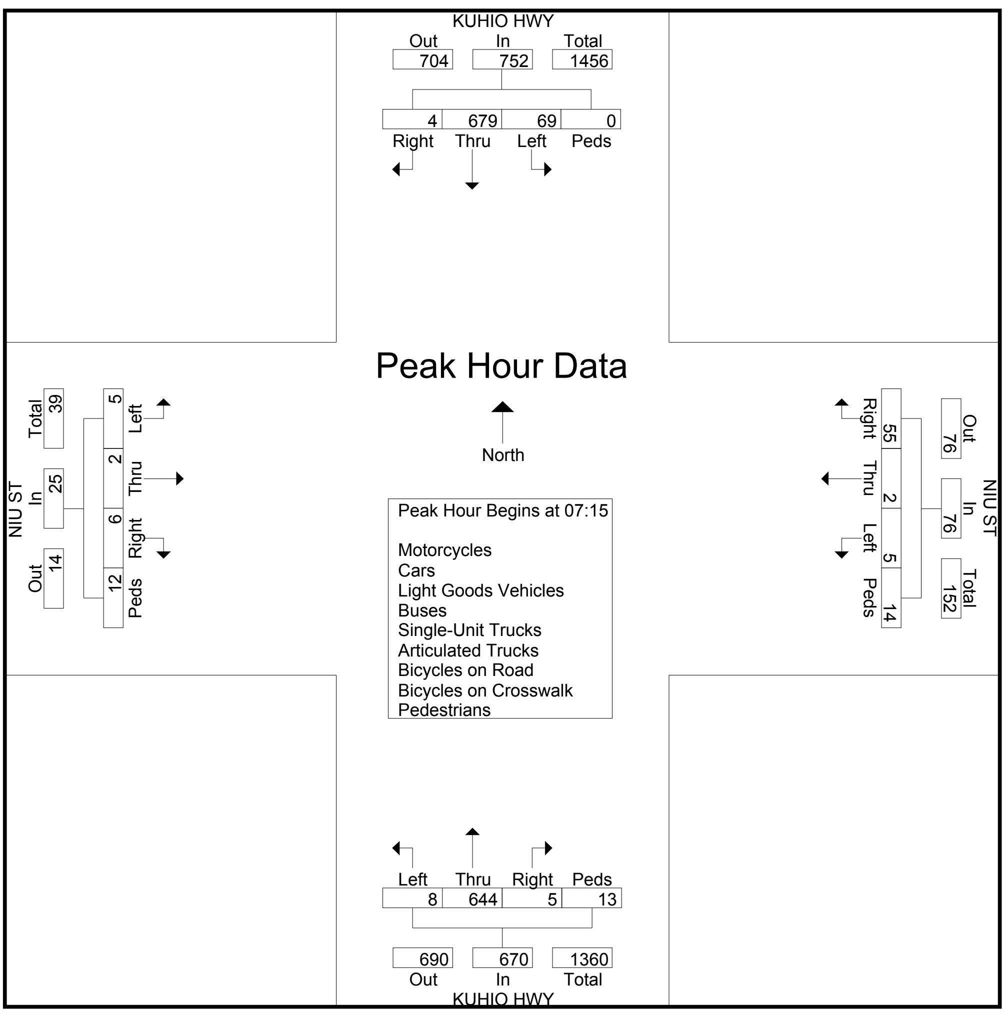
File Name : AM_Kuhio Hwy - Niu St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/19/2017

	KUHIO HWY Southbound					NIU ST Westbound					KUHIO HWY Northbound					NIU ST Eastbound					
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	0	**185**	12	0	**197**	14	0	1	**5**	20	**2**	160	0	**5**	167	1	**1**	1	5	8	**392**
07:30	0	164	**20**	0	184	9	0	**2**	2	13	0	**165**	1	4	170	**2**	1	1	**7**	**11**	378
07:45	**2**	168	18	0	188	**17**	**2**	1	5	**25**	1	165	**5**	1	**172**	1	0	**3**	0	4	389
08:00	2	162	19	0	183	15	0	1	2	18	2	154	2	3	161	2	0	0	0	2	364
Total Volume	4	679	69	0	752	55	2	5	14	76	5	644	8	13	670	6	2	5	12	25	1523
% App. Total	0.5	90.3	9.2	0		72.4	2.6	6.6	18.4		0.7	96.1	1.2	1.9		24	8	20	48		
PHF	.500	.918	.863	.000	.954	.809	.250	.625	.700	.760	.625	.976	.400	.650	.974	.750	.500	.417	.429	.568	.971



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File Name : AM_Kuhio Hwy - Kukui_Huluili St
Site Code : 17-035
Start Date : 4/19/2017

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound				KUKUI ST Westbound				KUHIO HWY Northbound				KUKUI ST Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:15	12	175	0	2	2	0	0	5	5	152	8	0	8	1	6	0	376
07:30	5	161	0	3	1	0	0	1	2	166	9	4	10	0	6	2	370
07:45	9	157	0	0	4	0	0	1	5	155	2	2	17	2	12	0	366
Total	26	493	0	5	7	0	0	7	12	473	19	6	35	3	24	2	1112
08:00	8	163	0	1	7	0	0	6	4	146	0	1	11	0	5	0	352
Grand Total	34	656	0	6	14	0	0	13	16	619	19	7	46	3	29	2	1464
Apprch %	4.9	94.3	0	0.9	51.9	0	0	48.1	2.4	93.6	2.9	1.1	57.5	3.8	36.2	2.5	
Total %	2.3	44.8	0	0.4	1	0	0	0.9	1.1	42.3	1.3	0.5	3.1	0.2	2	0.1	
Motorcycles	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
% Motorcycles	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.1
Cars	20	441	0	0	8	0	0	0	9	389	15	0	36	1	18	0	937
% Cars	58.8	67.2	0	0	57.1	0	0	0	56.2	62.8	78.9	0	78.3	33.3	62.1	0	64
Light Goods Vehicles	12	193	0	0	6	0	0	0	7	204	4	0	10	2	9	0	447
% Light Goods Vehicles	35.3	29.4	0	0	42.9	0	0	0	43.8	33	21.1	0	21.7	66.7	31	0	30.5
Buses	1	9	0	0	0	0	0	0	0	3	0	0	0	0	1	0	14
% Buses	2.9	1.4	0	0	0	0	0	0	0	0.5	0	0	0	0	3.4	0	1
Single-Unit Trucks	0	11	0	0	0	0	0	0	0	20	0	0	0	0	0	0	31
% Single-Unit Trucks	0	1.7	0	0	0	0	0	0	0	3.2	0	0	0	0	0	0	2.1
Articulated Trucks	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.1
Bicycles on Road	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
% Bicycles on Road	2.9	0.2	0	0	0	0	0	0	0	0	0	0	0	0	3.4	0	0.2
Bicycles on Crosswalk	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	0	0	0	0	7.7	0	0	0	0	0	0	0	0	0.1
Pedestrians	0	0	0	6	0	0	0	12	0	0	0	7	0	0	0	2	27
% Pedestrians	0	0	0	100	0	0	0	92.3	0	0	0	100	0	0	0	100	1.8

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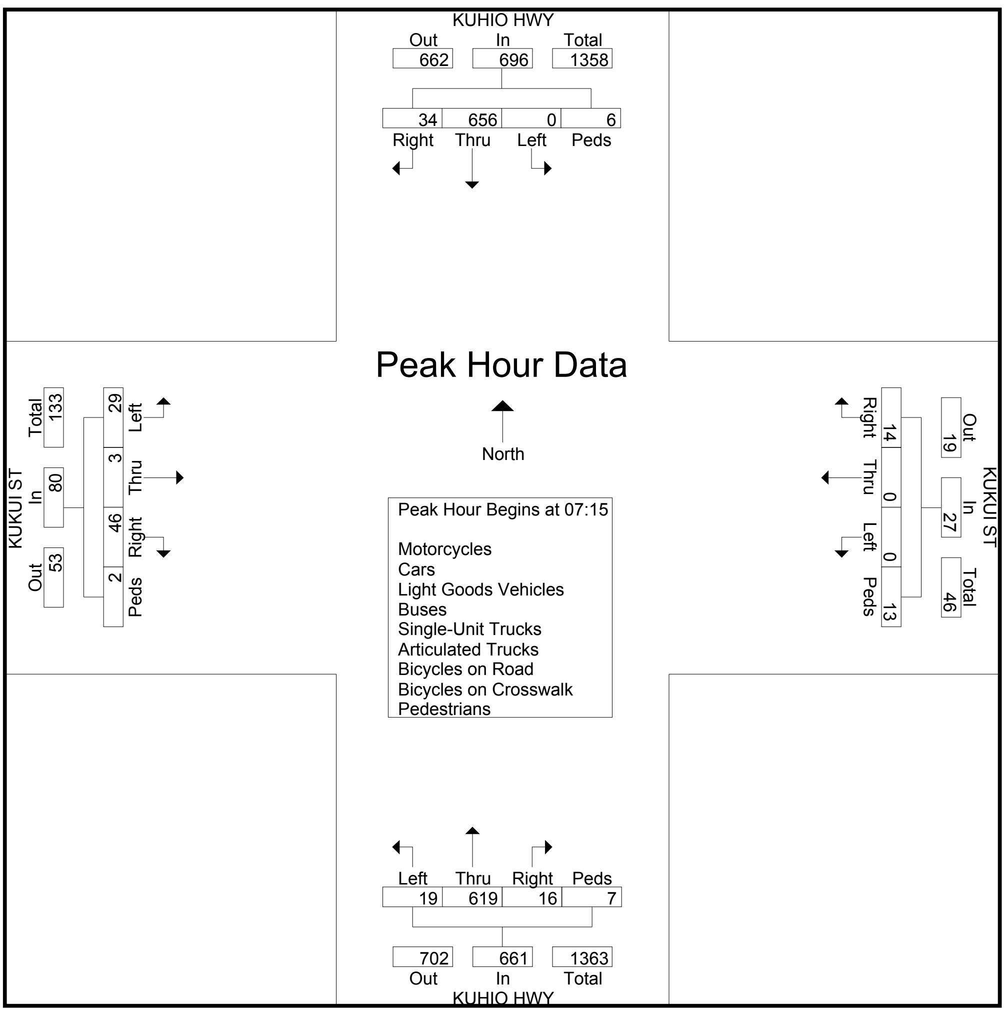
File Name : AM_Kuhio Hwy - Kukui_Huluili St
Site Code : 17-035
Start Date : 4/19/2017
Page No : 2

	KUHIO HWY Southbound					KUKUI ST Westbound					KUHIO HWY Northbound					KUKUI ST Eastbound					
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**	**175**	0	2	**189**	2	0	0	5	7	**5**	152	8	0	165	8	1	6	0	15	**376**
07:30	5	161	0	**3**	169	1	0	0	1	2	2	**166**	**9**	**4**	**181**	10	0	6	**2**	18	370
07:45	9	157	0	0	166	4	0	0	1	5	5	155	2	2	164	**17**	**2**	**12**	0	**31**	366
08:00	8	163	0	1	172	**7**	0	0	**6**	**13**	4	146	0	1	151	11	0	5	0	16	352
Total Volume	34	656	0	6	696	14	0	0	13	27	16	619	19	7	661	46	3	29	2	80	1464
% App. Total	4.9	94.3	0	0.9		51.9	0	0	48.1		2.4	93.6	2.9	1.1		57.5	3.8	36.2	2.5		
PHF	.708	.937	.000	.500	.921	.500	.000	.000	.542	.519	.800	.932	.528	.438	.913	.676	.375	.604	.250	.645	.973



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File Name : PM_Kealia Rd - Kaao Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KEALIA RD Southbound			KAAO RD Westbound			KEALIA RD Northbound				
Start Time	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:45	4	0	0	0	4	0	6	7	0	0	21
Total	4	0	0	0	4	0	6	7	0	0	21
16:00	0	0	0	0	0	0	3	6	0	0	9
16:15	4	0	0	0	2	0	5	3	0	0	14
16:30	1	1	0	0	3	0	2	11	0	0	18
Grand Total	9	1	0	0	9	0	16	27	0	0	62
Apprch %	90	10	0	0	100	0	37.2	62.8	0	0	
Total %	14.5	1.6	0	0	14.5	0	25.8	43.5	0	0	
Motorcycles	0	0	0	0	0	0	0	0	0	0	0
% Motorcycles	0	0	0	0	0	0	0	0	0	0	0
Cars	5	0	0	0	4	0	9	6	0	0	24
% Cars	55.6	0	0	0	44.4	0	56.2	22.2	0	0	38.7
Light Goods Vehicles	4	1	0	0	5	0	7	19	0	0	36
% Light Goods Vehicles	44.4	100	0	0	55.6	0	43.8	70.4	0	0	58.1
Buses	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0
Single-Unit Trucks	0	0	0	0	0	0	0	1	0	0	1
% Single-Unit Trucks	0	0	0	0	0	0	0	3.7	0	0	1.6
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	1	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	3.7	0	0	1.6
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0

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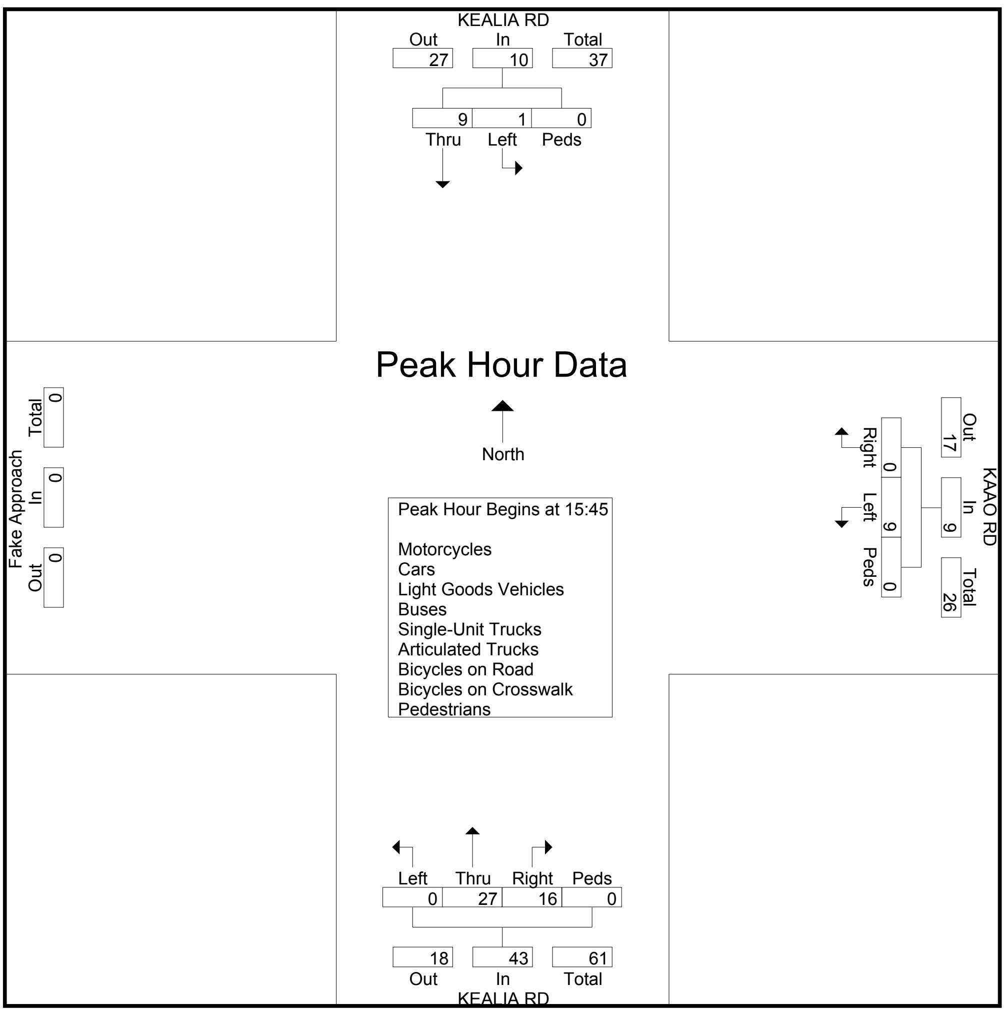
File Name : PM_Kealia Rd - Kaao Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017

	KEALIA RD Southbound				KAAO RD Westbound				KEALIA RD Northbound					
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:45 to 16:30 - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 15:45														
15:45	**4**	0	0	**4**	0	**4**	0	**4**	**6**	7	0	0	**13**	**21**
16:00	0	0	0	0	0	0	0	0	3	6	0	0	9	9
16:15	4	0	0	4	0	2	0	2	5	3	0	0	8	14
16:30	1	**1**	0	2	0	3	0	3	2	**11**	0	0	13	18
Total Volume	9	1	0	10	0	9	0	9	16	27	0	0	43	62
% App. Total	90	10	0		0	100	0		37.2	62.8	0	0		
PHF	.563	.250	.000	.625	.000	.563	.000	.563	.667	.614	.000	.000	.827	.738



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File Name : PM_Kuhio Hwy - Kealia Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound				KEALIA RD Westbound				KUHIO HWY Northbound				KEALIA RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:45	3	163	6	0	2	0	8	0	7	133	15	0	12	0	2	0	351
Total	3	163	6	0	2	0	8	0	7	133	15	0	12	0	2	0	351
16:00	1	157	1	1	1	0	1	0	6	181	14	0	1	0	1	0	365
16:15	1	177	7	0	2	0	10	0	5	161	11	0	6	0	0	0	380
16:30	3	219	5	0	2	1	7	0	5	148	9	0	7	0	0	0	406
Grand Total	8	716	19	1	7	1	26	0	23	623	49	0	26	0	3	0	1502
Apprch %	1.1	96.2	2.6	0.1	20.6	2.9	76.5	0	3.3	89.6	7.1	0	89.7	0	10.3	0	
Total %	0.5	47.7	1.3	0.1	0.5	0.1	1.7	0	1.5	41.5	3.3	0	1.7	0	0.2	0	
Motorcycles	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
% Motorcycles	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.2
Cars	5	478	13	0	5	1	14	0	12	452	22	0	16	0	2	0	1020
% Cars	62.5	66.8	68.4	0	71.4	100	53.8	0	52.2	72.6	44.9	0	61.5	0	66.7	0	67.9
Light Goods Vehicles	3	213	5	0	2	0	12	0	11	163	26	0	10	0	1	0	446
% Light Goods Vehicles	37.5	29.7	26.3	0	28.6	0	46.2	0	47.8	26.2	53.1	0	38.5	0	33.3	0	29.7
Buses	0	9	0	0	0	0	0	0	0	2	0	0	0	0	0	0	11
% Buses	0	1.3	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0.7
Single-Unit Trucks	0	14	1	0	0	0	0	0	0	3	1	0	0	0	0	0	19
% Single-Unit Trucks	0	2	5.3	0	0	0	0	0	0	0.5	2	0	0	0	0	0	1.3
Articulated Trucks	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
% Articulated Trucks	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Crosswalk	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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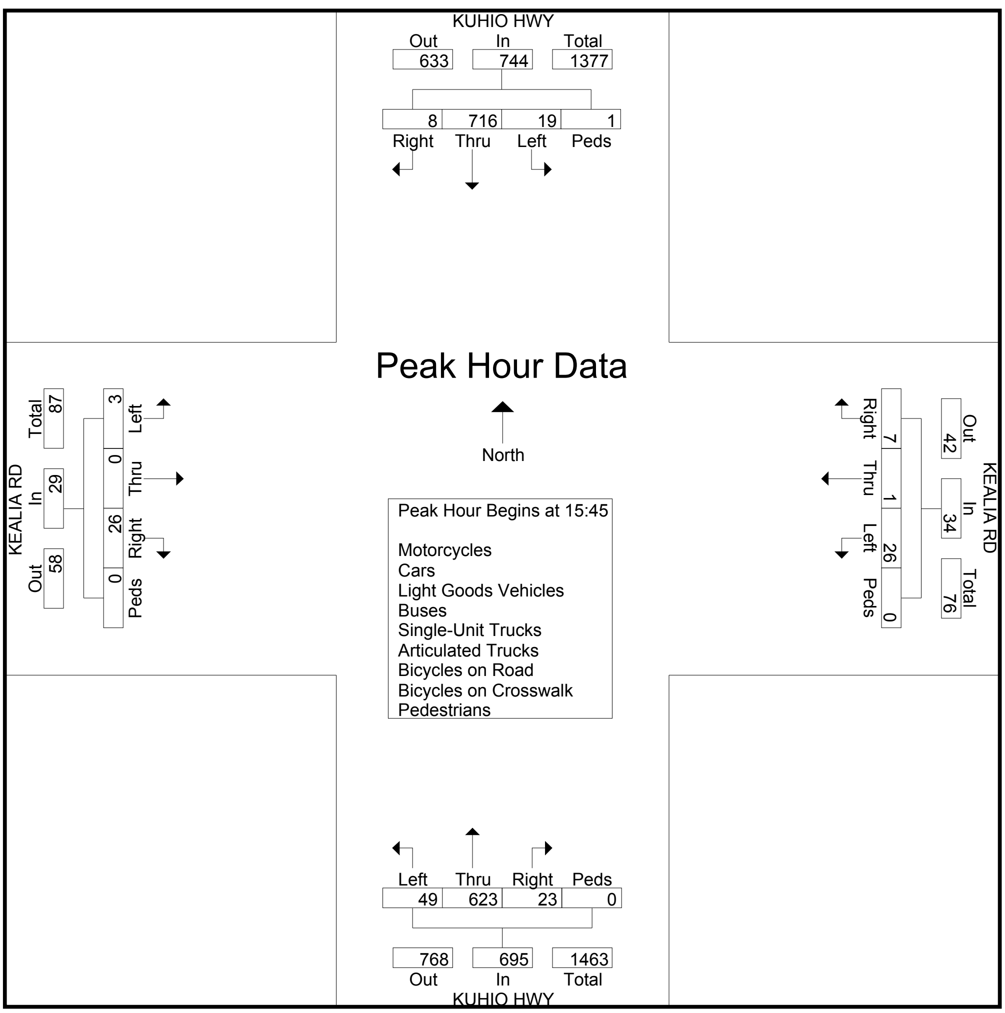
File Name : PM_Kuhio Hwy - Kealia Rd
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017

	KUHIO HWY Southbound					KEALIA RD Westbound					KUHIO HWY Northbound					KEALIA RD Eastbound					
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 15:45 to 16:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	**3**	163	6	0	172	**2**	0	8	0	10	**7**	133	**15**	0	155	**12**	0	**2**	0	**14**	351
16:00	1	157	1	**1**	160	1	0	1	0	2	6	**181**	14	0	**201**	1	0	1	0	2	365
16:15	1	177	**7**	0	185	2	0	**10**	0	**12**	5	161	11	0	177	6	0	0	0	6	380
16:30	3	**219**	5	0	**227**	2	**1**	7	0	10	5	148	9	0	162	7	0	0	0	7	**406**
Total Volume	8	716	19	1	744	7	1	26	0	34	23	623	49	0	695	26	0	3	0	29	1502
% App. Total	1.1	96.2	2.6	0.1		20.6	2.9	76.5	0		3.3	89.6	7.1	0		89.7	0	10.3	0		
PHF	.667	.817	.679	.250	.819	.875	.250	.650	.000	.708	.821	.860	.817	.000	.864	.542	.000	.375	.000	.518	.925



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File Name : PM_Kuhio Hwy - Mailihuna Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				MAILIHUNA RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:45	36	157	0	0	0	0	0	0	0	137	6	0	11	0	25	0	372
Total	36	157	0	0	0	0	0	0	0	137	6	0	11	0	25	0	372
16:00	33	126	0	0	0	0	0	0	0	176	6	0	11	0	36	1	389
16:15	42	144	0	0	0	1	0	0	0	139	8	0	6	0	38	0	378
16:30	43	140	0	0	0	0	0	0	0	136	8	0	8	0	35	0	370
Grand Total	154	567	0	0	0	1	0	0	0	588	28	0	36	0	134	1	1509
Apprch %	21.4	78.6	0	0	0	100	0	0	0	95.5	4.5	0	21.1	0	78.4	0.6	
Total %	10.2	37.6	0	0	0	0.1	0	0	0	39	1.9	0	2.4	0	8.9	0.1	

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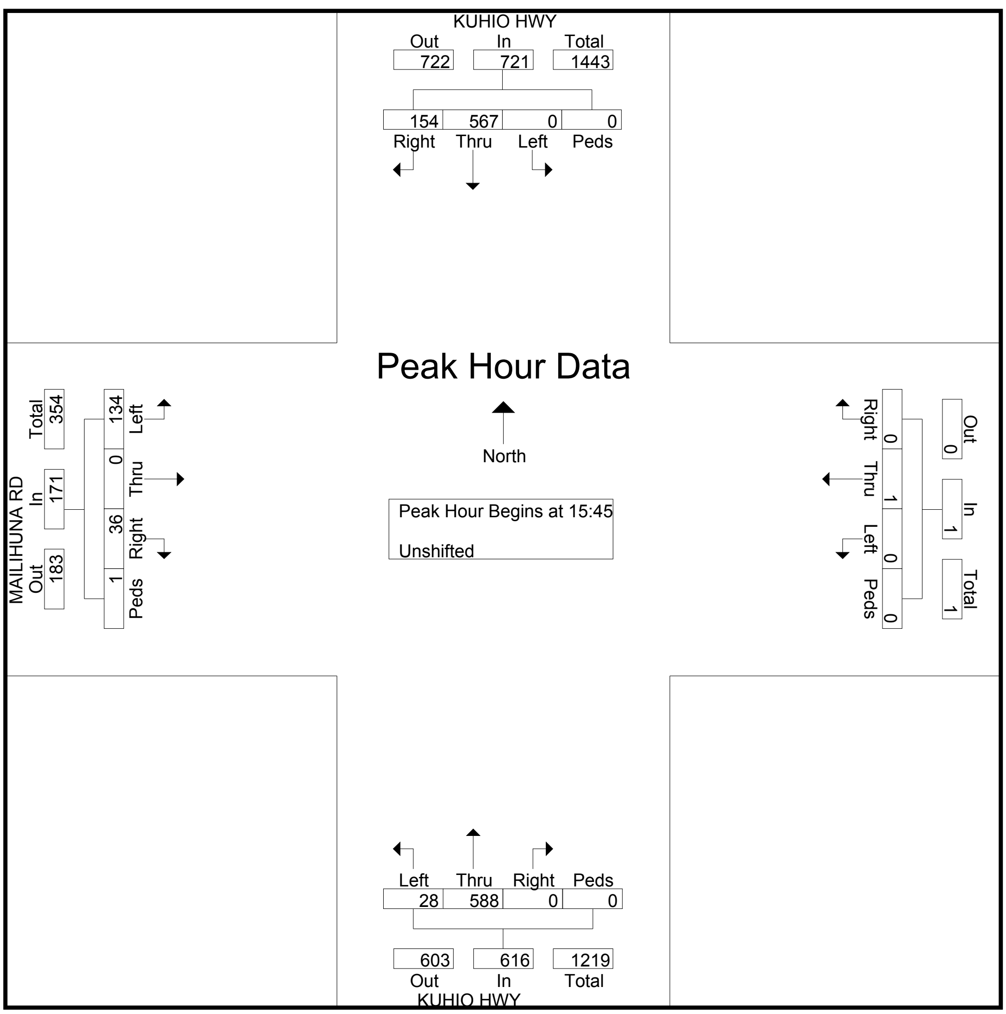
File Name : PM_Kuhio Hwy - Mailihuna Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					MAILIHUNA RD Eastbound					
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 15:45 to 16:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	36	**157**	0	0	**193**	0	0	0	0	0	0	137	6	0	143	**11**	0	25	0	36	372
16:00	33	126	0	0	159	0	0	0	0	0	0	**176**	6	0	**182**	11	0	36	**1**	**48**	**389**
16:15	42	144	0	0	186	0	**1**	0	0	**1**	0	139	**8**	0	147	6	0	**38**	0	44	378
16:30	**43**	140	0	0	183	0	0	0	0	0	0	136	8	0	144	8	0	35	0	43	370
Total Volume	154	567	0	0	721	0	1	0	0	1	0	588	28	0	616	36	0	134	1	171	1509
% App. Total	21.4	78.6	0	0		0	100	0	0		0	95.5	4.5	0		21.1	0	78.4	0.6		
PHF	.895	.903	.000	.000	.934	.000	.250	.000	.000	.250	.000	.835	.875	.000	.846	.818	.000	.882	.250	.891	.970



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File Name : PM_Kuhio Hwy - Kawaihau Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				KAWAIHAU RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	4	163	0	3	0	0	0	0	0	125	51	0	54	0	0	1	401
15:45	2	169	0	2	0	0	0	0	0	152	57	0	69	0	0	0	451
Total	6	332	0	5	0	0	0	0	0	277	108	0	123	0	0	1	852
16:00	5	138	0	0	0	0	0	0	0	163	58	0	55	0	0	0	419
16:15	3	156	0	5	0	0	0	0	0	135	65	0	29	0	1	8	402
16:30	3	181	0	1	0	0	0	0	0	160	64	0	58	0	0	0	467
16:45	4	157	0	1	0	0	0	0	0	167	55	0	54	0	0	2	440
Total	15	632	0	7	0	0	0	0	0	625	242	0	196	0	1	10	1728
17:00	2	135	0	2	0	0	0	0	0	145	52	0	52	0	0	1	389
17:15	2	132	0	3	0	0	0	0	0	133	67	0	39	0	0	1	377
Grand Total	25	1231	0	17	0	0	0	0	0	1180	469	0	410	0	1	13	3346
Apprch %	2	96.7	0	1.3	0	0	0	0	0	71.6	28.4	0	96.7	0	0.2	3.1	
Total %	0.7	36.8	0	0.5	0	0	0	0	0	35.3	14	0	12.3	0	0	0.4	

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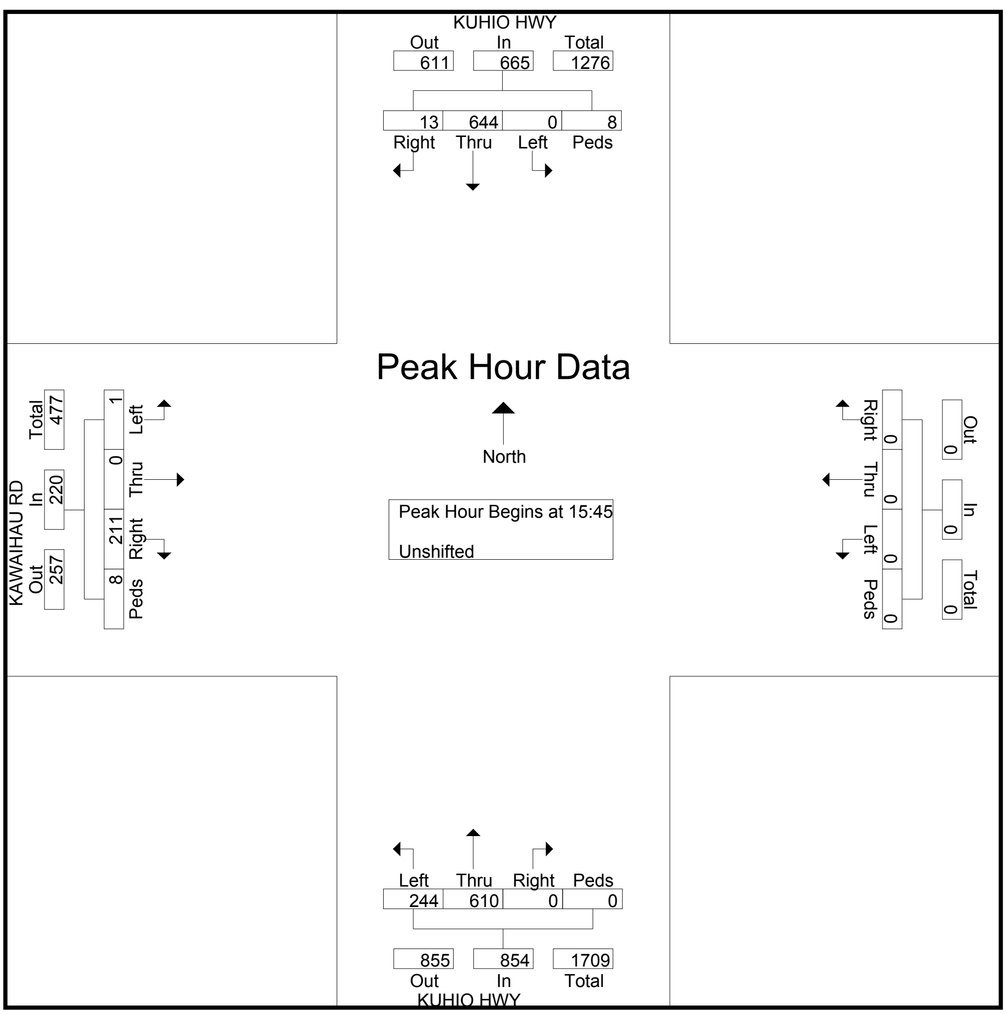
File Name : PM_Kuhio Hwy - Kawaihau Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					KAWAIHAU RD Eastbound					
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 15:30 to 17:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	2	169	0	2	173	0	0	0	0	0	0	152	57	0	209	**69**	0	0	0	**69**	451
16:00	**5**	138	0	0	143	0	0	0	0	0	0	**163**	58	0	221	55	0	0	0	55	419
16:15	3	156	0	**5**	164	0	0	0	0	0	0	135	**65**	0	200	29	0	**1**	**8**	38	402
16:30	3	**181**	0	1	**185**	0	0	0	0	0	0	160	64	0	**224**	58	0	0	0	58	**467**
Total Volume	13	644	0	8	665	0	0	0	0	0	0	610	244	0	854	211	0	1	8	220	1739
% App. Total	2	96.8	0	1.2		0	0	0	0		0	71.4	28.6	0		95.9	0	0.5	3.6		
PHF	.650	.890	.000	.400	.899	.000	.000	.000	.000	.000	.000	.936	.938	.000	.953	.764	.000	.250	.250	.797	.931



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File Name : PM_Kuhio Hwy - Hauaala Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				HAUAALA RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	1	215	0	0	0	0	0	0	0	176	26	0	36	0	0	1	455
15:45	4	235	0	0	0	0	0	0	0	209	30	0	41	0	1	0	520
Total	5	450	0	0	0	0	0	0	0	385	56	0	77	0	1	1	975
16:00	3	190	0	0	0	0	0	0	0	221	27	0	42	0	1	0	484
16:15	5	185	0	0	0	0	0	0	0	200	22	0	33	0	0	8	453
16:30	3	238	0	0	0	0	0	0	0	222	20	0	40	0	1	0	524
16:45	1	210	0	0	0	0	0	0	0	224	23	0	26	0	2	2	488
Total	12	823	0	0	0	0	0	0	0	867	92	0	141	0	4	10	1949
17:00	4	183	0	0	0	0	0	0	0	198	22	0	34	0	0	1	442
17:15	0	171	0	0	0	0	0	0	0	200	28	0	46	0	1	1	447
Grand Total	21	1627	0	0	0	0	0	0	0	1650	198	0	298	0	6	13	3813
Apprch %	1.3	98.7	0	0	0	0	0	0	0	89.3	10.7	0	94	0	1.9	4.1	
Total %	0.6	42.7	0	0	0	0	0	0	0	43.3	5.2	0	7.8	0	0.2	0.3	

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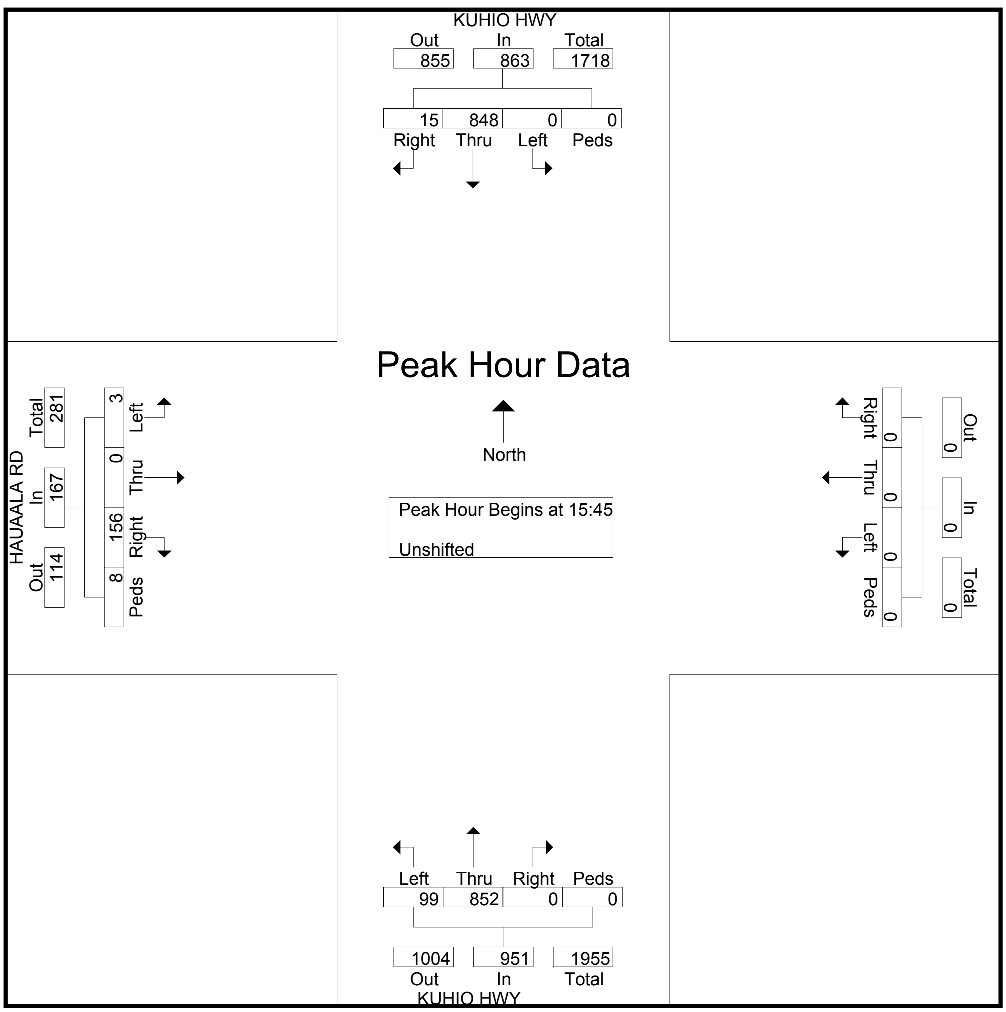
File Name : PM_Kuhio Hwy - Hauaala Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					**Westbound**					**KUHIO HWY Northbound**					**HAUAALA RD Eastbound**					
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 15:30 to 17:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	4	235	0	0	239	0	0	0	0	0	0	209	**30**	0	239	41	0	**1**	0	42	520
16:00	3	190	0	0	193	0	0	0	0	0	0	221	27	0	**248**	**42**	0	1	0	**43**	484
16:15	**5**	185	0	0	190	0	0	0	0	0	0	200	22	0	222	33	0	0	**8**	41	453
16:30	3	**238**	0	0	**241**	0	0	0	0	0	0	**222**	20	0	242	40	0	1	0	41	**524**
Total Volume	15	848	0	0	863	0	0	0	0	0	0	852	99	0	951	156	0	3	8	167	1981
% App. Total	1.7	98.3	0	0		0	0	0	0		0	89.6	10.4	0		93.4	0	1.8	4.8		
PHF	.750	.891	.000	.000	.895	.000	.000	.000	.000	.000	.000	.959	.825	.000	.959	.929	.000	.750	.250	.971	.945



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File Name : PM_Kuhio Hwy - Cane Haul Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 1

Groups Printed- Unshifted

	KUHIO HWY Southbound				Westbound				KUHIO HWY Northbound				CANE HAUL RD Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	71	180	0	0	0	0	0	0	0	202	7	0	0	0	0	0	460
15:45	73	201	0	0	0	0	0	0	0	239	3	0	0	0	0	0	516
Total	144	381	0	0	0	0	0	0	0	441	10	0	0	0	0	0	976
16:00	71	159	0	0	0	0	0	0	0	248	7	0	0	0	0	0	485
16:15	70	167	0	0	0	0	0	0	0	222	2	0	0	0	0	0	461
16:30	81	169	0	0	0	0	0	0	0	242	2	0	0	0	0	0	494
16:45	72	170	0	0	0	0	0	0	0	247	3	0	0	0	0	0	492
Total	294	665	0	0	0	0	0	0	0	959	14	0	0	0	0	0	1932
17:00	57	164	0	0	0	0	0	0	0	220	2	0	0	0	0	0	443
17:15	58	167	0	0	0	0	0	0	0	228	2	0	0	0	0	0	455
Grand Total	553	1377	0	0	0	0	0	0	0	1848	28	0	0	0	0	0	3806
Apprch %	28.7	71.3	0	0	0	0	0	0	0	98.5	1.5	0	0	0	0	0	
Total %	14.5	36.2	0	0	0	0	0	0	0	48.6	0.7	0	0	0	0	0	

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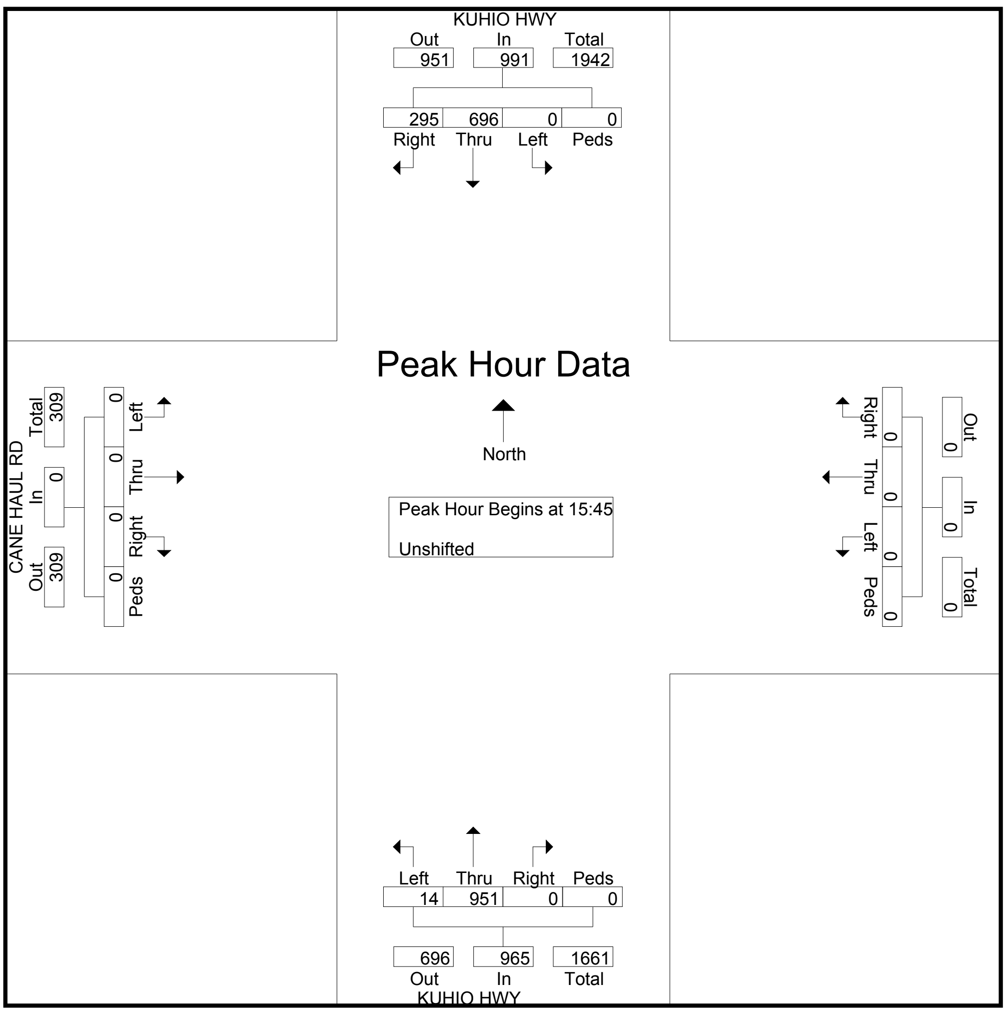
File Name : PM_Kuhio Hwy - Cane Haul Rd
Site Code : 00000000
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					Westbound					KUHIO HWY Northbound					CANE HAUL RD Eastbound					
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 15:30 to 17:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	73	**201**	0	0	**274**	0	0	0	0	0	0	239	3	0	242	0	0	0	0	0	**516**
16:00	71	159	0	0	230	0	0	0	0	0	0	**248**	**7**	0	**255**	0	0	0	0	0	485
16:15	70	167	0	0	237	0	0	0	0	0	0	222	2	0	224	0	0	0	0	0	461
16:30	**81**	169	0	0	250	0	0	0	0	0	0	242	2	0	244	0	0	0	0	0	494
Total Volume	295	696	0	0	991	0	0	0	0	0	0	951	14	0	965	0	0	0	0	0	1956
% App. Total	29.8	70.2	0	0		0	0	0	0		0	98.5	1.5	0		0	0	0	0		
PHF	.910	.866	.000	.000	.904	.000	.000	.000	.000	.000	.000	.959	.500	.000	.946	.000	.000	.000	.000	.000	.948



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File Name : PM_Kuhio Hwy - Lehua St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound			KUHIO HWY Northbound			LEHUA ST Eastbound			
Start Time	Right	Thru	Peds	Thru	Left	Peds	Right	Left	Peds	Int. Total
15:45	39	157	0	166	5	0	7	71	1	446
Total	39	157	0	166	5	0	7	71	1	446
16:00	35	141	0	174	2	0	0	87	4	443
16:15	35	124	0	154	4	0	2	80	1	400
16:30	42	149	0	170	7	0	0	59	2	429
Grand Total	151	571	0	664	18	0	9	297	8	1718
Apprch %	20.9	79.1	0	97.4	2.6	0	2.9	94.6	2.5	
Total %	8.8	33.2	0	38.6	1	0	0.5	17.3	0.5	
Motorcycles	0	1	0	4	0	0	0	1	0	6
% Motorcycles	0	0.2	0	0.6	0	0	0	0.3	0	0.3
Cars	100	423	0	479	13	0	6	185	0	1206
% Cars	66.2	74.1	0	72.1	72.2	0	66.7	62.3	0	70.2
Light Goods Vehicles	41	136	0	176	5	0	3	106	0	467
% Light Goods Vehicles	27.2	23.8	0	26.5	27.8	0	33.3	35.7	0	27.2
Buses	4	1	0	1	0	0	0	4	0	10
% Buses	2.6	0.2	0	0.2	0	0	0	1.3	0	0.6
Single-Unit Trucks	5	6	0	2	0	0	0	1	0	14
% Single-Unit Trucks	3.3	1.1	0	0.3	0	0	0	0.3	0	0.8
Articulated Trucks	0	1	0	0	0	0	0	0	0	1
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0.1
Bicycles on Road	1	3	0	2	0	0	0	0	0	6
% Bicycles on Road	0.7	0.5	0	0.3	0	0	0	0	0	0.3
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	8	8
% Pedestrians	0	0	0	0	0	0	0	0	100	0.5

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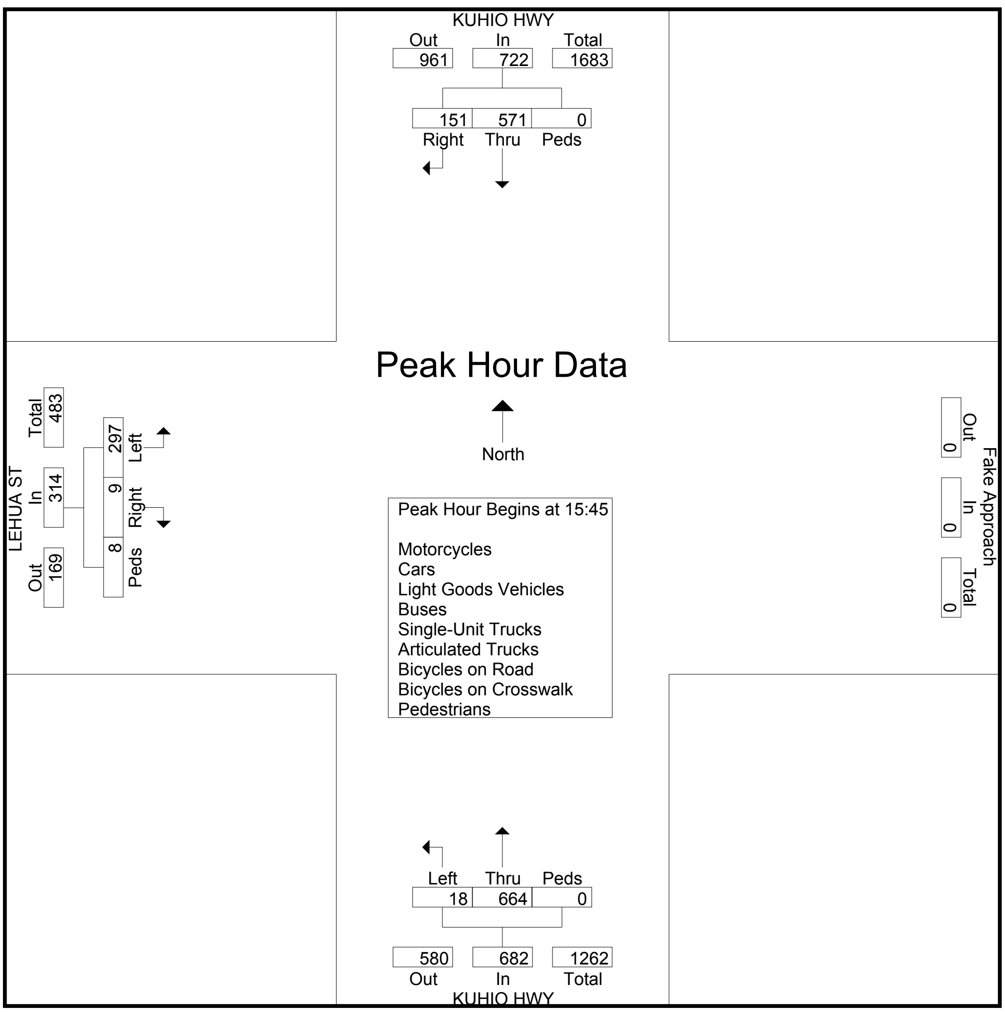
File Name : PM_Kuhio Hwy - Lehua St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017

	KUHIO HWY Southbound				KUHIO HWY Northbound				LEHUA ST Eastbound				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:45 to 16:30 - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 15:45													
15:45	39	**157**	0	**196**	166	5	0	171	**7**	71	1	79	**446**
16:00	35	141	0	176	**174**	2	0	176	0	**87**	**4**	**91**	443
16:15	35	124	0	159	154	4	0	158	2	80	1	83	400
16:30	**42**	149	0	191	170	**7**	0	**177**	0	59	2	61	429
Total Volume	151	571	0	722	664	18	0	682	9	297	8	314	1718
% App. Total	20.9	79.1	0		97.4	2.6	0		2.9	94.6	2.5		
PHF	.899	.909	.000	.921	.954	.643	.000	.963	.321	.853	.500	.863	.963



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File Name : PM_Kuhio Hwy - Niu St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound				NIU ST Westbound				KUHIO HWY Northbound				NIU ST Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	4	152	11	0	13	1	0	4	1	147	3	10	2	0	2	10	360
15:45	6	151	9	0	22	0	1	9	1	146	9	8	4	0	0	5	371
Total	10	303	20	0	35	1	1	13	2	293	12	18	6	0	2	15	731
16:00	1	142	6	0	21	1	1	15	3	159	1	10	5	1	0	6	372
16:15	7	111	8	0	25	1	1	3	0	139	5	9	11	0	0	9	329
16:30	1	139	13	0	26	1	2	8	0	153	4	7	3	0	1	10	368
16:45	2	153	6	2	12	1	0	10	4	149	1	19	4	1	0	4	368
Total	11	545	33	2	84	4	4	36	7	600	11	45	23	2	1	29	1437
17:00	1	146	3	1	6	1	0	7	2	145	2	13	7	1	0	8	343
17:15	5	137	4	1	7	2	3	1	1	164	2	7	4	0	1	15	354
Grand Total	27	1131	60	4	132	8	8	57	12	1202	27	83	40	3	4	67	2865
Apprch %	2.2	92.6	4.9	0.3	64.4	3.9	3.9	27.8	0.9	90.8	2	6.3	35.1	2.6	3.5	58.8	
Total %	0.9	39.5	2.1	0.1	4.6	0.3	0.3	2	0.4	42	0.9	2.9	1.4	0.1	0.1	2.3	
Motorcycles	0	3	1	0	2	0	1	0	0	2	0	0	1	0	0	0	10
% Motorcycles	0	0.3	1.7	0	1.5	0	12.5	0	0	0.2	0	0	2.5	0	0	0	0.3
Cars	20	829	41	0	85	7	7	0	10	857	20	0	21	2	3	0	1902
% Cars	74.1	73.3	68.3	0	64.4	87.5	87.5	0	83.3	71.3	74.1	0	52.5	66.7	75	0	66.4
Light Goods Vehicles	7	276	18	0	42	1	0	0	0	329	7	0	14	1	1	0	696
% Light Goods Vehicles	25.9	24.4	30	0	31.8	12.5	0	0	0	27.4	25.9	0	35	33.3	25	0	24.3
Buses	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	4
% Buses	0	0.2	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.1
Single-Unit Trucks	0	12	0	0	2	0	0	0	0	8	0	0	3	0	0	0	25
% Single-Unit Trucks	0	1.1	0	0	1.5	0	0	0	0	0.7	0	0	7.5	0	0	0	0.9
Articulated Trucks	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
% Articulated Trucks	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Road	0	6	0	0	1	0	0	0	2	4	0	0	1	0	0	0	14
% Bicycles on Road	0	0.5	0	0	0.8	0	0	0	16.7	0.3	0	0	2.5	0	0	0	0.5
Bicycles on Crosswalk	0	0	0	2	0	0	0	3	0	0	0	6	0	0	0	3	14
% Bicycles on Crosswalk	0	0	0	50	0	0	0	5.3	0	0	0	7.2	0	0	0	4.5	0.5
Pedestrians	0	0	0	2	0	0	0	54	0	0	0	77	0	0	0	64	197
% Pedestrians	0	0	0	50	0	0	0	94.7	0	0	0	92.8	0	0	0	95.5	6.9

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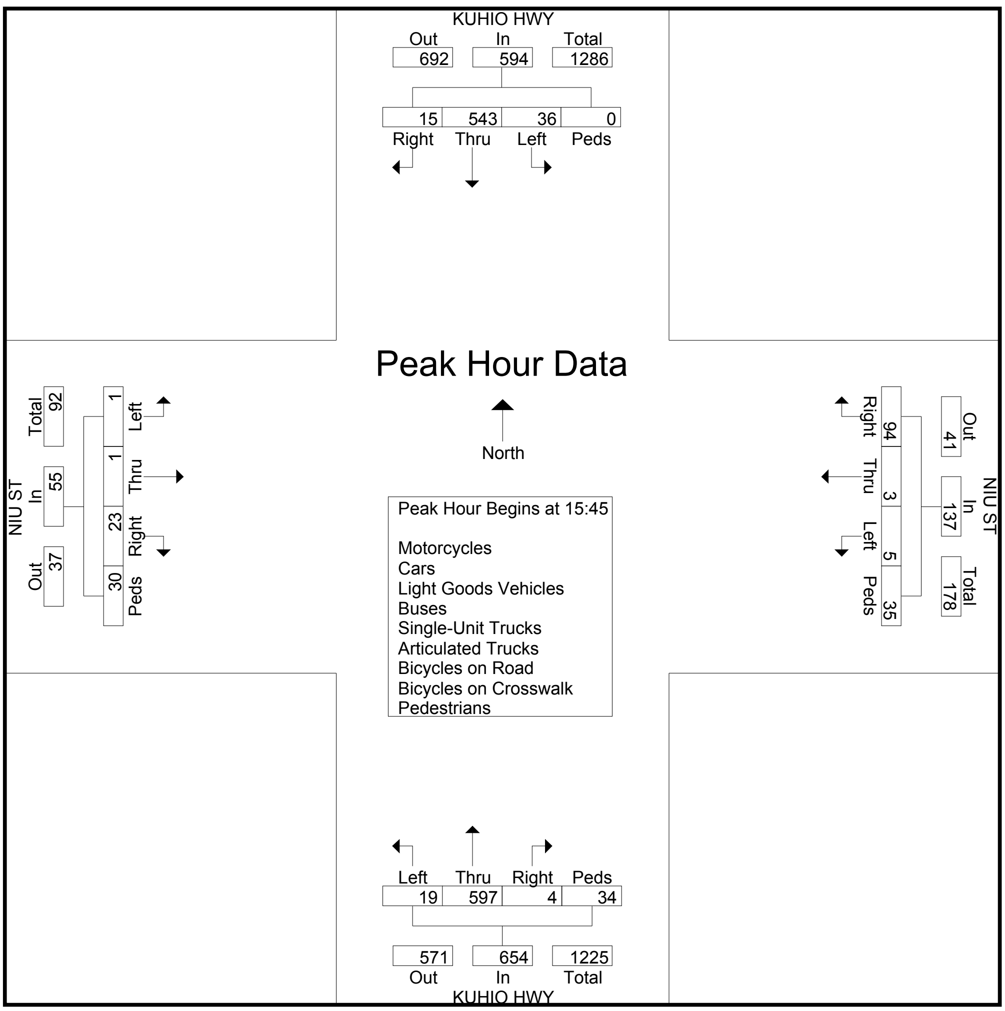
File Name : PM_Kuhio Hwy - Niu St
Site Code : 17-035 Kealia Residential Subdivision
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					NIU ST Westbound					KUHIO HWY Northbound					NIU ST Eastbound					
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 15:30 to 17:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	6	**151**	9	0	**166**	22	0	1	9	32	1	146	**9**	8	164	4	0	0	5	9	371
16:00	1	142	6	0	149	21	**1**	1	**15**	**38**	**3**	**159**	1	**10**	**173**	5	**1**	0	6	12	**372**
16:15	**7**	111	8	0	126	25	1	1	3	30	0	139	5	9	153	**11**	0	0	9	**20**	329
16:30	1	139	**13**	0	153	**26**	1	**2**	8	37	0	153	4	7	164	3	0	**1**	**10**	14	368
Total Volume	15	543	36	0	594	94	3	5	35	137	4	597	19	34	654	23	1	1	30	55	1440
% App. Total	2.5	91.4	6.1	0		68.6	2.2	3.6	25.5		0.6	91.3	2.9	5.2		41.8	1.8	1.8	54.5		
PHF	.536	.899	.692	.000	.895	.904	.750	.625	.583	.901	.333	.939	.528	.850	.945	.523	.250	.250	.750	.688	.968



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File Name : PM_Kuhio Hwy - Kukui_Huluili St
Site Code : 17-035
Start Date : 4/18/2017
Page No : 1

Groups Printed- Motorcycles - Cars - Light Goods Vehicles - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUHIO HWY Southbound				KUKUI ST Westbound				KUHIO HWY Northbound				KUKUI ST Eastbound				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
15:30	11	143	2	2	5	0	0	17	3	135	7	9	4	2	6	9	355
15:45	13	144	1	6	6	0	0	15	1	153	11	8	16	6	6	7	393
Total	24	287	3	8	11	0	0	32	4	288	18	17	20	8	12	16	748
16:00	12	135	1	8	3	0	0	28	2	157	8	8	12	2	8	13	397
16:15	11	112	2	8	9	0	0	10	3	130	4	6	7	0	3	8	313
16:30	13	134	0	8	5	0	0	15	1	138	8	19	6	2	9	18	376
16:45	12	139	1	4	3	0	0	15	1	135	8	12	5	0	10	8	353
Total	48	520	4	28	20	0	0	68	7	560	28	45	30	4	30	47	1439
17:00	7	134	0	7	3	0	0	9	2	130	4	10	4	0	7	0	317
17:15	11	134	1	6	3	0	0	25	1	155	13	11	3	2	8	11	384
Grand Total	90	1075	8	49	37	0	0	134	14	1133	63	83	57	14	57	74	2888
Apprch %	7.4	88	0.7	4	21.6	0	0	78.4	1.1	87.6	4.9	6.4	28.2	6.9	28.2	36.6	
Total %	3.1	37.2	0.3	1.7	1.3	0	0	4.6	0.5	39.2	2.2	2.9	2	0.5	2	2.6	
Motorcycles	1	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6
% Motorcycles	1.1	0.3	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.2
Cars	62	786	5	0	31	0	0	0	13	809	47	0	43	9	42	0	1847
% Cars	68.9	73.1	62.5	0	83.8	0	0	0	92.9	71.4	74.6	0	75.4	64.3	73.7	0	64
Light Goods Vehicles	24	266	3	0	6	0	0	0	1	311	15	0	13	4	15	0	658
% Light Goods Vehicles	26.7	24.7	37.5	0	16.2	0	0	0	7.1	27.4	23.8	0	22.8	28.6	26.3	0	22.8
Buses	0	2	0	0	0	0	0	0	0	1	1	0	1	0	0	0	5
% Buses	0	0.2	0	0	0	0	0	0	0	0.1	1.6	0	1.8	0	0	0	0.2
Single-Unit Trucks	2	11	0	0	0	0	0	0	0	8	0	0	0	1	0	0	22
% Single-Unit Trucks	2.2	1	0	0	0	0	0	0	0	0.7	0	0	0	7.1	0	0	0.8
Articulated Trucks	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
% Articulated Trucks	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Bicycles on Road	1	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	8
% Bicycles on Road	1.1	0.5	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0.3
Bicycles on Crosswalk	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	2	10
% Bicycles on Crosswalk	0	0	0	0	0	0	0	3.7	0	0	0	3.6	0	0	0	2.7	0.3
Pedestrians	0	0	0	49	0	0	0	129	0	0	0	80	0	0	0	72	330
% Pedestrians	0	0	0	100	0	0	0	96.3	0	0	0	96.4	0	0	0	97.3	11.4

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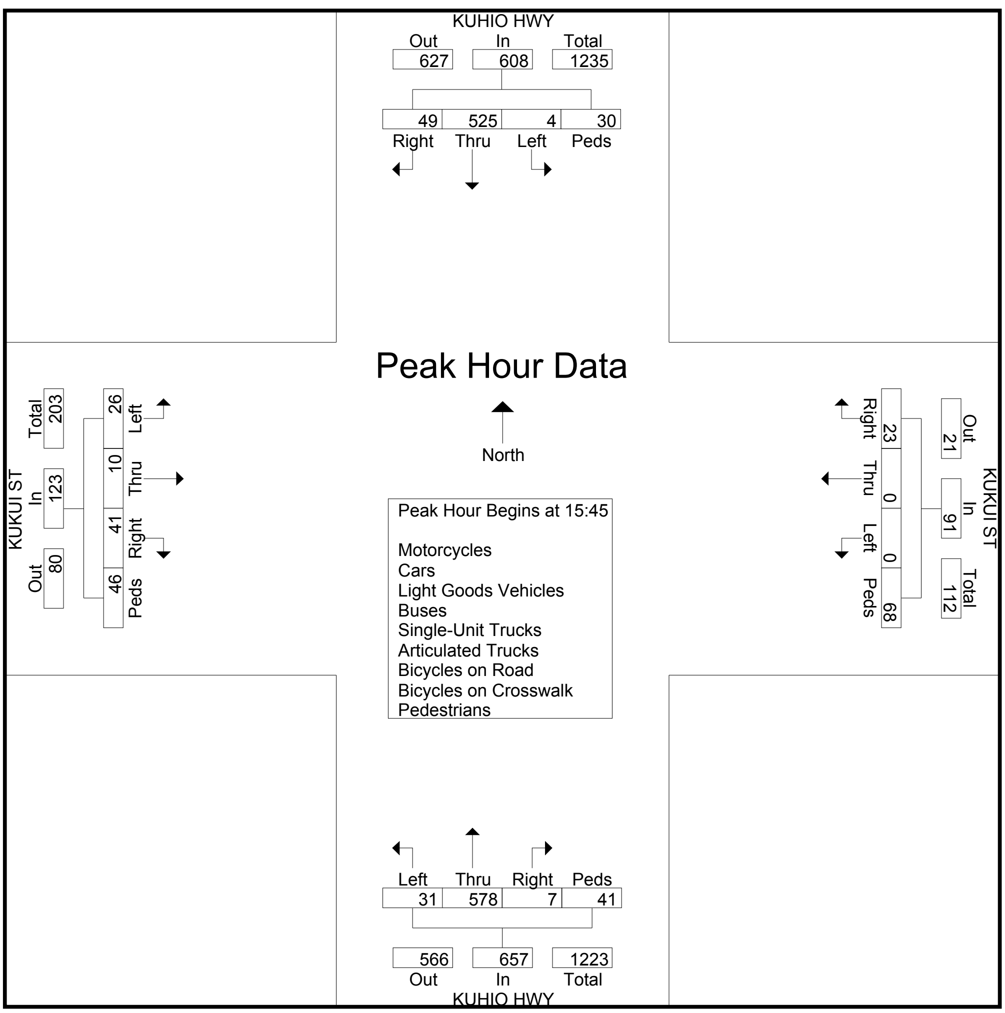
File Name : PM_Kuhio Hwy - Kukui_Huluili St
Site Code : 17-035
Start Date : 4/18/2017
Page No : 2

	KUHIO HWY Southbound					KUKUI ST Westbound					KUHIO HWY Northbound					KUKUI ST Eastbound					
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 15:30 to 17:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	**13**	**144**	1	6	**164**	6	0	0	15	21	1	153	**11**	8	173	**16**	**6**	6	7	**35**	393
16:00	12	135	1	**8**	156	3	0	0	**28**	**31**	2	**157**	8	8	**175**	12	2	8	13	35	**397**
16:15	11	112	**2**	8	133	**9**	0	0	10	19	**3**	130	4	6	143	7	0	3	8	18	313
16:30	13	134	0	8	155	5	0	0	15	20	1	138	8	**19**	166	6	2	**9**	**18**	35	376
Total Volume	49	525	4	30	608	23	0	0	68	91	7	578	31	41	657	41	10	26	46	123	1479
% App. Total	8.1	86.3	0.7	4.9		25.3	0	0	74.7		1.1	88	4.7	6.2		33.3	8.1	21.1	37.4		
PHF	.942	.911	.500	.938	.927	.639	.000	.000	.607	.734	.583	.920	.705	.539	.939	.641	.417	.722	.639	.879	.931



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 2010)

Level of service for vehicles at 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 the 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.

VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 2010)

The level of service criteria for vehicles at 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

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing AM Peak

Intersection	
Int Delay, s/veh	4.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	17	3	3	13	2	8
Future Vol, veh/h	17	3	3	13	2	8
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	18	3	3	14	2	9

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	24	10	0	0	17	0
Stage 1	10	-	-	-	-	-
Stage 2	14	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	992	1071	-	-	1600	-
Stage 1	1013	-	-	-	-	-
Stage 2	1009	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	990	1071	-	-	1600	-
Mov Cap-2 Maneuver	990	-	-	-	-	-
Stage 1	1012	-	-	-	-	-
Stage 2	1008	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	1.5
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	1001	1600	-
HCM Lane V/C Ratio	-	-	0.022	0.001	-
HCM Control Delay (s)	-	-	8.7	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	9	0	24	20	1	6	20	626	30	9	655	4
Future Vol, veh/h	9	0	24	20	1	6	20	626	30	9	655	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	10	0	26	22	1	7	22	680	33	10	712	4

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1479	1491	714	1488	1477	697	716	0	0	713	0	0
Stage 1	734	734	-	741	741	-	-	-	-	-	-	-
Stage 2	745	757	-	747	736	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	104	124	431	102	126	441	885	-	-	887	-	-
Stage 1	412	426	-	408	423	-	-	-	-	-	-	-
Stage 2	406	416	-	405	425	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	99	120	431	93	121	441	885	-	-	887	-	-
Mov Cap-2 Maneuver	99	120	-	93	121	-	-	-	-	-	-	-
Stage 1	402	421	-	398	412	-	-	-	-	-	-	-
Stage 2	389	406	-	376	420	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24	47.2	0.3	0.1
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	885	-	-	225	114	887	-	-
HCM Lane V/C Ratio	0.025	-	-	0.159	0.257	0.011	-	-
HCM Control Delay (s)	9.2	-	-	24	47.2	9.1	-	-
HCM Lane LOS	A	-	-	C	E	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	1	0	-	-

Intersection						
Int Delay, s/veh	89.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	234	78	96	459	534	163
Future Vol, veh/h	234	78	96	459	534	163
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	254	85	104	499	580	177

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1287	580	757	0	-	0
Stage 1	580	-	-	-	-	-
Stage 2	707	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 181	514	854	-	-	-
Stage 1	560	-	-	-	-	-
Stage 2	489	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 151	514	854	-	-	-
Mov Cap-2 Maneuver	~ 151	-	-	-	-	-
Stage 1	466	-	-	-	-	-
Stage 2	489	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 447.4	1.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	854	-	183	-	-
HCM Lane V/C Ratio	0.122	-	1.853	-	-
HCM Control Delay (s)	9.8	0	$ 447.4	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0.4	-	24.7	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	16.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	321	330	484	559	26
Future Vol, veh/h	11	321	330	484	559	26
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	349	359	526	608	28

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1883	630	644	0	-	0
Stage 1	630	-	-	-	-	-
Stage 2	1253	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	78	482	941	-	-	-
Stage 1	531	-	-	-	-	-
Stage 2	269	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	47	478	934	-	-	-
Mov Cap-2 Maneuver	47	-	-	-	-	-
Stage 1	324	-	-	-	-	-
Stage 2	267	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	77	4.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	934	-	367	-	-
HCM Lane V/C Ratio	0.384	-	0.983	-	-
HCM Control Delay (s)	11.2	-	77	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	1.8	-	11.3	-	-

Intersection						
Int Delay, s/veh	36.2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	338	66	813	870	10
Future Vol, veh/h	14	338	66	813	870	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	367	72	884	946	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1551	956	961	0	-	0
Stage 1	956	-	-	-	-	-
Stage 2	595	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	114	~ 312	714	-	-	-
Stage 1	372	-	-	-	-	-
Stage 2	515	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	91	~ 311	711	-	-	-
Mov Cap-2 Maneuver	91	-	-	-	-	-
Stage 1	297	-	-	-	-	-
Stage 2	513	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	213.2	1.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	711	-	284	-	-
HCM Lane V/C Ratio	0.101	-	1.347	-	-
HCM Control Delay (s)	10.6	0.9	213.2	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.3	-	19.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	17	935	839	401
Future Volume (Veh/h)	0	0	17	935	839	401
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)	0	0	18	1016	912	436
Pedestrians	4				9	
Lane Width (ft)	0.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1687	1134	1352			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1687	1134	1352			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	96			
cM capacity (veh/h)	81	196	505			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	357	677	1348
Volume Left	18	0	0
Volume Right	0	0	436
cSH	505	1700	1700
Volume to Capacity	0.04	0.40	0.79
Queue Length 95th (ft)	3	0	0
Control Delay (s)	1.1	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.4		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		

Intersection						
Int Delay, s/veh	16.1					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	285	10	4	701	740	71
Future Vol, veh/h	285	10	4	701	740	71
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	310	11	4	762	804	77

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1618	848	886	0	-	0
Stage 1	848	-	-	-	-	-
Stage 2	770	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 114	361	764	-	-	-
Stage 1	420	-	-	-	-	-
Stage 2	457	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 112	359	760	-	-	-
Mov Cap-2 Maneuver	~ 309	-	-	-	-	-
Stage 1	416	-	-	-	-	-
Stage 2	455	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	98.3	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	760	-	310	-	-
HCM Lane V/C Ratio	0.006	-	1.034	-	-
HCM Control Delay (s)	9.8	-	98.3	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0	-	11.7	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	2	6	5	2	55	8	644	5	69	679	4
Future Vol, veh/h	5	2	6	5	2	55	8	644	5	69	679	4
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	2	7	5	2	60	9	700	5	75	738	4

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1654	1639	765	1643	1639	717	754	0	0	719	0	0
Stage 1	902	902	-	735	735	-	-	-	-	-	-	-
Stage 2	752	737	-	908	904	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	78	100	403	80	100	430	856	-	-	882	-	-
Stage 1	332	356	-	411	425	-	-	-	-	-	-	-
Stage 2	402	425	-	330	356	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	57	82	393	66	82	424	846	-	-	870	-	-
Mov Cap-2 Maneuver	57	82	-	66	82	-	-	-	-	-	-	-
Stage 1	322	300	-	398	412	-	-	-	-	-	-	-
Stage 2	337	412	-	271	300	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	45.9	22.7	0.1	0.9
HCM LOS	E	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	846	-	-	102	270	870	-	-
HCM Lane V/C Ratio	0.01	-	-	0.139	0.25	0.086	-	-
HCM Control Delay (s)	9.3	0	-	45.9	22.7	9.5	0	-
HCM Lane LOS	A	A	-	E	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.5	1	0.3	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	3	46	0	0	14	19	619	16	0	656	34
Future Volume (vph)	29	3	46	0	0	14	19	619	16	0	656	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1000	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.93	1.00	1.00			1.00	
Flpb, ped/bikes		0.97	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.96	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1735	1500			1505	1769	800			1167	
Flt Permitted		0.96	1.00			1.00	0.34	1.00			1.00	
Satd. Flow (perm)		1735	1500			1505	629	975			1167	
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)	32	3	50	0	0	15	21	673	17	0	713	37
RTOR Reduction (vph)	0	0	47	0	0	14	0	0	0	0	1	0
Lane Group Flow (vph)	0	35	3	0	0	1	21	690	0	0	749	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA			NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		13.5	13.5			13.5	188.5	188.5			180.9	
Effective Green, g (s)		13.5	13.5			13.5	188.5	188.5			180.9	
Actuated g/C Ratio		0.06	0.06			0.06	0.90	0.90			0.86	
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)		111	96			96	584	718			1005	
v/s Ratio Prot							0.00	c0.86			0.64	
v/s Ratio Perm		0.02	0.00			0.00	0.03					
v/c Ratio		0.32	0.03			0.01	0.04	0.96			0.75	
Uniform Delay, d1		93.8	92.1			92.0	2.2	8.0			5.6	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		1.6	0.1			0.0	0.0	25.2			5.0	
Delay (s)		95.5	92.3			92.0	2.2	33.2			10.7	
Level of Service		F	F			F	A	C			B	
Approach Delay (s)		93.6			92.0			32.3			10.7	
Approach LOS		F			F			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	27.6
Intersection LOS	D

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	694	194	65	534
Demand Flow Rate, veh/h	708	198	66	544
Vehicles Circulating, veh/h	420	50	517	248
Vehicles Exiting, veh/h	372	533	611	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	46.5	5.1	6.5	13.7
Approach LOS	E	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	708	198	66	544
Cap Entry Lane, veh/h	742	1075	674	882
Entry HV Adj Factor	0.981	0.979	0.985	0.981
Flow Entry, veh/h	694	194	65	534
Cap Entry, veh/h	728	1052	664	865
V/C Ratio	0.954	0.184	0.098	0.617
Control Delay, s/veh	46.5	5.1	6.5	13.7
LOS	E	A	A	B
95th %tile Queue, veh	14	1	0	4

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing PM Peak

Intersection	
Int Delay, s/veh	1.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	9	0	27	16	1	9
Future Vol, veh/h	9	0	27	16	1	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	10	0	29	17	1	10

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	50	38	0	0	46	0
Stage 1	38	-	-	-	-	-
Stage 2	12	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	959	1034	-	-	1562	-
Stage 1	984	-	-	-	-	-
Stage 2	1011	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	958	1034	-	-	1562	-
Mov Cap-2 Maneuver	958	-	-	-	-	-
Stage 1	983	-	-	-	-	-
Stage 2	1011	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.8	0	0.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	958	1562	-
HCM Lane V/C Ratio	-	-	0.01	0.001	-
HCM Control Delay (s)	-	-	8.8	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	0	26	26	1	7	49	623	23	19	716	8
Future Vol, veh/h	3	0	26	26	1	7	49	623	23	19	716	8
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	0	28	28	1	8	53	677	25	21	778	9

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1626	1633	783	1635	1625	691	787	0	0	702	0	0
Stage 1	825	825	-	796	796	-	-	-	-	-	-	-
Stage 2	801	808	-	839	829	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	82	101	394	81	102	445	832	-	-	895	-	-
Stage 1	367	387	-	380	399	-	-	-	-	-	-	-
Stage 2	378	394	-	360	385	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	75	92	394	70	93	445	832	-	-	895	-	-
Mov Cap-2 Maneuver	75	92	-	70	93	-	-	-	-	-	-	-
Stage 1	344	378	-	356	373	-	-	-	-	-	-	-
Stage 2	347	369	-	326	376	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.8	76.6	0.7	0.2
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	832	-	-	274	85	895	-	-
HCM Lane V/C Ratio	0.064	-	-	0.115	0.435	0.023	-	-
HCM Control Delay (s)	9.6	-	-	19.8	76.6	9.1	-	-
HCM Lane LOS	A	-	-	C	F	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.4	1.8	0.1	-	-

Intersection						
Int Delay, s/veh	12.3					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	134	36	28	588	567	154
Future Vol, veh/h	134	36	28	588	567	154
Conflicting Peds, #/hr	0	0	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	50
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	146	39	30	639	616	167

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1316	617	784	0	-	0
Stage 1	617	-	-	-	-	-
Stage 2	699	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	174	490	834	-	-	-
Stage 1	538	-	-	-	-	-
Stage 2	493	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	164	490	833	-	-	-
Mov Cap-2 Maneuver	164	-	-	-	-	-
Stage 1	507	-	-	-	-	-
Stage 2	493	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	107.4	0.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	833	-	191	-	-
HCM Lane V/C Ratio	0.037	-	0.967	-	-
HCM Control Delay (s)	9.5	0	107.4	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th %tile Q(veh)	0.1	-	7.9	-	-

Intersection						
Int Delay, s/veh	4.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	211	244	610	644	13
Future Vol, veh/h	1	211	244	610	644	13
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	229	265	663	700	14

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1916	715	722	0	-	0
Stage 1	715	-	-	-	-	-
Stage 2	1201	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	74	431	880	-	-	-
Stage 1	485	-	-	-	-	-
Stage 2	285	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	51	428	873	-	-	-
Mov Cap-2 Maneuver	51	-	-	-	-	-
Stage 1	335	-	-	-	-	-
Stage 2	283	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24.1	3.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	873	-	414	-	-
HCM Lane V/C Ratio	0.304	-	0.557	-	-
HCM Control Delay (s)	10.9	-	24.1	-	-
HCM Lane LOS	B	-	C	-	-
HCM 95th %tile Q(veh)	1.3	-	3.3	-	-

Intersection	
Int Delay, s/veh	3.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	156	99	852	848	15
Future Vol, veh/h	3	156	99	852	848	15
Conflicting Peds, #/hr	0	0	8	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	170	108	926	922	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1617	938	946	0	-	0
Stage 1	938	-	-	-	-	-
Stage 2	679	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	104	320	723	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	466	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	71	318	717	-	-	-
Mov Cap-2 Maneuver	71	-	-	-	-	-
Stage 1	260	-	-	-	-	-
Stage 2	462	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	32.5		2.4		0	
HCM LOS	D					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	717	-	298	-	-
HCM Lane V/C Ratio	0.15	-	0.58	-	-
HCM Control Delay (s)	10.9	1.4	32.5	-	-
HCM Lane LOS	B	A	D	-	-
HCM 95th %tile Q(veh)	0.5	-	3.4	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	14	951	696	295
Future Volume (Veh/h)	0	0	14	951	696	295
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)	0	0	15	1034	757	321
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	1464	918	1078			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1464	918	1078			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	98			
cM capacity (veh/h)	116	274	643			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	360	689	1078
Volume Left	15	0	0
Volume Right	0	0	321
cSH	643	1700	1700
Volume to Capacity	0.02	0.41	0.63
Queue Length 95th (ft)	2	0	0
Control Delay (s)	0.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.3		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

Intersection						
Int Delay, s/veh	15.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	297	9	18	664	571	151
Future Vol, veh/h	297	9	18	664	571	151
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	323	10	20	722	621	164

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1473	711	793	0	-	0
Stage 1	711	-	-	-	-	-
Stage 2	762	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 140	433	828	-	-	-
Stage 1	487	-	-	-	-	-
Stage 2	461	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 134	430	822	-	-	-
Mov Cap-2 Maneuver	329	-	-	-	-	-
Stage 1	471	-	-	-	-	-
Stage 2	457	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	87.1	0.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	822	-	331	-	-
HCM Lane V/C Ratio	0.024	-	1.005	-	-
HCM Control Delay (s)	9.5	-	87.1	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	11.3	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s   +: Computation Not Defined   *: All major volume in platoon

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	1	23	5	3	94	19	597	4	36	543	15
Future Vol, veh/h	1	1	23	5	3	94	19	597	4	36	543	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	1	25	5	3	102	21	649	4	39	590	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1452	1436	662	1451	1442	686	636	0	0	688	0	0
Stage 1	706	706	-	728	728	-	-	-	-	-	-	-
Stage 2	746	730	-	723	714	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	108	133	462	109	132	447	947	-	-	906	-	-
Stage 1	427	439	-	415	429	-	-	-	-	-	-	-
Stage 2	405	428	-	417	435	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	72	112	434	88	112	432	920	-	-	876	-	-
Mov Cap-2 Maneuver	72	112	-	88	112	-	-	-	-	-	-	-
Stage 1	400	398	-	387	400	-	-	-	-	-	-	-
Stage 2	296	399	-	354	394	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.9	20.7	0.3	0.6
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	920	-	-	330	339	876	-	-
HCM Lane V/C Ratio	0.022	-	-	0.082	0.327	0.045	-	-
HCM Control Delay (s)	9	0	-	16.9	20.7	9.3	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.3	1.4	0.1	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	10	41	0	0	23	31	578	7	4	525	49
Future Volume (vph)	26	10	41	0	0	23	31	578	7	4	525	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1000	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.96			0.96	1.00	1.00			1.00	
Flpb, ped/bikes		0.99	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.97	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1777	1522			1547	1769	850			1160	
Flt Permitted		0.97	1.00			1.00	0.39	1.00			1.00	
Satd. Flow (perm)		1777	1522			1547	723	978			1158	
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)	28	11	45	0	0	25	34	628	8	4	571	53
RTOR Reduction (vph)	0	0	38	0	0	21	0	0	0	0	2	0
Lane Group Flow (vph)	0	39	7	0	0	4	34	636	0	0	626	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA		Perm	NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		17.6	17.6			17.6	94.4	94.4			86.6	
Effective Green, g (s)		17.6	17.6			17.6	94.4	94.4			86.6	
Actuated g/C Ratio		0.15	0.15			0.15	0.79	0.79			0.72	
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)		260	223			226	601	668			835	
v/s Ratio Prot							0.00	c0.75				
v/s Ratio Perm		0.02	0.00			0.00	0.04				0.54	
v/c Ratio		0.15	0.03			0.02	0.06	0.95			0.75	
Uniform Delay, d1		44.7	43.9			43.8	3.5	10.9			10.1	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		0.3	0.1			0.0	0.0	24.8			6.1	
Delay (s)		44.9	43.9			43.8	3.5	35.6			16.2	
Level of Service		D	D			D	A	D			B	
Approach Delay (s)		44.4			43.8			34.0			16.2	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	26.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	13.0
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	417	388	328	420
Demand Flow Rate, veh/h	425	396	335	429
Vehicles Circulating, veh/h	381	151	381	547
Vehicles Exiting, veh/h	594	565	425	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	13.2	8.4	10.5	19.0
Approach LOS	B	A	B	C

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	425	396	335	429
Cap Entry Lane, veh/h	772	972	772	654
Entry HV Adj Factor	0.981	0.979	0.979	0.978
Flow Entry, veh/h	417	388	328	420
Cap Entry, veh/h	758	951	756	640
V/C Ratio	0.551	0.408	0.434	0.656
Control Delay, s/veh	13.2	8.4	10.5	19.0
LOS	B	A	B	C
95th %tile Queue, veh	3	2	2	5

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 AM Peak

Intersection	
Int Delay, s/veh	4.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	5	15	5	10
Future Vol, veh/h	20	5	5	15	5	10
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	5	16	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	35	13	0	0	21	0
Stage 1	13	-	-	-	-	-
Stage 2	22	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	978	1067	-	-	1595	-
Stage 1	1010	-	-	-	-	-
Stage 2	1001	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	974	1067	-	-	1595	-
Mov Cap-2 Maneuver	974	-	-	-	-	-
Stage 1	1007	-	-	-	-	-
Stage 2	1000	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	2.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	991	1595	-
HCM Lane V/C Ratio	-	-	0.027	0.003	-
HCM Control Delay (s)	-	-	8.7	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Future Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	0	27	22	5	11	22	810	33	11	875	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1779	1787	878	1784	1773	827	880	0	0	843	0	0
Stage 1	900	900	-	871	871	-	-	-	-	-	-	-
Stage 2	879	887	-	913	902	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	64	81	347	63	83	371	768	-	-	793	-	-
Stage 1	333	357	-	346	368	-	-	-	-	-	-	-
Stage 2	342	362	-	328	356	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	57	78	347	56	79	371	768	-	-	793	-	-
Mov Cap-2 Maneuver	57	78	-	56	79	-	-	-	-	-	-	-
Stage 1	323	352	-	336	357	-	-	-	-	-	-	-
Stage 2	318	352	-	298	351	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	39.7	88.9	0.2	0.1
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	768	-	-	141	78	793	-	-
HCM Lane V/C Ratio	0.028	-	-	0.27	0.488	0.014	-	-
HCM Control Delay (s)	9.8	-	-	39.7	88.9	9.6	-	-
HCM Lane LOS	A	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1	2	0	-	-

Intersection	
Intersection Delay, s/veh	16.0
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	430	707	907
Demand Flow Rate, veh/h	438	721	926
Vehicles Circulating, veh/h	743	277	111
Vehicles Exiting, veh/h	294	904	887
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	20.1	14.6	15.1
Approach LOS	C	B	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	438	721	926
Cap Entry Lane, veh/h	647	1040	1232
Entry HV Adj Factor	0.982	0.981	0.980
Flow Entry, veh/h	430	707	907
Cap Entry, veh/h	635	1020	1207
V/C Ratio	0.677	0.693	0.752
Control Delay, s/veh	20.1	14.6	15.1
LOS	C	B	C
95th %tile Queue, veh	5	6	8

Intersection						
Int Delay, s/veh	14.8					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	260	330	580	760	30
Future Vol, veh/h	5	260	330	580	760	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	283	359	630	826	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2208	851	867	0	-	0
Stage 1	851	-	-	-	-	-
Stage 2	1357	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	49	360	777	-	-	-
Stage 1	419	-	-	-	-	-
Stage 2	240	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	26	357	771	-	-	-
Mov Cap-2 Maneuver	26	-	-	-	-	-
Stage 1	222	-	-	-	-	-
Stage 2	238	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	92.5	5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	771	-	288	-	-
HCM Lane V/C Ratio	0.465	-	1	-	-
HCM Control Delay (s)	13.7	-	92.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	2.5	-	10.4	-	-

Intersection	
Int Delay, s/veh	56

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	340	70	950	1040	10
Future Vol, veh/h	10	340	70	950	1040	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	370	76	1033	1130	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1818	1140	1145	0	-	0
Stage 1	1140	-	-	-	-	-
Stage 2	678	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	77	~ 244	608	-	-	-
Stage 1	304	-	-	-	-	-
Stage 2	467	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	54	~ 243	606	-	-	-
Mov Cap-2 Maneuver	54	-	-	-	-	-
Stage 1	214	-	-	-	-	-
Stage 2	465	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	$ 381		2.2		0	
HCM LOS	F					

Minor Lane/Major Mvmt		NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)		606	-	221	-	-
HCM Lane V/C Ratio		0.126	-	1.721	-	-
HCM Control Delay (s)		11.8	1.5	$ 381	-	-
HCM Lane LOS		B	A	F	-	-
HCM 95th %tile Q(veh)		0.4	-	25.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	20	1085	995	455
Future Volume (Veh/h)	0	0	20	1085	995	455
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)	0	0	22	1179	1082	495
Pedestrians	4				9	
Lane Width (ft)	0.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1976	1334	1581			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1976	1334	1581			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	95			
cM capacity (veh/h)	51	144	412			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	415	786	1577
Volume Left	22	0	0
Volume Right	0	0	495
cSH	412	1700	1700
Volume to Capacity	0.05	0.46	0.93
Queue Length 95th (ft)	4	0	0
Control Delay (s)	1.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.6		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

Intersection						
Int Delay, s/veh	45.8					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	345	10	5	800	880	80
Future Vol, veh/h	345	10	5	800	880	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	375	11	5	870	957	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1886	1006	1049	0	-	0
Stage 1	1006	-	-	-	-	-
Stage 2	880	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 78	293	663	-	-	-
Stage 1	~ 353	-	-	-	-	-
Stage 2	406	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 77	292	660	-	-	-
Mov Cap-2 Maneuver	~ 259	-	-	-	-	-
Stage 1	~ 348	-	-	-	-	-
Stage 2	404	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	273.1	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	660	-	260	-	-
HCM Lane V/C Ratio	0.008	-	1.484	-	-
HCM Control Delay (s)	10.5	-	273.1	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0	-	22.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	10	5	5	55	10	740	5	70	810	5
Future Vol, veh/h	5	5	10	5	5	55	10	740	5	70	810	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	11	5	5	60	11	804	5	76	880	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1908	1892	908	1899	1892	821	897	0	0	823	0	0
Stage 1	1047	1047	-	843	843	-	-	-	-	-	-	-
Stage 2	861	845	-	1056	1049	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	52	70	334	53	70	374	757	-	-	807	-	-
Stage 1	276	305	-	358	380	-	-	-	-	-	-	-
Stage 2	350	379	-	272	304	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	33	54	326	39	54	369	748	-	-	796	-	-
Mov Cap-2 Maneuver	33	54	-	39	54	-	-	-	-	-	-	-
Stage 1	266	245	-	344	365	-	-	-	-	-	-	-
Stage 2	281	364	-	206	244	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	74	38.5	0.1	0.8
HCM LOS	F	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	748	-	-	73	176	796	-	-
HCM Lane V/C Ratio	0.015	-	-	0.298	0.401	0.096	-	-
HCM Control Delay (s)	9.9	0	-	74	38.5	10	0	-
HCM Lane LOS	A	A	-	F	E	B	A	-
HCM 95th %tile Q(veh)	0	-	-	1.1	1.8	0.3	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	5	60	0	0	15	25	710	20	0	785	35
Future Volume (vph)	40	5	60	0	0	15	25	710	20	0	785	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1000	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.94	1.00	1.00			1.00	
Flpb, ped/bikes		0.97	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.96	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737	1500			1509	1770	800			1168	
Flt Permitted		0.96	1.00			1.00	0.28	1.00			1.00	
Satd. Flow (perm)		1737	1500			1509	518	975			1168	
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)	43	5	65	0	0	16	27	772	22	0	853	38
RTOR Reduction (vph)	0	0	61	0	0	15	0	0	0	0	1	0
Lane Group Flow (vph)	0	48	4	0	0	1	27	794	0	0	890	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA			NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Effective Green, g (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Actuated g/C Ratio		0.07	0.07			0.07	0.89	0.89			0.85	
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)		118	102			102	491	715			995	
v/s Ratio Prot							0.00	c0.99			0.76	
v/s Ratio Perm		0.03	0.00			0.00	0.05					
v/c Ratio		0.41	0.04			0.01	0.05	1.11			0.89	
Uniform Delay, d1		93.8	91.5			91.3	3.5	11.2			9.7	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		2.3	0.2			0.0	0.0	68.0			12.2	
Delay (s)		96.1	91.6			91.3	3.6	79.2			21.9	
Level of Service		F	F			F	A	E			C	
Approach Delay (s)		93.5			91.3			76.7			21.9	
Approach LOS		F			F			E			C	

Intersection Summary			
HCM 2000 Control Delay	51.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	14.6
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	669	250	44	581
Demand Flow Rate, veh/h	682	255	44	592
Vehicles Circulating, veh/h	460	22	632	277
Vehicles Exiting, veh/h	409	654	510	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	22.1	4.3	5.6	10.9
Approach LOS	C	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	682	255	44	592
Cap Entry Lane, veh/h	863	1349	724	1040
Entry HV Adj Factor	0.981	0.979	1.000	0.982
Flow Entry, veh/h	669	250	44	581
Cap Entry, veh/h	847	1322	724	1021
V/C Ratio	0.790	0.189	0.061	0.569
Control Delay, s/veh	22.1	4.3	5.6	10.9
LOS	C	A	A	B
95th %tile Queue, veh	8	1	0	4

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 PM Peak

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	30	20	5	10
Future Vol, veh/h	10	0	30	20	5	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	33	22	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	65	44	0	0	55	0
Stage 1	44	-	-	-	-	-
Stage 2	21	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	941	1026	-	-	1550	-
Stage 1	978	-	-	-	-	-
Stage 2	1002	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	938	1026	-	-	1550	-
Mov Cap-2 Maneuver	938	-	-	-	-	-
Stage 1	975	-	-	-	-	-
Stage 2	1002	-	-	-	-	-

Approach	WB		NB		SB	
HCM Control Delay, s	8.9		0		2.4	
HCM LOS	A					

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	938	1550	-
HCM Lane V/C Ratio	-	-	0.012	0.004	-
HCM Control Delay (s)	-	-	8.9	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Future Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	33	33	5	11	54	880	27	22	984	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2045	2049	990	2052	2041	895	995	0	0	907	0	0
Stage 1	1034	1034	-	1002	1002	-	-	-	-	-	-	-
Stage 2	1011	1015	-	1050	1039	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	41	56	299	41	56	339	695	-	-	750	-	-
Stage 1	280	309	-	292	320	-	-	-	-	-	-	-
Stage 2	289	316	-	275	308	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	33	50	299	34	50	339	695	-	-	750	-	-
Mov Cap-2 Maneuver	33	50	-	34	50	-	-	-	-	-	-	-
Stage 1	258	300	-	269	295	-	-	-	-	-	-	-
Stage 2	253	291	-	238	299	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	40.4	$ 315.8	0.6	0.2
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	695	-	-	139	44	750	-	-
HCM Lane V/C Ratio	0.078	-	-	0.274	1.112	0.029	-	-
HCM Control Delay (s)	10.6	-	-	40.4	$ 315.8	9.9	-	-
HCM Lane LOS	B	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1	4.6	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	14.5
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	239	870	972
Demand Flow Rate, veh/h	244	888	991
Vehicles Circulating, veh/h	820	155	34
Vehicles Exiting, veh/h	205	909	1009
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	12.4	15.7	14.0
Approach LOS	B	C	B

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	244	888	991
Cap Entry Lane, veh/h	598	1178	1333
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	239	870	972
Cap Entry, veh/h	586	1155	1307
V/C Ratio	0.408	0.754	0.744
Control Delay, s/veh	12.4	15.7	14.0
LOS	B	C	B
95th %tile Queue, veh	2	8	7

Intersection						
Int Delay, s/veh	4.2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	170	245	795	865	15
Future Vol, veh/h	0	170	245	795	865	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	185	266	864	940	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2360	956	964	0	-	0
Stage 1	956	-	-	-	-	-
Stage 2	1404	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	39	313	714	-	-	-
Stage 1	373	-	-	-	-	-
Stage 2	227	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	24	311	709	-	-	-
Mov Cap-2 Maneuver	24	-	-	-	-	-
Stage 1	231	-	-	-	-	-
Stage 2	225	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.2	3.1	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	709	-	311	-	-
HCM Lane V/C Ratio	0.376	-	0.594	-	-
HCM Control Delay (s)	13.1	-	32.2	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	1.7	-	3.6	-	-

Intersection	
Int Delay, s/veh	8.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	160	100	1065	1050	15
Future Vol, veh/h	5	160	100	1065	1050	15
Conflicting Peds, #/hr	0	0	8	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	174	109	1158	1141	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1954	1157	1165	0	-	0
Stage 1	1157	-	-	-	-	-
Stage 2	797	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	63	238	598	-	-	-
Stage 1	298	-	-	-	-	-
Stage 2	405	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	30	236	593	-	-	-
Mov Cap-2 Maneuver	30	-	-	-	-	-
Stage 1	143	-	-	-	-	-
Stage 2	402	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	94.7	3.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	593	-	195	-	-
HCM Lane V/C Ratio	0.183	-	0.92	-	-
HCM Control Delay (s)	12.4	2.7	94.7	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.7	-	7.3	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	15	1170	850	360
Future Volume (Veh/h)	0	0	15	1170	850	360
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)	0	0	16	1272	924	391
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	1788	1120	1315			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1788	1120	1315			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	97			
cM capacity (veh/h)	70	201	522			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	440	848	1315
Volume Left	16	0	0
Volume Right	0	0	391
cSH	522	1700	1700
Volume to Capacity	0.03	0.50	0.77
Queue Length 95th (ft)	2	0	0
Control Delay (s)	0.9	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.3		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	54

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	370	10	20	815	695	175
Future Vol, veh/h	370	10	20	815	695	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	402	11	22	886	755	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1788	858	953	0	-	0
Stage 1	858	-	-	-	-	-
Stage 2	930	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 89	357	721	-	-	-
Stage 1	415	-	-	-	-	-
Stage 2	~ 384	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 85	354	716	-	-	-
Mov Cap-2 Maneuver	~ 266	-	-	-	-	-
Stage 1	~ 399	-	-	-	-	-
Stage 2	~ 381	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	295.6	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	716	-	268	-	-
HCM Lane V/C Ratio	0.03	-	1.541	-	-
HCM Control Delay (s)	10.2	-	295.6	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	24.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	25	5	5	95	20	740	5	40	660	15
Future Vol, veh/h	5	5	25	5	5	95	20	740	5	40	660	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	27	5	5	103	22	804	5	43	717	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1746	1729	789	1747	1735	842	763	0	0	844	0	0
Stage 1	841	841	-	886	886	-	-	-	-	-	-	-
Stage 2	905	888	-	861	849	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	68	88	391	67	88	364	850	-	-	792	-	-
Stage 1	359	380	-	339	363	-	-	-	-	-	-	-
Stage 2	331	362	-	350	377	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	39	71	368	49	71	352	826	-	-	766	-	-
Mov Cap-2 Maneuver	39	71	-	49	71	-	-	-	-	-	-	-
Stage 1	332	334	-	312	334	-	-	-	-	-	-	-
Stage 2	219	333	-	279	331	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	43.4	33.5	0.2	0.6
HCM LOS	E	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	826	-	-	131	237	766	-	-
HCM Lane V/C Ratio	0.026	-	-	0.29	0.482	0.057	-	-
HCM Control Delay (s)	9.5	0	-	43.4	33.5	10	0	-
HCM Lane LOS	A	A	-	E	D	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	2.4	0.2	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	15	60	0	0	25	35	715	10	5	640	55
Future Volume (vph)	35	15	60	0	0	25	35	715	10	5	640	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1000	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.95	1.00	1.00			1.00	
Flpb, ped/bikes		0.98	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.97	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1768	1507			1534	1769	850			1161	
Flt Permitted		0.97	1.00			1.00	0.35	1.00			1.00	
Satd. Flow (perm)		1768	1507			1534	660	978			1156	
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)	38	16	65	0	0	27	38	777	11	5	696	60
RTOR Reduction (vph)	0	0	58	0	0	24	0	0	0	0	1	0
Lane Group Flow (vph)	0	54	7	0	0	3	38	788	0	0	760	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA		Perm	NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		18.9	18.9			18.9	153.1	153.1			144.1	
Effective Green, g (s)		18.9	18.9			18.9	153.1	153.1			144.1	
Actuated g/C Ratio		0.10	0.10			0.10	0.85	0.85			0.80	
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)		185	158			161	592	722			925	
v/s Ratio Prot							0.00	c0.93				
v/s Ratio Perm		0.03	0.00			0.00	0.05				0.66	
v/c Ratio		0.29	0.04			0.02	0.06	1.09			0.82	
Uniform Delay, d1		74.4	72.4			72.2	2.7	13.5			10.5	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		0.9	0.1			0.0	0.0	61.1			8.1	
Delay (s)		75.3	72.5			72.3	2.7	74.5			18.6	
Level of Service		E	E			E	A	E			B	
Approach Delay (s)		73.8			72.3			71.2			18.6	
Approach LOS		E			E			E			B	

Intersection Summary			
HCM 2000 Control Delay	48.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	10.9
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	451	511	266	479
Demand Flow Rate, veh/h	460	522	272	489
Vehicles Circulating, veh/h	412	78	500	600
Vehicles Exiting, veh/h	677	694	372	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	10.7	6.9	8.2	16.9
Approach LOS	B	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	460	522	272	489
Cap Entry Lane, veh/h	906	1274	829	748
Entry HV Adj Factor	0.980	0.980	0.978	0.980
Flow Entry, veh/h	451	511	266	479
Cap Entry, veh/h	888	1248	810	733
V/C Ratio	0.507	0.410	0.328	0.653
Control Delay, s/veh	10.7	6.9	8.2	16.9
LOS	B	A	A	C
95th %tile Queue, veh	3	2	1	5

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 with Mitigation (Without Bypass) AM Peak

Intersection						
Int Delay, s/veh	4.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	5	15	5	10
Future Vol, veh/h	20	5	5	15	5	10
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	5	16	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	35	13	0	0	21	0
Stage 1	13	-	-	-	-	-
Stage 2	22	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	978	1067	-	-	1595	-
Stage 1	1010	-	-	-	-	-
Stage 2	1001	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	974	1067	-	-	1595	-
Mov Cap-2 Maneuver	974	-	-	-	-	-
Stage 1	1007	-	-	-	-	-
Stage 2	1000	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	2.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	991	1595	-
HCM Lane V/C Ratio	-	-	0.027	0.003	-
HCM Control Delay (s)	-	-	8.7	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Future Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	0	27	22	5	11	22	810	33	11	875	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1779	1787	878	1784	1773	827	880	0	0	843	0	0
Stage 1	900	900	-	871	871	-	-	-	-	-	-	-
Stage 2	879	887	-	913	902	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	64	81	347	63	83	371	768	-	-	793	-	-
Stage 1	333	357	-	346	368	-	-	-	-	-	-	-
Stage 2	342	362	-	328	356	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	57	78	347	56	79	371	768	-	-	793	-	-
Mov Cap-2 Maneuver	57	78	-	56	79	-	-	-	-	-	-	-
Stage 1	323	352	-	336	357	-	-	-	-	-	-	-
Stage 2	318	352	-	298	351	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	39.7	88.9	0.2	0.1
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	768	-	-	141	78	793	-	-
HCM Lane V/C Ratio	0.028	-	-	0.27	0.488	0.014	-	-
HCM Control Delay (s)	9.8	-	-	39.7	88.9	9.6	-	-
HCM Lane LOS	A	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1	2	0	-	-

Intersection	
Intersection Delay, s/veh	17.8
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	500	707	907
Demand Flow Rate, veh/h	510	721	926
Vehicles Circulating, veh/h	743	277	111
Vehicles Exiting, veh/h	294	976	887
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	27.5	14.6	15.1
Approach LOS	D	B	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	510	721	926
Cap Entry Lane, veh/h	647	1040	1232
Entry HV Adj Factor	0.980	0.981	0.980
Flow Entry, veh/h	500	707	907
Cap Entry, veh/h	634	1020	1207
V/C Ratio	0.789	0.693	0.752
Control Delay, s/veh	27.5	14.6	15.1
LOS	D	B	C
95th %tile Queue, veh	8	6	8

Intersection						
Int Delay, s/veh	19.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	260	330	580	830	30
Future Vol, veh/h	5	260	330	580	830	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	283	359	630	902	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2284	927	943	0	-	0
Stage 1	927	-	-	-	-	-
Stage 2	1357	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	44	325	727	-	-	-
Stage 1	385	-	-	-	-	-
Stage 2	240	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	22	323	721	-	-	-
Mov Cap-2 Maneuver	22	-	-	-	-	-
Stage 1	192	-	-	-	-	-
Stage 2	238	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	134.5	5.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	721	-	257	-	-
HCM Lane V/C Ratio	0.497	-	1.121	-	-
HCM Control Delay (s)	14.8	-	134.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	2.8	-	12.5	-	-

Intersection	
Int Delay, s/veh	38.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	270	70	950	1110	10
Future Vol, veh/h	10	270	70	950	1110	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	293	76	1033	1207	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1895	1217	1222	0	-	0
Stage 1	1217	-	-	-	-	-
Stage 2	678	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	69	~ 220	568	-	-	-
Stage 1	279	-	-	-	-	-
Stage 2	467	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	47	~ 219	566	-	-	-
Mov Cap-2 Maneuver	47	-	-	-	-	-
Stage 1	190	-	-	-	-	-
Stage 2	465	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 323.2	2.4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	566	-	194	-	-
HCM Lane V/C Ratio	0.134	-	1.569	-	-
HCM Control Delay (s)	12.3	1.7	$ 323.2	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.5	-	19.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	20	1085	995	455
Future Volume (Veh/h)	0	0	20	1085	995	455
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)	0	0	22	1179	1082	495
Pedestrians	4				9	
Lane Width (ft)	0.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1976	1334	1581			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1976	1334	1581			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	95			
cM capacity (veh/h)	51	144	412			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	415	786	1577
Volume Left	22	0	0
Volume Right	0	0	495
cSH	412	1700	1700
Volume to Capacity	0.05	0.46	0.93
Queue Length 95th (ft)	4	0	0
Control Delay (s)	1.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.6		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	8.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	195	10	5	950	880	80
Future Vol, veh/h	195	10	5	950	880	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	212	11	5	1033	957	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2049	1006	1049	0	-	0
Stage 1	1006	-	-	-	-	-
Stage 2	1043	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 61	293	663	-	-	-
Stage 1	353	-	-	-	-	-
Stage 2	339	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 60	292	660	-	-	-
Mov Cap-2 Maneuver	234	-	-	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	337	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	89.2	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	660	-	236	-	-
HCM Lane V/C Ratio	0.008	-	0.944	-	-
HCM Control Delay (s)	10.5	-	89.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0	-	8.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	10.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	115	5	10	5	5	65	10	770	15	70	810	5
Future Vol, veh/h	115	5	10	5	5	65	10	770	15	70	810	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	125	5	11	5	5	71	11	837	16	76	880	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1952	1936	908	1937	1930	859	897	0	0	867	0	0
Stage 1	1047	1047	-	881	881	-	-	-	-	-	-	-
Stage 2	905	889	-	1056	1049	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 48	66	334	49	66	356	757	-	-	777	-	-
Stage 1	276	305	-	341	365	-	-	-	-	-	-	-
Stage 2	331	361	-	272	304	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 29	50	326	38	50	351	748	-	-	767	-	-
Mov Cap-2 Maneuver	141	177	-	38	50	-	-	-	-	-	-	-
Stage 1	265	243	-	327	350	-	-	-	-	-	-	-
Stage 2	253	346	-	204	242	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	119.7	40.6	0.1	0.8
HCM LOS	F	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	748	-	-	149	180	767	-	-
HCM Lane V/C Ratio	0.015	-	-	0.948	0.453	0.099	-	-
HCM Control Delay (s)	9.9	0	-	119.7	40.6	10.2	0	-
HCM Lane LOS	A	A	-	F	E	B	A	-
HCM 95th %tile Q(veh)	0	-	-	6.8	2.1	0.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	80	65	25	725	785	35
Future Volume (vph)	80	65	25	725	785	35
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.95	1.00	1.00	1.00	
Flpb, ped/bikes	0.98	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1726	1507	1770	800	1168	
Flt Permitted	0.95	1.00	0.27	1.00	1.00	
Satd. Flow (perm)	1726	1507	495	980	1168	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	71	27	788	853	38
RTOR Reduction (vph)	0	65	0	0	1	0
Lane Group Flow (vph)	87	6	27	788	890	0
Confl. Peds. (#/hr)	6	7	2			2
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	14.8	14.8	157.2	157.2	148.4	
Effective Green, g (s)	14.8	14.8	157.2	157.2	148.4	
Actuated g/C Ratio	0.08	0.08	0.87	0.87	0.82	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	141	123	466	698	962	
v/s Ratio Prot			0.00	c0.98	0.76	
v/s Ratio Perm	c0.05	0.00	0.05			
v/c Ratio	0.62	0.05	0.06	1.13	0.93	
Uniform Delay, d1	79.9	76.1	4.3	11.4	11.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.8	0.2	0.1	75.4	15.8	
Delay (s)	87.7	76.3	4.3	86.8	27.5	
Level of Service	F	E	A	F	C	
Approach Delay (s)	82.5			84.1	27.5	
Approach LOS	F			F	C	

Intersection Summary			
HCM 2000 Control Delay	56.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	14.6
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	669	250	44	581
Demand Flow Rate, veh/h	682	255	44	592
Vehicles Circulating, veh/h	460	22	632	277
Vehicles Exiting, veh/h	409	654	510	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	22.1	4.3	5.6	10.9
Approach LOS	C	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	682	255	44	592
Cap Entry Lane, veh/h	863	1349	724	1040
Entry HV Adj Factor	0.981	0.979	1.000	0.982
Flow Entry, veh/h	669	250	44	581
Cap Entry, veh/h	847	1322	724	1021
V/C Ratio	0.790	0.189	0.061	0.569
Control Delay, s/veh	22.1	4.3	5.6	10.9
LOS	C	A	A	B
95th %tile Queue, veh	8	1	0	4

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 with Mitigation (Without Bypass) PM Peak

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	30	20	5	10
Future Vol, veh/h	10	0	30	20	5	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	33	22	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	65	44	0	0	55	0
Stage 1	44	-	-	-	-	-
Stage 2	21	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	941	1026	-	-	1550	-
Stage 1	978	-	-	-	-	-
Stage 2	1002	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	938	1026	-	-	1550	-
Mov Cap-2 Maneuver	938	-	-	-	-	-
Stage 1	975	-	-	-	-	-
Stage 2	1002	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.9	0	2.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	938	1550	-
HCM Lane V/C Ratio	-	-	0.012	0.004	-
HCM Control Delay (s)	-	-	8.9	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Future Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	33	33	5	11	54	880	27	22	984	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2045	2049	990	2052	2041	895	995	0	0	907	0	0
Stage 1	1034	1034	-	1002	1002	-	-	-	-	-	-	-
Stage 2	1011	1015	-	1050	1039	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	41	56	299	41	56	339	695	-	-	750	-	-
Stage 1	280	309	-	292	320	-	-	-	-	-	-	-
Stage 2	289	316	-	275	308	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	33	50	299	34	50	339	695	-	-	750	-	-
Mov Cap-2 Maneuver	33	50	-	34	50	-	-	-	-	-	-	-
Stage 1	258	300	-	269	295	-	-	-	-	-	-	-
Stage 2	253	291	-	238	299	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	40.4	$ 315.8	0.6	0.2
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	695	-	-	139	44	750	-	-
HCM Lane V/C Ratio	0.078	-	-	0.274	1.112	0.029	-	-
HCM Control Delay (s)	10.6	-	-	40.4	$ 315.8	9.9	-	-
HCM Lane LOS	B	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1	4.6	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	14.9
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	304	870	972
Demand Flow Rate, veh/h	310	888	991
Vehicles Circulating, veh/h	820	155	34
Vehicles Exiting, veh/h	205	975	1009
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	15.2	15.7	14.0
Approach LOS	C	C	B

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	310	888	991
Cap Entry Lane, veh/h	598	1178	1333
Entry HV Adj Factor	0.981	0.980	0.981
Flow Entry, veh/h	304	870	972
Cap Entry, veh/h	586	1155	1307
V/C Ratio	0.519	0.754	0.744
Control Delay, s/veh	15.2	15.7	14.0
LOS	C	C	B
95th %tile Queue, veh	3	8	7

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	170	245	795	930	15
Future Vol, veh/h	0	170	245	795	930	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	185	266	864	1011	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2431	1027	1035	0	-	0
Stage 1	1027	-	-	-	-	-
Stage 2	1404	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	35	285	672	-	-	-
Stage 1	345	-	-	-	-	-
Stage 2	227	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	21	283	667	-	-	-
Mov Cap-2 Maneuver	21	-	-	-	-	-
Stage 1	206	-	-	-	-	-
Stage 2	225	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	38.8	3.3	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	667	-	283	-	-
HCM Lane V/C Ratio	0.399	-	0.653	-	-
HCM Control Delay (s)	13.9	-	38.8	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	1.9	-	4.2	-	-

Intersection						
Int Delay, s/veh	4.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	95	100	1065	1110	15
Future Vol, veh/h	5	95	100	1065	1110	15
Conflicting Peds, #/hr	0	0	8	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	103	109	1158	1207	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2020	1223	1231	0	-	0
Stage 1	1223	-	-	-	-	-
Stage 2	797	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	57	218	564	-	-	-
Stage 1	277	-	-	-	-	-
Stage 2	405	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	26	216	560	-	-	-
Mov Cap-2 Maneuver	26	-	-	-	-	-
Stage 1	125	-	-	-	-	-
Stage 2	402	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	67	3.9	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	560	-	158	-	-
HCM Lane V/C Ratio	0.194	-	0.688	-	-
HCM Control Delay (s)	13	3	67	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.7	-	4	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	15	1170	850	360
Future Volume (Veh/h)	0	0	15	1170	850	360
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)	0	0	16	1272	924	391
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	1788	1120	1315			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1788	1120	1315			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	97			
cM capacity (veh/h)	70	201	522			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	440	848	1315
Volume Left	16	0	0
Volume Right	0	0	391
cSH	522	1700	1700
Volume to Capacity	0.03	0.50	0.77
Queue Length 95th (ft)	2	0	0
Control Delay (s)	0.9	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.3		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	8.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	190	10	20	995	695	175
Future Vol, veh/h	190	10	20	995	695	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	207	11	22	1082	755	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1984	858	953	0	-	0
Stage 1	858	-	-	-	-	-
Stage 2	1126	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 67	357	721	-	-	-
Stage 1	415	-	-	-	-	-
Stage 2	310	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 64	354	716	-	-	-
Mov Cap-2 Maneuver	227	-	-	-	-	-
Stage 1	399	-	-	-	-	-
Stage 2	308	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	89.6	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	716	-	231	-	-
HCM Lane V/C Ratio	0.03	-	0.941	-	-
HCM Control Delay (s)	10.2	-	89.6	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	8.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	11.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	85	5	25	5	5	110	20	825	15	40	660	15
Future Vol, veh/h	85	5	25	5	5	110	20	825	15	40	660	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	5	27	5	5	120	22	897	16	43	717	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1853	1833	789	1845	1833	940	763	0	0	948	0	0
Stage 1	841	841	-	984	984	-	-	-	-	-	-	-
Stage 2	1012	992	-	861	849	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 57	76	391	57	76	320	850	-	-	724	-	-
Stage 1	359	380	-	299	327	-	-	-	-	-	-	-
Stage 2	288	324	-	350	377	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 28	60	368	43	60	309	826	-	-	700	-	-
Mov Cap-2 Maneuver	109	198	-	43	60	-	-	-	-	-	-	-
Stage 1	330	331	-	273	299	-	-	-	-	-	-	-
Stage 2	164	296	-	276	328	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	128.8	44.2	0.2	0.6
HCM LOS	F	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	826	-	-	132	216	700	-	-
HCM Lane V/C Ratio	0.026	-	-	0.947	0.604	0.062	-	-
HCM Control Delay (s)	9.5	0	-	128.8	44.2	10.5	0	-
HCM Lane LOS	A	A	-	F	E	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	6.4	3.5	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	145	65	35	730	640	55
Future Volume (vph)	145	65	35	730	640	55
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.82	1.00	1.00	0.99	
Flpb, ped/bikes	0.88	1.00	0.99	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1552	1291	1757	850	1150	
Flt Permitted	0.95	1.00	0.31	1.00	1.00	
Satd. Flow (perm)	1552	1291	568	980	1150	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	71	38	793	696	60
RTOR Reduction (vph)	0	63	0	0	1	0
Lane Group Flow (vph)	158	8	38	793	755	0
Confl. Peds. (#/hr)	30	41	46			46
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	21.0	21.0	151.0	151.0	142.0	
Effective Green, g (s)	21.0	21.0	151.0	151.0	142.0	
Actuated g/C Ratio	0.12	0.12	0.84	0.84	0.79	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	181	150	509	713	907	
v/s Ratio Prot			0.00	c0.93	0.66	
v/s Ratio Perm	c0.10	0.01	0.06			
v/c Ratio	0.87	0.06	0.07	1.11	0.83	
Uniform Delay, d1	78.2	70.7	4.6	14.5	11.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	33.9	0.2	0.1	68.8	8.8	
Delay (s)	112.1	70.8	4.7	83.3	20.5	
Level of Service	F	E	A	F	C	
Approach Delay (s)	99.3			79.7	20.5	
Approach LOS	F			E	C	

Intersection Summary			
HCM 2000 Control Delay	57.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	10.9
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	451	511	266	479
Demand Flow Rate, veh/h	460	522	272	489
Vehicles Circulating, veh/h	412	78	500	600
Vehicles Exiting, veh/h	677	694	372	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	10.7	6.9	8.2	16.9
Approach LOS	B	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	460	522	272	489
Cap Entry Lane, veh/h	906	1274	829	748
Entry HV Adj Factor	0.980	0.980	0.978	0.980
Flow Entry, veh/h	451	511	266	479
Cap Entry, veh/h	888	1248	810	733
V/C Ratio	0.507	0.410	0.328	0.653
Control Delay, s/veh	10.7	6.9	8.2	16.9
LOS	B	A	A	C
95th %tile Queue, veh	3	2	1	5

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 with Mitigation (With Bypass) AM Peak

Intersection	
Int Delay, s/veh	4.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	5	15	5	10
Future Vol, veh/h	20	5	5	15	5	10
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	5	16	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	35	13	0	0	21	0
Stage 1	13	-	-	-	-	-
Stage 2	22	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	978	1067	-	-	1595	-
Stage 1	1010	-	-	-	-	-
Stage 2	1001	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	974	1067	-	-	1595	-
Mov Cap-2 Maneuver	974	-	-	-	-	-
Stage 1	1007	-	-	-	-	-
Stage 2	1000	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	2.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	991	1595	-
HCM Lane V/C Ratio	-	-	0.027	0.003	-
HCM Control Delay (s)	-	-	8.7	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Future Vol, veh/h	10	0	25	20	5	10	20	745	30	10	805	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	0	27	22	5	11	22	810	33	11	875	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1779	1787	878	1784	1773	827	880	0	0	843	0	0
Stage 1	900	900	-	871	871	-	-	-	-	-	-	-
Stage 2	879	887	-	913	902	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	64	81	347	63	83	371	768	-	-	793	-	-
Stage 1	333	357	-	346	368	-	-	-	-	-	-	-
Stage 2	342	362	-	328	356	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	57	78	347	56	79	371	768	-	-	793	-	-
Mov Cap-2 Maneuver	57	78	-	56	79	-	-	-	-	-	-	-
Stage 1	323	352	-	336	357	-	-	-	-	-	-	-
Stage 2	318	352	-	298	351	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	39.7	88.9	0.2	0.1
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	768	-	-	141	78	793	-	-
HCM Lane V/C Ratio	0.028	-	-	0.27	0.488	0.014	-	-
HCM Control Delay (s)	9.8	-	-	39.7	88.9	9.6	-	-
HCM Lane LOS	A	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1	2	0	-	-

Intersection			
Intersection Delay, s/veh	16.7		
Intersection LOS	C		

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	462	669	907
Demand Flow Rate, veh/h	471	682	926
Vehicles Circulating, veh/h	743	310	111
Vehicles Exiting, veh/h	294	904	881
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	23.0	14.4	15.1
Approach LOS	C	B	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	471	682	926
Cap Entry Lane, veh/h	647	1006	1232
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	462	669	907
Cap Entry, veh/h	634	986	1207
V/C Ratio	0.728	0.678	0.752
Control Delay, s/veh	23.0	14.4	15.1
LOS	C	B	C
95th %tile Queue, veh	6	6	8

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	220	280	550	760	30
Future Vol, veh/h	5	220	280	550	760	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	239	304	598	826	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2066	851	867	0	-	0
Stage 1	851	-	-	-	-	-
Stage 2	1215	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	60	360	777	-	-	-
Stage 1	419	-	-	-	-	-
Stage 2	281	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	36	357	771	-	-	-
Mov Cap-2 Maneuver	36	-	-	-	-	-
Stage 1	252	-	-	-	-	-
Stage 2	279	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	54.8	4.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	771	-	298	-	-
HCM Lane V/C Ratio	0.395	-	0.821	-	-
HCM Control Delay (s)	12.7	-	54.8	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	1.9	-	6.8	-	-

Intersection						
Int Delay, s/veh	17.4					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	125	75	370	35	110	280
Future Vol, veh/h	125	75	370	35	110	280
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	136	82	402	38	120	304

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	440	0	-	0	775	421
Stage 1	-	-	-	-	421	-
Stage 2	-	-	-	-	354	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1120	-	-	-	366	632
Stage 1	-	-	-	-	662	-
Stage 2	-	-	-	-	710	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1120	-	-	-	320	632
Mov Cap-2 Maneuver	-	-	-	-	320	-
Stage 1	-	-	-	-	578	-
Stage 2	-	-	-	-	710	-

Approach	EB	WB	SB
HCM Control Delay, s	5.4	0	41.7
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1120	-	-	-	496
HCM Lane V/C Ratio	0.121	-	-	-	0.855
HCM Control Delay (s)	8.7	0	-	-	41.7
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.4	-	-	-	8.9

Intersection						
Int Delay, s/veh	5.2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	80	105	45	870	730	350
Future Vol, veh/h	80	105	45	870	730	350
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	87	114	49	946	793	380

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2040	987	1177	0	-	0
Stage 1	987	-	-	-	-	-
Stage 2	1053	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 62	300	593	-	-	-
Stage 1	361	-	-	-	-	-
Stage 2	336	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 56	299	591	-	-	-
Mov Cap-2 Maneuver	211	-	-	-	-	-
Stage 1	330	-	-	-	-	-
Stage 2	335	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	58	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	591	-	253	-	-
HCM Lane V/C Ratio	0.083	-	0.795	-	-
HCM Control Delay (s)	11.6	-	58	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	165	10	5	780	715	80
Future Vol, veh/h	165	10	5	780	715	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	179	11	5	848	777	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1684	826	869	0	-	0
Stage 1	826	-	-	-	-	-
Stage 2	858	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 104	372	775	-	-	-
Stage 1	430	-	-	-	-	-
Stage 2	415	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 102	370	771	-	-	-
Mov Cap-2 Maneuver	296	-	-	-	-	-
Stage 1	425	-	-	-	-	-
Stage 2	413	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	35.9	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	771	-	299	-	-
HCM Lane V/C Ratio	0.007	-	0.636	-	-
HCM Control Delay (s)	9.7	-	35.9	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0	-	4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	10	5	5	55	10	720	5	70	650	5
Future Vol, veh/h	5	5	10	5	5	55	10	720	5	70	650	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	11	5	5	60	11	783	5	76	707	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1714	1698	735	1705	1698	800	724	0	0	802	0	0
Stage 1	874	874	-	822	822	-	-	-	-	-	-	-
Stage 2	840	824	-	883	876	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	71	92	420	72	92	385	879	-	-	822	-	-
Stage 1	344	367	-	368	388	-	-	-	-	-	-	-
Stage 2	360	387	-	340	367	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	48	74	410	56	74	380	869	-	-	811	-	-
Mov Cap-2 Maneuver	48	74	-	56	74	-	-	-	-	-	-	-
Stage 1	332	307	-	355	374	-	-	-	-	-	-	-
Stage 2	292	373	-	271	307	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	49.6	29.6	0.1	1
HCM LOS	E	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	869	-	-	102	216	811	-	-
HCM Lane V/C Ratio	0.013	-	-	0.213	0.327	0.094	-	-
HCM Control Delay (s)	9.2	0	-	49.6	29.6	9.9	0	-
HCM Lane LOS	A	A	-	E	D	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.8	1.4	0.3	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	5	60	0	0	15	25	690	20	0	625	35
Future Volume (vph)	40	5	60	0	0	15	25	690	20	0	625	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.94	1.00	1.00			1.00	
Flpb, ped/bikes		0.97	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.96	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737	1500			1509	1769	1169			1166	
Flt Permitted		0.96	1.00			1.00	0.35	1.00			1.00	
Satd. Flow (perm)		1737	1500			1509	649	1169			1166	
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)	43	5	65	0	0	16	27	750	22	0	679	38
RTOR Reduction (vph)	0	0	61	0	0	15	0	0	0	0	1	0
Lane Group Flow (vph)	0	48	4	0	0	1	27	772	0	0	716	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA			NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Effective Green, g (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Actuated g/C Ratio		0.07	0.07			0.07	0.89	0.89			0.85	
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)		118	102			102	605	1044			993	
v/s Ratio Prot							0.00	c0.66			0.61	
v/s Ratio Perm		0.03	0.00			0.00	0.04					
v/c Ratio		0.41	0.04			0.01	0.04	0.74			0.72	
Uniform Delay, d1		93.8	91.5			91.3	2.3	3.5			6.0	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		2.3	0.2			0.0	0.0	4.7			4.5	
Delay (s)		96.1	91.6			91.3	2.3	8.2			10.5	
Level of Service		F	F			F	A	A			B	
Approach Delay (s)		93.5			91.3			8.0			10.5	
Approach LOS		F			F			A			B	

Intersection Summary			
HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	24.5
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	685	255	44	766
Demand Flow Rate, veh/h	698	260	44	781
Vehicles Circulating, veh/h	593	238	670	277
Vehicles Exiting, veh/h	465	476	621	221
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	40.9	5.7	5.9	17.1
Approach LOS	E	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	698	260	44	781
Cap Entry Lane, veh/h	754	1082	697	1040
Entry HV Adj Factor	0.981	0.980	0.995	0.981
Flow Entry, veh/h	685	255	44	766
Cap Entry, veh/h	739	1061	693	1020
V/C Ratio	0.926	0.240	0.063	0.751
Control Delay, s/veh	40.9	5.7	5.9	17.1
LOS	E	A	A	C
95th %tile Queue, veh	13	1	0	7

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Base Year 2027 with Mitigation (With Bypass) PM Peak

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	30	20	5	10
Future Vol, veh/h	10	0	30	20	5	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	33	22	5	11

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	65	44	0	0	55	0
Stage 1	44	-	-	-	-	-
Stage 2	21	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	941	1026	-	-	1550	-
Stage 1	978	-	-	-	-	-
Stage 2	1002	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	938	1026	-	-	1550	-
Mov Cap-2 Maneuver	938	-	-	-	-	-
Stage 1	975	-	-	-	-	-
Stage 2	1002	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.9	0	2.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	938	1550	-
HCM Lane V/C Ratio	-	-	0.012	0.004	-
HCM Control Delay (s)	-	-	8.9	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Future Vol, veh/h	5	0	30	30	5	10	50	810	25	20	905	10
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	0	33	33	5	11	54	880	27	22	984	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2045	2049	990	2052	2041	895	995	0	0	907	0	0
Stage 1	1034	1034	-	1002	1002	-	-	-	-	-	-	-
Stage 2	1011	1015	-	1050	1039	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	41	56	299	41	56	339	695	-	-	750	-	-
Stage 1	280	309	-	292	320	-	-	-	-	-	-	-
Stage 2	289	316	-	275	308	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	33	50	299	34	50	339	695	-	-	750	-	-
Mov Cap-2 Maneuver	33	50	-	34	50	-	-	-	-	-	-	-
Stage 1	258	300	-	269	295	-	-	-	-	-	-	-
Stage 2	253	291	-	238	299	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	40.4	$ 315.8	0.6	0.2
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	695	-	-	139	44	750	-	-
HCM Lane V/C Ratio	0.078	-	-	0.274	1.112	0.029	-	-
HCM Control Delay (s)	10.6	-	-	40.4	$ 315.8	9.9	-	-
HCM Lane LOS	B	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1	4.6	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	14.7
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	272	832	972
Demand Flow Rate, veh/h	278	849	991
Vehicles Circulating, veh/h	820	189	34
Vehicles Exiting, veh/h	205	909	1004
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	13.7	15.8	14.0
Approach LOS	B	C	B

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	278	849	991
Cap Entry Lane, veh/h	598	1138	1333
Entry HV Adj Factor	0.978	0.980	0.981
Flow Entry, veh/h	272	832	972
Cap Entry, veh/h	585	1115	1307
V/C Ratio	0.465	0.746	0.744
Control Delay, s/veh	13.7	15.8	14.0
LOS	B	C	B
95th %tile Queue, veh	2	7	7

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	145	210	760	865	15
Future Vol, veh/h	0	145	210	760	865	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	158	228	826	940	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2246	956	964	0	-	0
Stage 1	956	-	-	-	-	-
Stage 2	1290	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	46	313	714	-	-	-
Stage 1	373	-	-	-	-	-
Stage 2	258	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	31	311	709	-	-	-
Mov Cap-2 Maneuver	31	-	-	-	-	-
Stage 1	251	-	-	-	-	-
Stage 2	256	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	27.9	2.7	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	709	-	311	-	-
HCM Lane V/C Ratio	0.322	-	0.507	-	-
HCM Control Delay (s)	12.5	-	27.9	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	1.4	-	2.7	-	-

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	135	80	335	50	50	135
Future Vol, veh/h	135	80	335	50	50	135
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	147	87	364	54	54	147

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	418	0	-	0	772	391
Stage 1	-	-	-	-	391	-
Stage 2	-	-	-	-	381	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1141	-	-	-	368	658
Stage 1	-	-	-	-	683	-
Stage 2	-	-	-	-	691	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1141	-	-	-	318	658
Mov Cap-2 Maneuver	-	-	-	-	318	-
Stage 1	-	-	-	-	591	-
Stage 2	-	-	-	-	691	-

Approach	EB	WB	SB
HCM Control Delay, s	5.4	0	16.6
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1141	-	-	-	510
HCM Lane V/C Ratio	0.129	-	-	-	0.394
HCM Control Delay (s)	8.6	0	-	-	16.6
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.4	-	-	-	1.9

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	80	50	50	925	725	320
Future Vol, veh/h	80	50	50	925	725	320
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	87	54	54	1005	788	348

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2075	962	1136	0	-	0
Stage 1	962	-	-	-	-	-
Stage 2	1113	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 59	310	615	-	-	-
Stage 1	371	-	-	-	-	-
Stage 2	314	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 54	310	615	-	-	-
Mov Cap-2 Maneuver	201	-	-	-	-	-
Stage 1	338	-	-	-	-	-
Stage 2	314	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	42.1	0.6	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	615	-	232	-	-
HCM Lane V/C Ratio	0.088	-	0.609	-	-
HCM Control Delay (s)	11.4	-	42.1	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	0.3	-	3.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	10	20	795	615	175
Future Vol, veh/h	180	10	20	795	615	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	196	11	22	864	668	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1679	771	866	0	-	0
Stage 1	771	-	-	-	-	-
Stage 2	908	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 104	400	777	-	-	-
Stage 1	456	-	-	-	-	-
Stage 2	393	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 99	397	771	-	-	-
Mov Cap-2 Maneuver	283	-	-	-	-	-
Stage 1	439	-	-	-	-	-
Stage 2	390	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	44.1		0.2		0	
HCM LOS	E					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	771	-	287	-	-
HCM Lane V/C Ratio	0.028	-	0.72	-	-
HCM Control Delay (s)	9.8	-	44.1	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0.1	-	5.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	25	5	5	95	20	720	5	40	585	15
Future Vol, veh/h	5	5	25	5	5	95	20	720	5	40	585	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	27	5	5	103	22	783	5	43	636	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1644	1627	708	1645	1633	821	682	0	0	823	0	0
Stage 1	760	760	-	865	865	-	-	-	-	-	-	-
Stage 2	884	867	-	780	768	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	80	102	435	79	101	374	911	-	-	807	-	-
Stage 1	398	414	-	348	371	-	-	-	-	-	-	-
Stage 2	340	370	-	388	411	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	48	84	409	59	83	362	885	-	-	780	-	-
Mov Cap-2 Maneuver	48	84	-	59	83	-	-	-	-	-	-	-
Stage 1	370	367	-	322	343	-	-	-	-	-	-	-
Stage 2	229	342	-	315	365	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	35.4	29.6	0.2	0.6
HCM LOS	E	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	885	-	-	156	258	780	-	-
HCM Lane V/C Ratio	0.025	-	-	0.244	0.442	0.056	-	-
HCM Control Delay (s)	9.2	0	-	35.4	29.6	9.9	0	-
HCM Lane LOS	A	A	-	E	D	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	2.1	0.2	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	15	60	0	0	25	35	695	10	5	560	55
Future Volume (vph)	35	15	60	0	0	25	35	695	10	5	560	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.87			0.88	1.00	1.00			0.99	
Flpb, ped/bikes		0.94	1.00			1.00	0.99	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.97	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1696	1378			1418	1753	1171			1150	
Flt Permitted		0.97	1.00			1.00	0.37	1.00			1.00	
Satd. Flow (perm)		1696	1378			1418	682	1171			1146	
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)	38	16	65	0	0	27	38	755	11	5	609	60
RTOR Reduction (vph)	0	0	55	0	0	23	0	0	0	0	2	0
Lane Group Flow (vph)	0	54	10	0	0	4	38	766	0	0	672	0
Confl. Peds. (#/hr)	30		41	41		30	46		68	68		46
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA		Perm	NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Effective Green, g (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Actuated g/C Ratio		0.15	0.15			0.15	0.79	0.79			0.72	
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)		248	202			207	571	921			826	
v/s Ratio Prot							0.00	c0.65				
v/s Ratio Perm		0.03	0.01			0.00	0.05				0.59	
v/c Ratio		0.22	0.05			0.02	0.07	0.83			0.81	
Uniform Delay, d1		45.1	44.0			43.8	3.6	7.9			11.3	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		0.4	0.1			0.0	0.0	8.6			8.6	
Delay (s)		45.6	44.1			43.9	3.7	16.5			19.9	
Level of Service		D	D			D	A	B			B	
Approach Delay (s)		44.8			43.9			15.9			19.9	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	87.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	15.5
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	461	516	277	586
Demand Flow Rate, veh/h	471	527	283	598
Vehicles Circulating, veh/h	488	311	532	600
Vehicles Exiting, veh/h	710	504	427	238
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	12.6	10.2	8.8	25.4
Approach LOS	B	B	A	D

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	471	527	283	598
Cap Entry Lane, veh/h	839	1005	802	748
Entry HV Adj Factor	0.980	0.980	0.980	0.980
Flow Entry, veh/h	461	516	277	586
Cap Entry, veh/h	822	985	786	733
V/C Ratio	0.561	0.524	0.353	0.799
Control Delay, s/veh	12.6	10.2	8.8	25.4
LOS	B	B	A	D
95th %tile Queue, veh	4	3	2	8

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 (Without Bypass) AM Peak

Intersection						
Int Delay, s/veh	1.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	50	15	5	140
Future Vol, veh/h	20	5	50	15	5	140
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	54	16	5	152

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	225	62	0	0	70	0
Stage 1	62	-	-	-	-	-
Stage 2	163	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	763	1003	-	-	1531	-
Stage 1	961	-	-	-	-	-
Stage 2	866	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	759	1003	-	-	1531	-
Mov Cap-2 Maneuver	759	-	-	-	-	-
Stage 1	957	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	798	1531	-
HCM Lane V/C Ratio	-	-	0.034	0.004	-
HCM Control Delay (s)	-	-	9.7	7.4	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	31.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	0	120	20	5	10	60	745	30	10	805	15
Future Vol, veh/h	45	0	120	20	5	10	60	745	30	10	805	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	49	0	130	22	5	11	65	810	33	11	875	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1870	1878	883	1927	1870	827	891	0	0	843	0	0
Stage 1	905	905	-	957	957	-	-	-	-	-	-	-
Stage 2	965	973	-	970	913	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	55	71	345	50	72	371	761	-	-	793	-	-
Stage 1	331	355	-	310	336	-	-	-	-	-	-	-
Stage 2	306	330	-	304	352	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 46	64	345	29	65	371	761	-	-	793	-	-
Mov Cap-2 Maneuver	~ 46	64	-	29	65	-	-	-	-	-	-	-
Stage 1	303	350	-	284	307	-	-	-	-	-	-	-
Stage 2	267	302	-	186	347	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 304.7	237.4	0.7	0.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	761	-	-	124	44	793	-	-
HCM Lane V/C Ratio	0.086	-	-	1.446	0.865	0.014	-	-
HCM Control Delay (s)	10.2	-	-	$ 304.7	237.4	9.6	-	-
HCM Lane LOS	B	-	-	F	F	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	12.4	3.4	0	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	22.9
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	511	734	1005
Demand Flow Rate, veh/h	522	749	1025
Vehicles Circulating, veh/h	820	289	111
Vehicles Exiting, veh/h	316	1053	926
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	38.8	16.2	19.8
Approach LOS	E	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	522	749	1025
Cap Entry Lane, veh/h	598	1028	1232
Entry HV Adj Factor	0.979	0.981	0.980
Flow Entry, veh/h	511	734	1005
Cap Entry, veh/h	585	1008	1208
V/C Ratio	0.873	0.729	0.832
Control Delay, s/veh	38.8	16.2	19.8
LOS	E	C	C
95th %tile Queue, veh	10	7	11

Intersection						
Int Delay, s/veh	27.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	260	330	605	900	30
Future Vol, veh/h	5	260	330	605	900	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	283	359	658	978	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2388	1003	1019	0	-	0
Stage 1	1003	-	-	-	-	-
Stage 2	1385	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	37	294	681	-	-	-
Stage 1	355	-	-	-	-	-
Stage 2	232	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	17	292	676	-	-	-
Mov Cap-2 Maneuver	17	-	-	-	-	-
Stage 1	165	-	-	-	-	-
Stage 2	230	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	201.3	5.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	676	-	224	-	-
HCM Lane V/C Ratio	0.531	-	1.286	-	-
HCM Control Delay (s)	16.2	-	201.3	-	-
HCM Lane LOS	C	-	F	-	-
HCM 95th %tile Q(veh)	3.1	-	15.1	-	-

Intersection	
Int Delay, s/veh	47.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	270	70	975	1180	10
Future Vol, veh/h	10	270	70	975	1180	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	293	76	1060	1283	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1984	1293	1298	0	-	0
Stage 1	1293	-	-	-	-	-
Stage 2	691	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	60	~ 198	532	-	-	-
Stage 1	256	-	-	-	-	-
Stage 2	460	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	39	~ 197	530	-	-	-
Mov Cap-2 Maneuver	39	-	-	-	-	-
Stage 1	166	-	-	-	-	-
Stage 2	458	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 415	2.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	530	-	172	-	-
HCM Lane V/C Ratio	0.144	-	1.769	-	-
HCM Control Delay (s)	12.9	2	$ 415	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.5	-	21.8	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	20	1110	1010	515
Future Volume (Veh/h)	0	0	20	1110	1010	515
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)	0	0	22	1207	1098	560
Pedestrians	4				9	
Lane Width (ft)	0.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2038	1382	1662			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2038	1382	1662			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	94			
cM capacity (veh/h)	46	134	383			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	424	805	1658
Volume Left	22	0	0
Volume Right	0	0	560
cSH	383	1700	1700
Volume to Capacity	0.06	0.47	0.98
Queue Length 95th (ft)	5	0	0
Control Delay (s)	1.8	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.6		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	8.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	190	10	5	980	895	80
Future Vol, veh/h	190	10	5	980	895	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	207	11	5	1065	973	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2097	1022	1065	0	-	0
Stage 1	1022	-	-	-	-	-
Stage 2	1075	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 57	287	654	-	-	-
Stage 1	347	-	-	-	-	-
Stage 2	328	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 56	286	651	-	-	-
Mov Cap-2 Maneuver	227	-	-	-	-	-
Stage 1	342	-	-	-	-	-
Stage 2	326	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	92.1	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	651	-	229	-	-
HCM Lane V/C Ratio	0.008	-	0.949	-	-
HCM Control Delay (s)	10.6	-	92.1	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0	-	8.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	10.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	105	5	10	5	5	65	10	815	15	70	825	5
Future Vol, veh/h	105	5	10	5	5	65	10	815	15	70	825	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	114	5	11	5	5	71	11	886	16	76	897	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2018	2002	925	2003	1996	908	914	0	0	916	0	0
Stage 1	1064	1064	-	930	930	-	-	-	-	-	-	-
Stage 2	954	938	-	1073	1066	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 43	60	326	44	60	334	746	-	-	745	-	-
Stage 1	270	300	-	321	346	-	-	-	-	-	-	-
Stage 2	311	343	-	267	299	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 25	45	318	33	45	330	737	-	-	735	-	-
Mov Cap-2 Maneuver	128	168	-	33	45	-	-	-	-	-	-	-
Stage 1	259	235	-	307	331	-	-	-	-	-	-	-
Stage 2	233	328	-	197	234	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	129.5	47.4	0.1	0.8
HCM LOS	F	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	737	-	-	136	163	735	-	-
HCM Lane V/C Ratio	0.015	-	-	0.959	0.5	0.104	-	-
HCM Control Delay (s)	10	0	-	129.5	47.4	10.5	0	-
HCM Lane LOS	A	A	-	F	E	B	A	-
HCM 95th %tile Q(veh)	0	-	-	6.7	2.4	0.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	105	65	25	740	800	35
Future Volume (vph)	105	65	25	740	800	35
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.95	1.00	1.00	1.00	
Flpb, ped/bikes	0.98	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1726	1507	1770	800	1169	
Flt Permitted	0.95	1.00	0.25	1.00	1.00	
Satd. Flow (perm)	1726	1507	472	980	1169	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	71	27	804	870	38
RTOR Reduction (vph)	0	64	0	0	1	0
Lane Group Flow (vph)	114	7	27	804	907	0
Confl. Peds. (#/hr)	6	7	2			2
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	16.9	16.9	155.1	155.1	146.3	
Effective Green, g (s)	16.9	16.9	155.1	155.1	146.3	
Actuated g/C Ratio	0.09	0.09	0.86	0.86	0.81	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	162	141	441	689	950	
v/s Ratio Prot			0.00	c1.00	0.78	
v/s Ratio Perm	c0.07	0.00	0.05			
v/c Ratio	0.70	0.05	0.06	1.17	0.96	
Uniform Delay, d1	79.1	74.2	5.2	12.5	14.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	13.0	0.1	0.1	90.3	20.2	
Delay (s)	92.1	74.4	5.2	102.8	34.3	
Level of Service	F	E	A	F	C	
Approach Delay (s)	85.3			99.6	34.3	
Approach LOS	F			F	C	

Intersection Summary			
HCM 2000 Control Delay	67.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	17.6
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	669	250	49	647
Demand Flow Rate, veh/h	682	255	50	659
Vehicles Circulating, veh/h	527	22	632	277
Vehicles Exiting, veh/h	409	660	577	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	28.3	4.3	5.8	12.6
Approach LOS	D	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	682	255	50	659
Cap Entry Lane, veh/h	806	1349	724	1040
Entry HV Adj Factor	0.981	0.979	0.980	0.982
Flow Entry, veh/h	669	250	49	647
Cap Entry, veh/h	791	1322	710	1021
V/C Ratio	0.846	0.189	0.069	0.633
Control Delay, s/veh	28.3	4.3	5.8	12.6
LOS	D	A	A	B
95th %tile Queue, veh	10	1	0	5

Intersection	
Intersection Delay, s/veh	3.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	71	54	71
Demand Flow Rate, veh/h	0	72	56	72
Vehicles Circulating, veh/h	144	28	0	72
Vehicles Exiting, veh/h	0	28	144	28
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	3.1	3.0	3.3
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	0	72	56	72
Cap Entry Lane, veh/h	1191	1341	1380	1282
Entry HV Adj Factor	1.000	0.986	0.972	0.980
Flow Entry, veh/h	0	71	54	71
Cap Entry, veh/h	1191	1322	1342	1257
V/C Ratio	0.000	0.054	0.041	0.056
Control Delay, s/veh	3.0	3.1	3.0	3.3
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 (Without Bypass) PM Peak

Intersection						
Int Delay, s/veh	0.5					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	175	20	5	95
Future Vol, veh/h	10	0	175	20	5	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	190	22	5	103

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	314	201	0	0	212	0
Stage 1	201	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	679	840	-	-	1358	-
Stage 1	833	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	676	840	-	-	1358	-
Mov Cap-2 Maneuver	676	-	-	-	-	-
Stage 1	830	-	-	-	-	-
Stage 2	912	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.4	0	0.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	676	1358	-
HCM Lane V/C Ratio	-	-	0.016	0.004	-
HCM Control Delay (s)	-	-	10.4	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	51.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	15	0	105	30	5	10	175	810	25	20	905	30
Future Vol, veh/h	15	0	105	30	5	10	175	810	25	20	905	30
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	0	114	33	5	11	190	880	27	22	984	33

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2328	2332	1001	2376	2335	895	1017	0	0	907	0	0
Stage 1	1045	1045	-	1274	1274	-	-	-	-	-	-	-
Stage 2	1283	1287	-	1102	1061	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	26	37	295	~ 24	37	339	682	-	-	750	-	-
Stage 1	276	306	-	205	238	-	-	-	-	-	-	-
Stage 2	203	235	-	257	300	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 16	26	295	~ 11	26	339	682	-	-	750	-	-
Mov Cap-2 Maneuver	~ 16	26	-	~ 11	26	-	-	-	-	-	-	-
Stage 1	199	297	-	148	172	-	-	-	-	-	-	-
Stage 2	137	169	-	153	291	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 314.9	$ 1535.3	2.1	0.2
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	682	-	-	93	15	750	-	-
HCM Lane V/C Ratio	0.279	-	-	1.403	3.261	0.029	-	-
HCM Control Delay (s)	12.3	-	-	$ 314.9	$ 1535.3	9.9	-	-
HCM Lane LOS	B	-	-	F	F	A	-	-
HCM 95th %tile Q(veh)	1.1	-	-	9.7	6.9	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	20.1
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	326	979	1055
Demand Flow Rate, veh/h	332	999	1076
Vehicles Circulating, veh/h	887	177	34
Vehicles Exiting, veh/h	223	1042	1142
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	18.7	23.9	17.1
Approach LOS	C	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	332	999	1076
Cap Entry Lane, veh/h	558	1152	1333
Entry HV Adj Factor	0.982	0.980	0.980
Flow Entry, veh/h	326	979	1055
Cap Entry, veh/h	548	1129	1306
V/C Ratio	0.595	0.867	0.807
Control Delay, s/veh	18.7	23.9	17.1
LOS	C	C	C
95th %tile Queue, veh	4	12	10

Intersection						
Int Delay, s/veh	5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	170	245	895	990	15
Future Vol, veh/h	0	170	245	895	990	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	185	266	973	1076	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2605	1092	1100	0	-	0
Stage 1	1092	-	-	-	-	-
Stage 2	1513	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	27	261	635	-	-	-
Stage 1	322	-	-	-	-	-
Stage 2	201	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	15	259	630	-	-	-
Mov Cap-2 Maneuver	15	-	-	-	-	-
Stage 1	185	-	-	-	-	-
Stage 2	199	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	47.3	3.2	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	630	-	259	-	-
HCM Lane V/C Ratio	0.423	-	0.713	-	-
HCM Control Delay (s)	14.8	-	47.3	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	2.1	-	4.9	-	-

Intersection						
Int Delay, s/veh	7.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	95	100	1165	1175	15
Future Vol, veh/h	5	95	100	1165	1175	15
Conflicting Peds, #/hr	0	0	8	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	103	109	1266	1277	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2144	1293	1301	0	-	0
Stage 1	1293	-	-	-	-	-
Stage 2	851	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	47	198	530	-	-	-
Stage 1	256	-	-	-	-	-
Stage 2	380	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	14	196	526	-	-	-
Mov Cap-2 Maneuver	14	-	-	-	-	-
Stage 1	77	-	-	-	-	-
Stage 2	377	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	129	4.9	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	526	-	119	-	-
HCM Lane V/C Ratio	0.207	-	0.913	-	-
HCM Control Delay (s)	13.6	4.1	129	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.8	-	5.8	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	15	1275	895	375
Future Volume (Veh/h)	0	0	15	1275	895	375
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)	0	0	16	1386	973	408
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	1902	1177	1381			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1902	1177	1381			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	97			
cM capacity (veh/h)	59	184	492			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	478	924	1381
Volume Left	16	0	0
Volume Right	0	0	408
cSH	492	1700	1700
Volume to Capacity	0.03	0.54	0.81
Queue Length 95th (ft)	3	0	0
Control Delay (s)	1.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.3		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

Intersection						
Int Delay, s/veh	8.3					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	170	10	20	1115	735	175
Future Vol, veh/h	170	10	20	1115	735	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	185	11	22	1212	799	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2158	902	997	0	-	0
Stage 1	902	-	-	-	-	-
Stage 2	1256	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 52	336	694	-	-	-
Stage 1	396	-	-	-	-	-
Stage 2	268	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 50	333	689	-	-	-
Mov Cap-2 Maneuver	199	-	-	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	266	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	101.2	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	689	-	204	-	-
HCM Lane V/C Ratio	0.032	-	0.959	-	-
HCM Control Delay (s)	10.4	-	101.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	8.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	11.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	5	25	5	5	110	20	985	15	40	705	15
Future Vol, veh/h	45	5	25	5	5	110	20	985	15	40	705	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	49	5	27	5	5	120	22	1071	16	43	766	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2076	2056	838	2068	2056	1114	812	0	0	1122	0	0
Stage 1	890	890	-	1158	1158	-	-	-	-	-	-	-
Stage 2	1186	1166	-	910	898	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 39	55	366	40	55	253	814	-	-	623	-	-
Stage 1	337	361	-	239	270	-	-	-	-	-	-	-
Stage 2	230	268	-	329	358	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 15	42	344	29	42	245	791	-	-	602	-	-
Mov Cap-2 Maneuver	60	161	-	29	42	-	-	-	-	-	-	-
Stage 1	304	306	-	215	242	-	-	-	-	-	-	-
Stage 2	107	241	-	251	304	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	161	83.2	0.2	0.6
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	791	-	-	88	162	602	-	-
HCM Lane V/C Ratio	0.027	-	-	0.926	0.805	0.072	-	-
HCM Control Delay (s)	9.7	0	-	161	83.2	11.4	0	-
HCM Lane LOS	A	A	-	F	F	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	5.1	5.3	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	235	65	35	800	685	55
Future Volume (vph)	235	65	35	800	685	55
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.79	1.00	1.00	0.99	
Flpb, ped/bikes	0.86	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1516	1248	1770	800	1149	
Flt Permitted	0.95	1.00	0.26	1.00	1.00	
Satd. Flow (perm)	1516	1248	492	980	1149	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	255	71	38	870	745	60
RTOR Reduction (vph)	0	53	0	0	1	0
Lane Group Flow (vph)	255	18	38	870	804	0
Confl. Peds. (#/hr)	30	41	46			46
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	37.5	37.5	164.5	164.5	156.4	
Effective Green, g (s)	37.5	37.5	164.5	164.5	156.4	
Actuated g/C Ratio	0.18	0.18	0.78	0.78	0.74	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	270	222	410	626	855	
v/s Ratio Prot			0.00	c1.09	0.70	
v/s Ratio Perm	c0.17	0.01	0.07			
v/c Ratio	0.94	0.08	0.09	1.39	0.94	
Uniform Delay, d1	85.2	71.9	9.8	22.8	22.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	39.6	0.2	0.1	185.1	19.3	
Delay (s)	124.9	72.1	9.9	207.9	42.1	
Level of Service	F	E	A	F	D	
Approach Delay (s)	113.4			199.6	42.1	
Approach LOS	F			F	D	

Intersection Summary			
HCM 2000 Control Delay	123.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.33		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	103.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	451	511	304	501
Demand Flow Rate, veh/h	460	522	311	511
Vehicles Circulating, veh/h	434	78	500	600
Vehicles Exiting, veh/h	677	733	394	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	11.1	6.9	9.0	18.2
Approach LOS	B	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	460	522	311	511
Cap Entry Lane, veh/h	886	1274	829	748
Entry HV Adj Factor	0.980	0.980	0.977	0.980
Flow Entry, veh/h	451	511	304	501
Cap Entry, veh/h	869	1248	810	733
V/C Ratio	0.519	0.410	0.375	0.683
Control Delay, s/veh	11.1	6.9	9.0	18.2
LOS	B	A	A	C
95th %tile Queue, veh	3	2	2	5

Intersection	
Intersection Delay, s/veh	3.5
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	49	164	49
Demand Flow Rate, veh/h	0	50	168	50
Vehicles Circulating, veh/h	100	84	0	50
Vehicles Exiting, veh/h	0	84	100	84
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	3.2	3.6	3.1
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	0	50	168	50
Cap Entry Lane, veh/h	1246	1267	1380	1311
Entry HV Adj Factor	1.000	0.980	0.978	0.980
Flow Entry, veh/h	0	49	164	49
Cap Entry, veh/h	1246	1241	1350	1286
V/C Ratio	0.000	0.039	0.122	0.038
Control Delay, s/veh	2.9	3.2	3.6	3.1
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 (With Bypass) AM Peak

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	50	15	5	140
Future Vol, veh/h	20	5	50	15	5	140
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	54	16	5	152

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	225	62	0	0	70	0
Stage 1	62	-	-	-	-	-
Stage 2	163	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	763	1003	-	-	1531	-
Stage 1	961	-	-	-	-	-
Stage 2	866	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	759	1003	-	-	1531	-
Mov Cap-2 Maneuver	759	-	-	-	-	-
Stage 1	957	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	798	1531	-
HCM Lane V/C Ratio	-	-	0.034	0.004	-
HCM Control Delay (s)	-	-	9.7	7.4	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	31.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	0	120	20	5	10	60	745	30	10	805	15
Future Vol, veh/h	45	0	120	20	5	10	60	745	30	10	805	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	49	0	130	22	5	11	65	810	33	11	875	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1870	1878	883	1927	1870	827	891	0	0	843	0	0
Stage 1	905	905	-	957	957	-	-	-	-	-	-	-
Stage 2	965	973	-	970	913	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	55	71	345	50	72	371	761	-	-	793	-	-
Stage 1	331	355	-	310	336	-	-	-	-	-	-	-
Stage 2	306	330	-	304	352	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 46	64	345	29	65	371	761	-	-	793	-	-
Mov Cap-2 Maneuver	~ 46	64	-	29	65	-	-	-	-	-	-	-
Stage 1	303	350	-	284	307	-	-	-	-	-	-	-
Stage 2	267	302	-	186	347	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 304.7	237.4	0.7	0.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	761	-	-	124	44	793	-	-
HCM Lane V/C Ratio	0.086	-	-	1.446	0.865	0.014	-	-
HCM Control Delay (s)	10.2	-	-	$ 304.7	237.4	9.6	-	-
HCM Lane LOS	B	-	-	F	F	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	12.4	3.4	0	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	21.3
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	479	696	1005
Demand Flow Rate, veh/h	488	710	1025
Vehicles Circulating, veh/h	820	327	111
Vehicles Exiting, veh/h	316	981	926
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	31.8	16.2	19.8
Approach LOS	D	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	488	710	1025
Cap Entry Lane, veh/h	598	989	1232
Entry HV Adj Factor	0.982	0.981	0.980
Flow Entry, veh/h	479	696	1005
Cap Entry, veh/h	587	969	1208
V/C Ratio	0.816	0.718	0.832
Control Delay, s/veh	31.8	16.2	19.8
LOS	D	C	C
95th %tile Queue, veh	8	6	11

Intersection	
Int Delay, s/veh	11.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	220	280	575	835	30
Future Vol, veh/h	5	220	280	575	835	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	239	304	625	908	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2175	933	949	0	-	0
Stage 1	933	-	-	-	-	-
Stage 2	1242	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	51	323	724	-	-	-
Stage 1	383	-	-	-	-	-
Stage 2	272	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	29	321	718	-	-	-
Mov Cap-2 Maneuver	29	-	-	-	-	-
Stage 1	219	-	-	-	-	-
Stage 2	270	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	81.2		4.5		0	
HCM LOS	F					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	718	-	262	-	-
HCM Lane V/C Ratio	0.424	-	0.933	-	-
HCM Control Delay (s)	13.7	-	81.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	2.1	-	8.5	-	-

Intersection	
Int Delay, s/veh	20

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	130	80	395	35	110	280
Future Vol, veh/h	130	80	395	35	110	280
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	141	87	429	38	120	304

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	467	0	-	0	817	448
Stage 1	-	-	-	-	448	-
Stage 2	-	-	-	-	369	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1094	-	-	-	346	611
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	699	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1094	-	-	-	299	611
Mov Cap-2 Maneuver	-	-	-	-	299	-
Stage 1	-	-	-	-	557	-
Stage 2	-	-	-	-	699	-

Approach	EB	WB	SB
HCM Control Delay, s	5.4	0	49.8
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1094	-	-	-	472
HCM Lane V/C Ratio	0.129	-	-	-	0.898
HCM Control Delay (s)	8.8	0	-	-	49.8
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.4	-	-	-	10

Intersection						
Int Delay, s/veh	6.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	85	105	45	885	780	375
Future Vol, veh/h	85	105	45	885	780	375
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	92	114	49	962	848	408

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2125	1056	1260	0	-	0
Stage 1	1056	-	-	-	-	-
Stage 2	1069	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 55	274	552	-	-	-
Stage 1	335	-	-	-	-	-
Stage 2	330	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 50	273	550	-	-	-
Mov Cap-2 Maneuver	200	-	-	-	-	-
Stage 1	304	-	-	-	-	-
Stage 2	329	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	75.5	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	550	-	235	-	-
HCM Lane V/C Ratio	0.089	-	0.879	-	-
HCM Control Delay (s)	12.2	-	75.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	7.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	165	10	5	800	765	80
Future Vol, veh/h	165	10	5	800	765	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	179	11	5	870	832	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1761	881	924	0	-	0
Stage 1	881	-	-	-	-	-
Stage 2	880	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 93	346	739	-	-	-
Stage 1	405	-	-	-	-	-
Stage 2	406	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 91	344	735	-	-	-
Mov Cap-2 Maneuver	282	-	-	-	-	-
Stage 1	400	-	-	-	-	-
Stage 2	404	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	39.7	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	735	-	285	-	-
HCM Lane V/C Ratio	0.007	-	0.667	-	-
HCM Control Delay (s)	9.9	-	39.7	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0	-	4.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	10	5	5	55	10	735	5	70	700	5
Future Vol, veh/h	5	5	10	5	5	55	10	735	5	70	700	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	11	5	5	60	11	799	5	76	761	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1784	1768	789	1775	1768	816	778	0	0	818	0	0
Stage 1	928	928	-	838	838	-	-	-	-	-	-	-
Stage 2	856	840	-	937	930	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	63	84	391	64	84	377	839	-	-	810	-	-
Stage 1	321	347	-	361	382	-	-	-	-	-	-	-
Stage 2	352	381	-	318	346	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	42	67	382	49	67	372	829	-	-	799	-	-
Mov Cap-2 Maneuver	42	67	-	49	67	-	-	-	-	-	-	-
Stage 1	310	286	-	348	368	-	-	-	-	-	-	-
Stage 2	284	367	-	250	285	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	56.6	32.5	0.1	0.9
HCM LOS	F	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	829	-	-	91	200	799	-	-
HCM Lane V/C Ratio	0.013	-	-	0.239	0.353	0.095	-	-
HCM Control Delay (s)	9.4	0	-	56.6	32.5	10	0	-
HCM Lane LOS	A	A	-	F	D	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.9	1.5	0.3	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	5	60	0	0	15	25	705	20	0	670	35
Future Volume (vph)	40	5	60	0	0	15	25	705	20	0	670	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.94	1.00	1.00			1.00	
Flpb, ped/bikes		0.97	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.96	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737	1500			1509	1769	1169			1167	
Flt Permitted		0.96	1.00			1.00	0.33	1.00			1.00	
Satd. Flow (perm)		1737	1500			1509	610	1169			1167	
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)	43	5	65	0	0	16	27	766	22	0	728	38
RTOR Reduction (vph)	0	0	61	0	0	15	0	0	0	0	1	0
Lane Group Flow (vph)	0	48	4	0	0	1	27	788	0	0	765	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA			NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Effective Green, g (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Actuated g/C Ratio		0.07	0.07			0.07	0.89	0.89			0.85	
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)		118	102			102	571	1044			994	
v/s Ratio Prot							0.00	c0.67			c0.66	
v/s Ratio Perm		0.03	0.00			0.00	0.04					
v/c Ratio		0.41	0.04			0.01	0.05	0.75			0.77	
Uniform Delay, d1		93.8	91.5			91.3	2.5	3.6			6.7	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		2.3	0.2			0.0	0.0	5.1			5.7	
Delay (s)		96.1	91.6			91.3	2.6	8.7			12.4	
Level of Service		F	F			F	A	A			B	
Approach Delay (s)		93.5			91.3			8.5			12.4	
Approach LOS		F			F			A			B	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	27.2
Intersection LOS	D

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	685	255	49	793
Demand Flow Rate, veh/h	698	260	49	809
Vehicles Circulating, veh/h	621	243	670	277
Vehicles Exiting, veh/h	465	476	649	226
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	46.7	5.7	5.9	18.5
Approach LOS	E	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	698	260	49	809
Cap Entry Lane, veh/h	732	1077	697	1040
Entry HV Adj Factor	0.981	0.980	0.994	0.981
Flow Entry, veh/h	685	255	49	793
Cap Entry, veh/h	719	1055	692	1020
V/C Ratio	0.953	0.241	0.070	0.778
Control Delay, s/veh	46.7	5.7	5.9	18.5
LOS	E	A	A	C
95th %tile Queue, veh	14	1	0	8

Intersection	
Intersection Delay, s/veh	3.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	15	81	59	81
Demand Flow Rate, veh/h	15	82	61	82
Vehicles Circulating, veh/h	149	38	15	82
Vehicles Exiting, veh/h	15	38	149	38
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.2	3.2	3.1	3.4
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	15	82	61	82
Cap Entry Lane, veh/h	1185	1327	1359	1269
Entry HV Adj Factor	0.993	0.987	0.975	0.983
Flow Entry, veh/h	15	81	59	81
Cap Entry, veh/h	1178	1310	1324	1247
V/C Ratio	0.013	0.062	0.045	0.065
Control Delay, s/veh	3.2	3.2	3.1	3.4
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 (With Bypass) PM Peak

Intersection						
Int Delay, s/veh	0.5					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	175	20	5	95
Future Vol, veh/h	10	0	175	20	5	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	190	22	5	103

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	314	201	0	0	212	0
Stage 1	201	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	679	840	-	-	1358	-
Stage 1	833	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	676	840	-	-	1358	-
Mov Cap-2 Maneuver	676	-	-	-	-	-
Stage 1	830	-	-	-	-	-
Stage 2	912	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.4	0	0.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	676	1358	-
HCM Lane V/C Ratio	-	-	0.016	0.004	-
HCM Control Delay (s)	-	-	10.4	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	51.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	15	0	105	30	5	10	175	810	25	20	905	30
Future Vol, veh/h	15	0	105	30	5	10	175	810	25	20	905	30
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	0	114	33	5	11	190	880	27	22	984	33

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2328	2332	1001	2376	2335	895	1017	0	0	907	0	0
Stage 1	1045	1045	-	1274	1274	-	-	-	-	-	-	-
Stage 2	1283	1287	-	1102	1061	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	26	37	295	~ 24	37	339	682	-	-	750	-	-
Stage 1	276	306	-	205	238	-	-	-	-	-	-	-
Stage 2	203	235	-	257	300	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 16	26	295	~ 11	26	339	682	-	-	750	-	-
Mov Cap-2 Maneuver	~ 16	26	-	~ 11	26	-	-	-	-	-	-	-
Stage 1	199	297	-	148	172	-	-	-	-	-	-	-
Stage 2	137	169	-	153	291	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 314.9	$ 1535.3	2.1	0.2
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	682	-	-	93	15	750	-	-
HCM Lane V/C Ratio	0.279	-	-	1.403	3.261	0.029	-	-
HCM Control Delay (s)	12.3	-	-	$ 314.9	$ 1535.3	9.9	-	-
HCM Lane LOS	B	-	-	F	F	A	-	-
HCM 95th %tile Q(veh)	1.1	-	-	9.7	6.9	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	20.6
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	315	930	1055
Demand Flow Rate, veh/h	322	949	1076
Vehicles Circulating, veh/h	887	233	34
Vehicles Exiting, veh/h	223	976	1148
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	18.1	25.4	17.1
Approach LOS	C	D	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	322	949	1076
Cap Entry Lane, veh/h	558	1088	1333
Entry HV Adj Factor	0.978	0.980	0.980
Flow Entry, veh/h	315	930	1055
Cap Entry, veh/h	546	1066	1306
V/C Ratio	0.577	0.872	0.807
Control Delay, s/veh	18.1	25.4	17.1
LOS	C	D	C
95th %tile Queue, veh	4	12	10

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	145	210	850	925	15
Future Vol, veh/h	0	145	210	850	925	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	158	228	924	1005	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2409	1021	1029	0	-	0
Stage 1	1021	-	-	-	-	-
Stage 2	1388	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	36	287	675	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	231	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	23	285	670	-	-	-
Mov Cap-2 Maneuver	23	-	-	-	-	-
Stage 1	228	-	-	-	-	-
Stage 2	229	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.2	2.6	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	670	-	285	-	-
HCM Lane V/C Ratio	0.341	-	0.553	-	-
HCM Control Delay (s)	13.1	-	32.2	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	1.5	-	3.1	-	-

Intersection						
Int Delay, s/veh	5.5					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	150	100	350	50	50	135
Future Vol, veh/h	150	100	350	50	50	135
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	163	109	380	54	54	147

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	434	0	-	0	842	407
Stage 1	-	-	-	-	407	-
Stage 2	-	-	-	-	435	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1126	-	-	-	334	644
Stage 1	-	-	-	-	672	-
Stage 2	-	-	-	-	653	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1126	-	-	-	283	644
Mov Cap-2 Maneuver	-	-	-	-	283	-
Stage 1	-	-	-	-	569	-
Stage 2	-	-	-	-	653	-

Approach	EB	WB	SB
HCM Control Delay, s	5.2	0	17.8
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1126	-	-	-	479
HCM Lane V/C Ratio	0.145	-	-	-	0.42
HCM Control Delay (s)	8.7	0	-	-	17.8
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.5	-	-	-	2

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	50	50	995	770	335
Future Vol, veh/h	100	50	50	995	770	335
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	109	54	54	1082	837	364

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2209	1019	1201	0	-	0
Stage 1	1019	-	-	-	-	-
Stage 2	1190	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 49	288	581	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	289	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 44	288	581	-	-	-
Mov Cap-2 Maneuver	182	-	-	-	-	-
Stage 1	316	-	-	-	-	-
Stage 2	289	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	66.5	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	581	-	207	-	-
HCM Lane V/C Ratio	0.094	-	0.788	-	-
HCM Control Delay (s)	11.8	-	66.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	5.5	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection						
Int Delay, s/veh	5.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	10	20	860	655	175
Future Vol, veh/h	180	10	20	860	655	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	196	11	22	935	712	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1794	815	910	0	-	0
Stage 1	815	-	-	-	-	-
Stage 2	979	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 89	377	748	-	-	-
Stage 1	435	-	-	-	-	-
Stage 2	364	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 85	374	742	-	-	-
Mov Cap-2 Maneuver	262	-	-	-	-	-
Stage 1	418	-	-	-	-	-
Stage 2	361	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	53.4	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	742	-	266	-	-
HCM Lane V/C Ratio	0.029	-	0.776	-	-
HCM Control Delay (s)	10	-	53.4	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	5.8	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	5	5	25	5	5	95	20	785	5	40	625	15
Future Vol, veh/h	5	5	25	5	5	95	20	785	5	40	625	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	27	5	5	103	22	853	5	43	679	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1757	1740	751	1758	1746	891	725	0	0	893	0	0
Stage 1	803	803	-	935	935	-	-	-	-	-	-	-
Stage 2	954	937	-	823	811	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	66	87	411	66	86	341	878	-	-	759	-	-
Stage 1	377	396	-	318	344	-	-	-	-	-	-	-
Stage 2	311	343	-	368	393	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	37	70	386	48	69	330	853	-	-	734	-	-
Mov Cap-2 Maneuver	37	70	-	48	69	-	-	-	-	-	-	-
Stage 1	348	348	-	292	316	-	-	-	-	-	-	-
Stage 2	200	316	-	295	345	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	44.2	36.1	0.2	0.6
HCM LOS	E	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	853	-	-	129	226	734	-	-
HCM Lane V/C Ratio	0.025	-	-	0.295	0.505	0.059	-	-
HCM Control Delay (s)	9.3	0	-	44.2	36.1	10.2	0	-
HCM Lane LOS	A	A	-	E	E	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	2.6	0.2	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	15	60	0	0	25	35	765	10	5	605	55
Future Volume (vph)	35	15	60	0	0	25	35	765	10	5	605	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.87			0.88	1.00	1.00			0.99	
Flpb, ped/bikes		0.94	1.00			1.00	0.99	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.97	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1696	1378			1418	1755	1172			1152	
Flt Permitted		0.97	1.00			1.00	0.35	1.00			1.00	
Satd. Flow (perm)		1696	1378			1418	648	1172			1147	
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)	38	16	65	0	0	27	38	832	11	5	658	60
RTOR Reduction (vph)	0	0	55	0	0	23	0	0	0	0	2	0
Lane Group Flow (vph)	0	54	10	0	0	4	38	843	0	0	721	0
Confl. Peds. (#/hr)	30		41	41		30	46		68	68		46
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA		Perm	NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Effective Green, g (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Actuated g/C Ratio		0.15	0.15			0.15	0.79	0.79			0.72	
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)		248	202			207	545	921			826	
v/s Ratio Prot							0.00	c0.72				
v/s Ratio Perm		0.03	0.01			0.00	0.05				0.63	
v/c Ratio		0.22	0.05			0.02	0.07	0.92			0.87	
Uniform Delay, d1		45.1	44.0			43.8	3.7	9.7			12.6	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		0.4	0.1			0.0	0.1	15.1			12.3	
Delay (s)		45.6	44.1			43.9	3.8	24.8			24.9	
Level of Service		D	D			D	A	C			C	
Approach Delay (s)		44.8			43.9			23.9			24.9	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	16.5
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	461	516	315	603
Demand Flow Rate, veh/h	471	527	322	615
Vehicles Circulating, veh/h	505	349	532	600
Vehicles Exiting, veh/h	710	504	444	276
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	13.1	11.0	9.6	27.4
Approach LOS	B	B	A	D

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	471	527	322	615
Cap Entry Lane, veh/h	824	967	802	748
Entry HV Adj Factor	0.980	0.980	0.980	0.980
Flow Entry, veh/h	461	516	315	603
Cap Entry, veh/h	808	947	786	733
V/C Ratio	0.571	0.545	0.401	0.822
Control Delay, s/veh	13.1	11.0	9.6	27.4
LOS	B	B	A	D
95th %tile Queue, veh	4	3	2	9

Intersection	
Intersection Delay, s/veh	3.5
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	15	59	169	59
Demand Flow Rate, veh/h	15	60	173	60
Vehicles Circulating, veh/h	105	94	15	60
Vehicles Exiting, veh/h	15	94	105	94
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	3.3	3.7	3.2
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	15	60	173	60
Cap Entry Lane, veh/h	1240	1254	1359	1298
Entry HV Adj Factor	0.993	0.982	0.979	0.984
Flow Entry, veh/h	15	59	169	59
Cap Entry, veh/h	1232	1231	1330	1277
V/C Ratio	0.012	0.048	0.127	0.046
Control Delay, s/veh	3.0	3.3	3.7	3.2
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 with Mitigation (Without Bypass) AM Peak

Intersection						
Int Delay, s/veh	1.2					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	50	15	5	140
Future Vol, veh/h	20	5	50	15	5	140
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	54	16	5	152

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	225	62	0	0	70	0
Stage 1	62	-	-	-	-	-
Stage 2	163	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	763	1003	-	-	1531	-
Stage 1	961	-	-	-	-	-
Stage 2	866	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	759	1003	-	-	1531	-
Mov Cap-2 Maneuver	759	-	-	-	-	-
Stage 1	957	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	798	1531	-
HCM Lane V/C Ratio	-	-	0.034	0.004	-
HCM Control Delay (s)	-	-	9.7	7.4	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	0	120	20	5	10	60	745	30	10	805	15
Future Volume (veh/h)	45	0	120	20	5	10	60	745	30	10	805	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	49	0	130	22	5	11	65	810	33	11	875	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	125	17	174	209	56	69	380	1127	46	358	1051	891
Arrive On Green	0.15	0.00	0.15	0.15	0.15	0.15	0.08	0.63	0.63	0.01	0.56	0.56
Sat Flow, veh/h	313	114	1133	741	365	451	1781	1785	73	1781	1870	1585
Grp Volume(v), veh/h	179	0	0	38	0	0	65	0	843	11	875	16
Grp Sat Flow(s),veh/h/ln	1560	0	0	1557	0	0	1781	0	1857	1781	1870	1585
Q Serve(g_s), s	4.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	18.3	0.2	23.0	0.3
Cycle Q Clear(g_c), s	6.5	0.0	0.0	1.1	0.0	0.0	0.7	0.0	18.3	0.2	23.0	0.3
Prop In Lane	0.27		0.73	0.58		0.29	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	316	0	0	334	0	0	380	0	1173	358	1051	891
V/C Ratio(X)	0.57	0.00	0.00	0.11	0.00	0.00	0.17	0.00	0.72	0.03	0.83	0.02
Avail Cap(c_a), veh/h	747	0	0	730	0	0	708	0	2052	810	2067	1752
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.1	0.0	0.0	21.9	0.0	0.0	9.0	0.0	7.4	7.1	10.8	5.8
Incr Delay (d2), s/veh	1.6	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.8	0.0	1.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	0.0	0.4	0.0	0.0	0.3	0.0	5.2	0.0	7.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.7	0.0	0.0	22.0	0.0	0.0	9.2	0.0	8.3	7.1	12.6	5.8
LnGrp LOS	C	A	A	C	A	A	A	A	A	A	B	A
Approach Vol, veh/h		179			38			908			902	
Approach Delay, s/veh		25.7			22.0			8.3			12.4	
Approach LOS		C			C			A			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.8	41.7		13.2	9.0	37.6		13.2
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	16.0	66.0		26.0	16.0	66.0		26.0
Max Q Clear Time (g_c+I1), s	2.2	20.3		8.5	2.7	25.0		3.1
Green Ext Time (p_c), s	0.0	8.1		0.9	0.1	8.6		0.1

Intersection Summary			
HCM 6th Ctrl Delay			11.9
HCM 6th LOS			B

Intersection	
Intersection Delay, s/veh	22.9
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	511	734	1005
Demand Flow Rate, veh/h	522	749	1025
Vehicles Circulating, veh/h	820	289	111
Vehicles Exiting, veh/h	316	1053	926
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	38.8	16.2	19.8
Approach LOS	E	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	522	749	1025
Cap Entry Lane, veh/h	598	1028	1232
Entry HV Adj Factor	0.979	0.981	0.980
Flow Entry, veh/h	511	734	1005
Cap Entry, veh/h	585	1008	1208
V/C Ratio	0.873	0.729	0.832
Control Delay, s/veh	38.8	16.2	19.8
LOS	E	C	C
95th %tile Queue, veh	10	7	11

Intersection	
Int Delay, s/veh	27.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	260	330	605	900	30
Future Vol, veh/h	5	260	330	605	900	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	283	359	658	978	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2388	1003	1019	0	-	0
Stage 1	1003	-	-	-	-	-
Stage 2	1385	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	37	294	681	-	-	-
Stage 1	355	-	-	-	-	-
Stage 2	232	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	17	292	676	-	-	-
Mov Cap-2 Maneuver	17	-	-	-	-	-
Stage 1	165	-	-	-	-	-
Stage 2	230	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	201.3		5.7		0	
HCM LOS	F					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	676	-	224	-	-
HCM Lane V/C Ratio	0.531	-	1.286	-	-
HCM Control Delay (s)	16.2	-	201.3	-	-
HCM Lane LOS	C	-	F	-	-
HCM 95th %tile Q(veh)	3.1	-	15.1	-	-

Intersection	
Int Delay, s/veh	47.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	270	70	975	1180	10
Future Vol, veh/h	10	270	70	975	1180	10
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	293	76	1060	1283	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1984	1293	1298	0	-	0
Stage 1	1293	-	-	-	-	-
Stage 2	691	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	60	~ 198	532	-	-	-
Stage 1	256	-	-	-	-	-
Stage 2	460	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	39	~ 197	530	-	-	-
Mov Cap-2 Maneuver	39	-	-	-	-	-
Stage 1	166	-	-	-	-	-
Stage 2	458	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 415	2.7	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	530	-	172	-	-
HCM Lane V/C Ratio	0.144	-	1.769	-	-
HCM Control Delay (s)	12.9	2	$ 415	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.5	-	21.8	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	20	1110	1010	515
Future Volume (Veh/h)	0	0	20	1110	1010	515
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)	0	0	22	1207	1098	560
Pedestrians	4				9	
Lane Width (ft)	0.0				12.0	
Walking Speed (ft/s)	3.5				3.5	
Percent Blockage	0				1	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2038	1382	1662			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2038	1382	1662			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	94			
cM capacity (veh/h)	46	134	383			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	424	805	1658
Volume Left	22	0	0
Volume Right	0	0	560
cSH	383	1700	1700
Volume to Capacity	0.06	0.47	0.98
Queue Length 95th (ft)	5	0	0
Control Delay (s)	1.8	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.6		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		

Intersection						
Int Delay, s/veh	8.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	190	10	5	980	895	80
Future Vol, veh/h	190	10	5	980	895	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	207	11	5	1065	973	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2097	1022	1065	0	-	0
Stage 1	1022	-	-	-	-	-
Stage 2	1075	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 57	287	654	-	-	-
Stage 1	347	-	-	-	-	-
Stage 2	328	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 56	286	651	-	-	-
Mov Cap-2 Maneuver	227	-	-	-	-	-
Stage 1	342	-	-	-	-	-
Stage 2	326	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	92.1	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	651	-	229	-	-
HCM Lane V/C Ratio	0.008	-	0.949	-	-
HCM Control Delay (s)	10.6	-	92.1	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0	-	8.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	10.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	105	5	10	5	5	65	10	815	15	70	825	5
Future Vol, veh/h	105	5	10	5	5	65	10	815	15	70	825	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	114	5	11	5	5	71	11	886	16	76	897	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2018	2002	925	2003	1996	908	914	0	0	916	0	0
Stage 1	1064	1064	-	930	930	-	-	-	-	-	-	-
Stage 2	954	938	-	1073	1066	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 43	60	326	44	60	334	746	-	-	745	-	-
Stage 1	270	300	-	321	346	-	-	-	-	-	-	-
Stage 2	311	343	-	267	299	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 25	45	318	33	45	330	737	-	-	735	-	-
Mov Cap-2 Maneuver	128	168	-	33	45	-	-	-	-	-	-	-
Stage 1	259	235	-	307	331	-	-	-	-	-	-	-
Stage 2	233	328	-	197	234	-	-	-	-	-	-	-

Approach	EB			WB			NB			SB
HCM Control Delay, s	129.5			47.4			0.1			0.8
HCM LOS	F			E						

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	737	-	-	136	163	735	-	-
HCM Lane V/C Ratio	0.015	-	-	0.959	0.5	0.104	-	-
HCM Control Delay (s)	10	0	-	129.5	47.4	10.5	0	-
HCM Lane LOS	A	A	-	F	E	B	A	-
HCM 95th %tile Q(veh)	0	-	-	6.7	2.4	0.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	105	65	25	740	800	35
Future Volume (vph)	105	65	25	740	800	35
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.95	1.00	1.00	1.00	
Flpb, ped/bikes	0.98	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1726	1507	1770	800	1169	
Flt Permitted	0.95	1.00	0.25	1.00	1.00	
Satd. Flow (perm)	1726	1507	472	980	1169	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	71	27	804	870	38
RTOR Reduction (vph)	0	64	0	0	1	0
Lane Group Flow (vph)	114	7	27	804	907	0
Confl. Peds. (#/hr)	6	7	2			2
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	16.9	16.9	155.1	155.1	146.3	
Effective Green, g (s)	16.9	16.9	155.1	155.1	146.3	
Actuated g/C Ratio	0.09	0.09	0.86	0.86	0.81	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	162	141	441	689	950	
v/s Ratio Prot			0.00	c1.00	0.78	
v/s Ratio Perm	c0.07	0.00	0.05			
v/c Ratio	0.70	0.05	0.06	1.17	0.96	
Uniform Delay, d1	79.1	74.2	5.2	12.5	14.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	13.0	0.1	0.1	90.3	20.2	
Delay (s)	92.1	74.4	5.2	102.8	34.3	
Level of Service	F	E	A	F	C	
Approach Delay (s)	85.3			99.6	34.3	
Approach LOS	F			F	C	

Intersection Summary			
HCM 2000 Control Delay	67.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	17.6
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	669	250	49	647
Demand Flow Rate, veh/h	682	255	50	659
Vehicles Circulating, veh/h	527	22	632	277
Vehicles Exiting, veh/h	409	660	577	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	28.3	4.3	5.8	12.6
Approach LOS	D	A	A	B

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	682	255	50	659
Cap Entry Lane, veh/h	806	1349	724	1040
Entry HV Adj Factor	0.981	0.979	0.980	0.982
Flow Entry, veh/h	669	250	49	647
Cap Entry, veh/h	791	1322	710	1021
V/C Ratio	0.846	0.189	0.069	0.633
Control Delay, s/veh	28.3	4.3	5.8	12.6
LOS	D	A	A	B
95th %tile Queue, veh	10	1	0	5

Intersection	
Intersection Delay, s/veh	3.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	71	54	71
Demand Flow Rate, veh/h	0	72	56	72
Vehicles Circulating, veh/h	144	28	0	72
Vehicles Exiting, veh/h	0	28	144	28
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	3.1	3.0	3.3
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	0	72	56	72
Cap Entry Lane, veh/h	1191	1341	1380	1282
Entry HV Adj Factor	1.000	0.986	0.972	0.980
Flow Entry, veh/h	0	71	54	71
Cap Entry, veh/h	1191	1322	1342	1257
V/C Ratio	0.000	0.054	0.041	0.056
Control Delay, s/veh	3.0	3.1	3.0	3.3
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 with Mitigation (Without Bypass) PM Peak

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	175	20	5	95
Future Vol, veh/h	10	0	175	20	5	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	190	22	5	103

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	314	201	0	0	212	0
Stage 1	201	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	679	840	-	-	1358	-
Stage 1	833	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	676	840	-	-	1358	-
Mov Cap-2 Maneuver	676	-	-	-	-	-
Stage 1	830	-	-	-	-	-
Stage 2	912	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.4	0	0.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	676	1358	-
HCM Lane V/C Ratio	-	-	0.016	0.004	-
HCM Control Delay (s)	-	-	10.4	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	0	105	30	5	10	175	810	25	20	905	30
Future Volume (veh/h)	15	0	105	30	5	10	175	810	25	20	905	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	0	114	33	5	11	190	880	27	22	984	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	76	9	159	202	37	42	360	1212	37	379	1157	981
Arrive On Green	0.12	0.00	0.12	0.12	0.12	0.12	0.08	0.67	0.67	0.03	0.62	0.62
Sat Flow, veh/h	113	80	1382	936	322	364	1781	1805	55	1781	1870	1585
Grp Volume(v), veh/h	130	0	0	49	0	0	190	0	907	22	984	33
Grp Sat Flow(s),veh/h/ln	1576	0	0	1622	0	0	1781	0	1860	1781	1870	1585
Q Serve(g_s), s	2.1	0.0	0.0	0.0	0.0	0.0	2.1	0.0	20.0	0.3	27.1	0.5
Cycle Q Clear(g_c), s	5.1	0.0	0.0	1.6	0.0	0.0	2.1	0.0	20.0	0.3	27.1	0.5
Prop In Lane	0.12		0.88	0.67		0.22	1.00		0.03	1.00		1.00
Lane Grp Cap(c), veh/h	245	0	0	281	0	0	360	0	1250	379	1157	981
V/C Ratio(X)	0.53	0.00	0.00	0.17	0.00	0.00	0.53	0.00	0.73	0.06	0.85	0.03
Avail Cap(c_a), veh/h	697	0	0	683	0	0	667	0	1920	779	1930	1635
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	25.7	0.0	0.0	12.4	0.0	6.7	6.3	9.8	4.7
Incr Delay (d2), s/veh	1.8	0.0	0.0	0.3	0.0	0.0	1.2	0.0	0.8	0.1	2.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.0	0.0	0.7	0.0	0.0	1.6	0.0	5.5	0.1	8.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	29.0	0.0	0.0	26.0	0.0	0.0	13.6	0.0	7.5	6.4	11.8	4.8
LnGrp LOS	C	A	A	C	A	A	B	A	A	A	B	A
Approach Vol, veh/h		130			49			1097			1039	
Approach Delay, s/veh		29.0			26.0			8.6			11.5	
Approach LOS		C			C			A			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	47.0		11.4	9.0	43.6		11.4				
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0				
Max Green Setting (Gmax), s	16.0	66.0		26.0	16.0	66.0		26.0				
Max Q Clear Time (g_c+I1), s	2.3	22.0		7.1	4.1	29.1		3.6				
Green Ext Time (p_c), s	0.0	9.2		0.7	0.4	10.5		0.2				

Intersection Summary			
HCM 6th Ctrl Delay			11.4
HCM 6th LOS			B

Intersection	
Intersection Delay, s/veh	20.1
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	326	979	1055
Demand Flow Rate, veh/h	332	999	1076
Vehicles Circulating, veh/h	887	177	34
Vehicles Exiting, veh/h	223	1042	1142
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	18.7	23.9	17.1
Approach LOS	C	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	332	999	1076
Cap Entry Lane, veh/h	558	1152	1333
Entry HV Adj Factor	0.982	0.980	0.980
Flow Entry, veh/h	326	979	1055
Cap Entry, veh/h	548	1129	1306
V/C Ratio	0.595	0.867	0.807
Control Delay, s/veh	18.7	23.9	17.1
LOS	C	C	C
95th %tile Queue, veh	4	12	10

Intersection						
Int Delay, s/veh	5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	170	245	895	990	15
Future Vol, veh/h	0	170	245	895	990	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	185	266	973	1076	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2605	1092	1100	0	-	0
Stage 1	1092	-	-	-	-	-
Stage 2	1513	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	27	261	635	-	-	-
Stage 1	322	-	-	-	-	-
Stage 2	201	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	15	259	630	-	-	-
Mov Cap-2 Maneuver	15	-	-	-	-	-
Stage 1	185	-	-	-	-	-
Stage 2	199	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	47.3	3.2	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	630	-	259	-	-
HCM Lane V/C Ratio	0.423	-	0.713	-	-
HCM Control Delay (s)	14.8	-	47.3	-	-
HCM Lane LOS	B	-	E	-	-
HCM 95th %tile Q(veh)	2.1	-	4.9	-	-

Intersection	
Int Delay, s/veh	7.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	95	100	1165	1175	15
Future Vol, veh/h	5	95	100	1165	1175	15
Conflicting Peds, #/hr	0	0	8	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	103	109	1266	1277	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2144	1293	1301	0	-	0
Stage 1	1293	-	-	-	-	-
Stage 2	851	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.219	-	-	-
Pot Cap-1 Maneuver	47	198	530	-	-	-
Stage 1	256	-	-	-	-	-
Stage 2	380	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	14	196	526	-	-	-
Mov Cap-2 Maneuver	14	-	-	-	-	-
Stage 1	77	-	-	-	-	-
Stage 2	377	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	129	4.9	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	526	-	119	-	-
HCM Lane V/C Ratio	0.207	-	0.913	-	-
HCM Control Delay (s)	13.6	4.1	129	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0.8	-	5.8	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	15	1275	895	375
Future Volume (Veh/h)	0	0	15	1275	895	375
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)	0	0	16	1386	973	408
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	1902	1177	1381			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1902	1177	1381			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	97			
cM capacity (veh/h)	59	184	492			

Direction, Lane #	NB 1	NB 2	SB 1
Volume Total	478	924	1381
Volume Left	16	0	0
Volume Right	0	0	408
cSH	492	1700	1700
Volume to Capacity	0.03	0.54	0.81
Queue Length 95th (ft)	3	0	0
Control Delay (s)	1.0	0.0	0.0
Lane LOS	A		
Approach Delay (s)	0.3		0.0
Approach LOS			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	8.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	170	10	20	1115	735	175
Future Vol, veh/h	170	10	20	1115	735	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	185	11	22	1212	799	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2158	902	997	0	-	0
Stage 1	902	-	-	-	-	-
Stage 2	1256	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 52	336	694	-	-	-
Stage 1	396	-	-	-	-	-
Stage 2	268	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 50	333	689	-	-	-
Mov Cap-2 Maneuver	199	-	-	-	-	-
Stage 1	380	-	-	-	-	-
Stage 2	266	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	101.2	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	689	-	204	-	-
HCM Lane V/C Ratio	0.032	-	0.959	-	-
HCM Control Delay (s)	10.4	-	101.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	8.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	11.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	5	25	5	5	110	20	985	15	40	705	15
Future Vol, veh/h	45	5	25	5	5	110	20	985	15	40	705	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	2	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	49	5	27	5	5	120	22	1071	16	43	766	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2076	2056	838	2068	2056	1114	812	0	0	1122	0	0
Stage 1	890	890	-	1158	1158	-	-	-	-	-	-	-
Stage 2	1186	1166	-	910	898	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 39	55	366	40	55	253	814	-	-	623	-	-
Stage 1	337	361	-	239	270	-	-	-	-	-	-	-
Stage 2	230	268	-	329	358	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 15	42	344	29	42	245	791	-	-	602	-	-
Mov Cap-2 Maneuver	60	161	-	29	42	-	-	-	-	-	-	-
Stage 1	304	306	-	215	242	-	-	-	-	-	-	-
Stage 2	107	241	-	251	304	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	161	83.2	0.2	0.6
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	791	-	-	88	162	602	-	-
HCM Lane V/C Ratio	0.027	-	-	0.926	0.805	0.072	-	-
HCM Control Delay (s)	9.7	0	-	161	83.2	11.4	0	-
HCM Lane LOS	A	A	-	F	F	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	5.1	5.3	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	235	65	35	800	685	55
Future Volume (vph)	235	65	35	800	685	55
Ideal Flow (vphpl)	1900	1900	1900	1000	1200	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.80	1.00	1.00	0.99	
Flpb, ped/bikes	0.86	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1528	1262	1770	800	1150	
Flt Permitted	0.95	1.00	0.26	1.00	1.00	
Satd. Flow (perm)	1528	1262	485	980	1150	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	255	71	38	870	745	60
RTOR Reduction (vph)	0	55	0	0	1	0
Lane Group Flow (vph)	255	16	38	870	804	0
Confl. Peds. (#/hr)	30	41	46			46
Turn Type	Perm	Perm	pm+pt	NA	NA	
Protected Phases			5	2	6	
Permitted Phases	4	4	2			
Actuated Green, G (s)	35.1	35.1	156.9	156.9	147.6	
Effective Green, g (s)	35.1	35.1	156.9	156.9	147.6	
Actuated g/C Ratio	0.18	0.18	0.78	0.78	0.74	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	268	221	414	627	848	
v/s Ratio Prot			0.00	c1.09	0.70	
v/s Ratio Perm	c0.17	0.01	0.07			
v/c Ratio	0.95	0.07	0.09	1.39	0.95	
Uniform Delay, d1	81.6	68.8	9.5	21.5	22.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	41.7	0.1	0.1	184.1	20.5	
Delay (s)	123.3	69.0	9.6	205.7	43.4	
Level of Service	F	E	A	F	D	
Approach Delay (s)	111.4			197.5	43.4	
Approach LOS	F			F	D	

Intersection Summary			
HCM 2000 Control Delay	122.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.33		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	103.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	451	511	304	501
Demand Flow Rate, veh/h	460	522	311	511
Vehicles Circulating, veh/h	434	78	500	600
Vehicles Exiting, veh/h	677	733	394	0
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	11.1	6.9	9.0	18.2
Approach LOS	B	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	TR	LT	LR	LTR
Assumed Moves	TR	LT	LR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	460	522	311	511
Cap Entry Lane, veh/h	886	1274	829	748
Entry HV Adj Factor	0.980	0.980	0.977	0.980
Flow Entry, veh/h	451	511	304	501
Cap Entry, veh/h	869	1248	810	733
V/C Ratio	0.519	0.410	0.375	0.683
Control Delay, s/veh	11.1	6.9	9.0	18.2
LOS	B	A	A	C
95th %tile Queue, veh	3	2	2	5

Intersection	
Intersection Delay, s/veh	3.5
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	0	49	164	49
Demand Flow Rate, veh/h	0	50	168	50
Vehicles Circulating, veh/h	100	84	0	50
Vehicles Exiting, veh/h	0	84	100	84
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	0.0	3.2	3.6	3.1
Approach LOS	-	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	0	50	168	50
Cap Entry Lane, veh/h	1246	1267	1380	1311
Entry HV Adj Factor	1.000	0.980	0.978	0.980
Flow Entry, veh/h	0	49	164	49
Cap Entry, veh/h	1246	1241	1350	1286
V/C Ratio	0.000	0.039	0.122	0.038
Control Delay, s/veh	2.9	3.2	3.6	3.1
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 with Mitigation (With Bypass) AM Peak

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	5	50	15	5	140
Future Vol, veh/h	20	5	50	15	5	140
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	5	54	16	5	152

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	225	62	0	0	70	0
Stage 1	62	-	-	-	-	-
Stage 2	163	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	763	1003	-	-	1531	-
Stage 1	961	-	-	-	-	-
Stage 2	866	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	759	1003	-	-	1531	-
Mov Cap-2 Maneuver	759	-	-	-	-	-
Stage 1	957	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	798	1531	-
HCM Lane V/C Ratio	-	-	0.034	0.004	-
HCM Control Delay (s)	-	-	9.7	7.4	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	0	120	20	5	10	60	745	30	10	805	15
Future Volume (veh/h)	45	0	120	20	5	10	60	745	30	10	805	15
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	49	0	130	22	5	11	65	810	33	11	875	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	125	17	174	209	56	69	380	1127	46	358	1051	891
Arrive On Green	0.15	0.00	0.15	0.15	0.15	0.15	0.08	0.63	0.63	0.01	0.56	0.56
Sat Flow, veh/h	313	114	1133	741	365	451	1781	1785	73	1781	1870	1585
Grp Volume(v), veh/h	179	0	0	38	0	0	65	0	843	11	875	16
Grp Sat Flow(s),veh/h/ln	1560	0	0	1557	0	0	1781	0	1857	1781	1870	1585
Q Serve(g_s), s	4.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	18.3	0.2	23.0	0.3
Cycle Q Clear(g_c), s	6.5	0.0	0.0	1.1	0.0	0.0	0.7	0.0	18.3	0.2	23.0	0.3
Prop In Lane	0.27		0.73	0.58		0.29	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	316	0	0	334	0	0	380	0	1173	358	1051	891
V/C Ratio(X)	0.57	0.00	0.00	0.11	0.00	0.00	0.17	0.00	0.72	0.03	0.83	0.02
Avail Cap(c_a), veh/h	747	0	0	730	0	0	708	0	2052	810	2067	1752
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.1	0.0	0.0	21.9	0.0	0.0	9.0	0.0	7.4	7.1	10.8	5.8
Incr Delay (d2), s/veh	1.6	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.8	0.0	1.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	0.0	0.4	0.0	0.0	0.3	0.0	5.2	0.0	7.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.7	0.0	0.0	22.0	0.0	0.0	9.2	0.0	8.3	7.1	12.6	5.8
LnGrp LOS	C	A	A	C	A	A	A	A	A	A	B	A
Approach Vol, veh/h		179			38			908			902	
Approach Delay, s/veh		25.7			22.0			8.3			12.4	
Approach LOS		C			C			A			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	4.8	41.7		13.2	9.0	37.6		13.2				
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0				
Max Green Setting (Gmax), s	16.0	66.0		26.0	16.0	66.0		26.0				
Max Q Clear Time (g_c+I1), s	2.2	20.3		8.5	2.7	25.0		3.1				
Green Ext Time (p_c), s	0.0	8.1		0.9	0.1	8.6		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			11.9									
HCM 6th LOS			B									

Intersection	
Intersection Delay, s/veh	21.3
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	479	696	1005
Demand Flow Rate, veh/h	488	710	1025
Vehicles Circulating, veh/h	820	327	111
Vehicles Exiting, veh/h	316	981	926
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	31.8	16.2	19.8
Approach LOS	D	C	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	488	710	1025
Cap Entry Lane, veh/h	598	989	1232
Entry HV Adj Factor	0.982	0.981	0.980
Flow Entry, veh/h	479	696	1005
Cap Entry, veh/h	587	969	1208
V/C Ratio	0.816	0.718	0.832
Control Delay, s/veh	31.8	16.2	19.8
LOS	D	C	C
95th %tile Queue, veh	8	6	11

Intersection						
Int Delay, s/veh	11.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	220	280	575	835	30
Future Vol, veh/h	5	220	280	575	835	30
Conflicting Peds, #/hr	9	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	239	304	625	908	33

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2175	933	949	0	-	0
Stage 1	933	-	-	-	-	-
Stage 2	1242	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	51	323	724	-	-	-
Stage 1	383	-	-	-	-	-
Stage 2	272	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	29	321	718	-	-	-
Mov Cap-2 Maneuver	29	-	-	-	-	-
Stage 1	219	-	-	-	-	-
Stage 2	270	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	81.2	4.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	718	-	262	-	-
HCM Lane V/C Ratio	0.424	-	0.933	-	-
HCM Control Delay (s)	13.7	-	81.2	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	2.1	-	8.5	-	-

Intersection						
Int Delay, s/veh	20					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	130	80	395	35	110	280
Future Vol, veh/h	130	80	395	35	110	280
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	141	87	429	38	120	304

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	467	0	-	0	817	448
Stage 1	-	-	-	-	448	-
Stage 2	-	-	-	-	369	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1094	-	-	-	346	611
Stage 1	-	-	-	-	644	-
Stage 2	-	-	-	-	699	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1094	-	-	-	299	611
Mov Cap-2 Maneuver	-	-	-	-	299	-
Stage 1	-	-	-	-	557	-
Stage 2	-	-	-	-	699	-

Approach	EB		WB		SB	
HCM Control Delay, s	5.4		0		49.8	
HCM LOS					E	

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1094	-	-	-	472
HCM Lane V/C Ratio	0.129	-	-	-	0.898
HCM Control Delay (s)	8.8	0	-	-	49.8
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.4	-	-	-	10

Intersection						
Int Delay, s/veh	6.6					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	85	105	45	885	780	375
Future Vol, veh/h	85	105	45	885	780	375
Conflicting Peds, #/hr	9	0	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	92	114	49	962	848	408

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2125	1056	1260	0	-	0
Stage 1	1056	-	-	-	-	-
Stage 2	1069	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 55	274	552	-	-	-
Stage 1	335	-	-	-	-	-
Stage 2	330	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 50	273	550	-	-	-
Mov Cap-2 Maneuver	200	-	-	-	-	-
Stage 1	304	-	-	-	-	-
Stage 2	329	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	75.5	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	550	-	235	-	-
HCM Lane V/C Ratio	0.089	-	0.879	-	-
HCM Control Delay (s)	12.2	-	75.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	7.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	3.9					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	165	10	5	800	765	80
Future Vol, veh/h	165	10	5	800	765	80
Conflicting Peds, #/hr	0	0	5	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	179	11	5	870	832	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1761	881	924	0	-	0
Stage 1	881	-	-	-	-	-
Stage 2	880	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 93	346	739	-	-	-
Stage 1	405	-	-	-	-	-
Stage 2	406	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 91	344	735	-	-	-
Mov Cap-2 Maneuver	282	-	-	-	-	-
Stage 1	400	-	-	-	-	-
Stage 2	404	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	39.7	0.1	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	735	-	285	-	-
HCM Lane V/C Ratio	0.007	-	0.667	-	-
HCM Control Delay (s)	9.9	-	39.7	-	-
HCM Lane LOS	A	-	E	-	-
HCM 95th %tile Q(veh)	0	-	4.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	5	5	10	5	5	55	10	735	5	70	700	5
Future Vol, veh/h	5	5	10	5	5	55	10	735	5	70	700	5
Conflicting Peds, #/hr	0	0	13	13	0	0	12	0	14	14	0	12
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	11	5	5	60	11	799	5	76	761	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1784	1768	789	1775	1768	816	778	0	0	818	0	0
Stage 1	928	928	-	838	838	-	-	-	-	-	-	-
Stage 2	856	840	-	937	930	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	63	84	391	64	84	377	839	-	-	810	-	-
Stage 1	321	347	-	361	382	-	-	-	-	-	-	-
Stage 2	352	381	-	318	346	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	42	67	382	49	67	372	829	-	-	799	-	-
Mov Cap-2 Maneuver	42	67	-	49	67	-	-	-	-	-	-	-
Stage 1	310	286	-	348	368	-	-	-	-	-	-	-
Stage 2	284	367	-	250	285	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	56.6	32.5	0.1	0.9
HCM LOS	F	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	829	-	-	91	200	799	-	-
HCM Lane V/C Ratio	0.013	-	-	0.239	0.353	0.095	-	-
HCM Control Delay (s)	9.4	0	-	56.6	32.5	10	0	-
HCM Lane LOS	A	A	-	F	D	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.9	1.5	0.3	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	5	60	0	0	15	25	705	20	0	670	35
Future Volume (vph)	40	5	60	0	0	15	25	705	20	0	670	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.95			0.94	1.00	1.00			1.00	
Flpb, ped/bikes		0.97	1.00			1.00	1.00	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.96	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1737	1500			1509	1769	1169			1167	
Flt Permitted		0.96	1.00			1.00	0.33	1.00			1.00	
Satd. Flow (perm)		1737	1500			1509	610	1169			1167	
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)	43	5	65	0	0	16	27	766	22	0	728	38
RTOR Reduction (vph)	0	0	61	0	0	15	0	0	0	0	1	0
Lane Group Flow (vph)	0	48	4	0	0	1	27	788	0	0	765	0
Confl. Peds. (#/hr)	6		7			6	2		13	13		2
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA			NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Effective Green, g (s)		14.3	14.3			14.3	187.7	187.7			178.9	
Actuated g/C Ratio		0.07	0.07			0.07	0.89	0.89			0.85	
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)		118	102			102	571	1044			994	
v/s Ratio Prot							0.00	c0.67			c0.66	
v/s Ratio Perm		0.03	0.00			0.00	0.04					
v/c Ratio		0.41	0.04			0.01	0.05	0.75			0.77	
Uniform Delay, d1		93.8	91.5			91.3	2.5	3.6			6.7	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		2.3	0.2			0.0	0.0	5.1			5.7	
Delay (s)		96.1	91.6			91.3	2.6	8.7			12.4	
Level of Service		F	F			F	A	A			B	
Approach Delay (s)		93.5			91.3			8.5			12.4	
Approach LOS		F			F			A			B	

Intersection Summary			
HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	210.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	27.2
Intersection LOS	D

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	685	255	49	793
Demand Flow Rate, veh/h	698	260	49	809
Vehicles Circulating, veh/h	621	243	670	277
Vehicles Exiting, veh/h	465	476	649	226
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	46.7	5.7	5.9	18.5
Approach LOS	E	A	A	C

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	698	260	49	809
Cap Entry Lane, veh/h	732	1077	697	1040
Entry HV Adj Factor	0.981	0.980	0.994	0.981
Flow Entry, veh/h	685	255	49	793
Cap Entry, veh/h	719	1055	692	1020
V/C Ratio	0.953	0.241	0.070	0.778
Control Delay, s/veh	46.7	5.7	5.9	18.5
LOS	E	A	A	C
95th %tile Queue, veh	14	1	0	8

Intersection	
Intersection Delay, s/veh	3.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	15	81	59	81
Demand Flow Rate, veh/h	15	82	61	82
Vehicles Circulating, veh/h	149	38	15	82
Vehicles Exiting, veh/h	15	38	149	38
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.2	3.2	3.1	3.4
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	15	82	61	82
Cap Entry Lane, veh/h	1185	1327	1359	1269
Entry HV Adj Factor	0.993	0.987	0.975	0.983
Flow Entry, veh/h	15	81	59	81
Cap Entry, veh/h	1178	1310	1324	1247
V/C Ratio	0.013	0.062	0.045	0.065
Control Delay, s/veh	3.2	3.2	3.1	3.4
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Future Year 2027 with Mitigation (With Bypass) PM Peak

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	0	175	20	5	95
Future Vol, veh/h	10	0	175	20	5	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	0	190	22	5	103

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	314	201	0	0	212	0
Stage 1	201	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	679	840	-	-	1358	-
Stage 1	833	-	-	-	-	-
Stage 2	912	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	676	840	-	-	1358	-
Mov Cap-2 Maneuver	676	-	-	-	-	-
Stage 1	830	-	-	-	-	-
Stage 2	912	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.4	0	0.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	676	1358	-
HCM Lane V/C Ratio	-	-	0.016	0.004	-
HCM Control Delay (s)	-	-	10.4	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	0	105	30	5	10	175	810	25	20	905	30
Future Volume (veh/h)	15	0	105	30	5	10	175	810	25	20	905	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	16	0	114	33	5	11	190	880	27	22	984	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	76	9	159	202	37	42	360	1212	37	379	1157	981
Arrive On Green	0.12	0.00	0.12	0.12	0.12	0.12	0.08	0.67	0.67	0.03	0.62	0.62
Sat Flow, veh/h	113	80	1382	936	322	364	1781	1805	55	1781	1870	1585
Grp Volume(v), veh/h	130	0	0	49	0	0	190	0	907	22	984	33
Grp Sat Flow(s),veh/h/ln	1576	0	0	1622	0	0	1781	0	1860	1781	1870	1585
Q Serve(g_s), s	2.1	0.0	0.0	0.0	0.0	0.0	2.1	0.0	20.0	0.3	27.1	0.5
Cycle Q Clear(g_c), s	5.1	0.0	0.0	1.6	0.0	0.0	2.1	0.0	20.0	0.3	27.1	0.5
Prop In Lane	0.12		0.88	0.67		0.22	1.00		0.03	1.00		1.00
Lane Grp Cap(c), veh/h	245	0	0	281	0	0	360	0	1250	379	1157	981
V/C Ratio(X)	0.53	0.00	0.00	0.17	0.00	0.00	0.53	0.00	0.73	0.06	0.85	0.03
Avail Cap(c_a), veh/h	697	0	0	683	0	0	667	0	1920	779	1930	1635
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.2	0.0	0.0	25.7	0.0	0.0	12.4	0.0	6.7	6.3	9.8	4.7
Incr Delay (d2), s/veh	1.8	0.0	0.0	0.3	0.0	0.0	1.2	0.0	0.8	0.1	2.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.0	0.0	0.7	0.0	0.0	1.6	0.0	5.5	0.1	8.7	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	29.0	0.0	0.0	26.0	0.0	0.0	13.6	0.0	7.5	6.4	11.8	4.8
LnGrp LOS	C	A	A	C	A	A	B	A	A	A	B	A
Approach Vol, veh/h		130			49			1097			1039	
Approach Delay, s/veh		29.0			26.0			8.6			11.5	
Approach LOS		C			C			A			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.6	47.0		11.4	9.0	43.6		11.4				
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0	4.0		4.0				
Max Green Setting (Gmax), s	16.0	66.0		26.0	16.0	66.0		26.0				
Max Q Clear Time (g_c+I1), s	2.3	22.0		7.1	4.1	29.1		3.6				
Green Ext Time (p_c), s	0.0	9.2		0.7	0.4	10.5		0.2				
Intersection Summary												
HCM 6th Ctrl Delay			11.4									
HCM 6th LOS			B									

Intersection	
Intersection Delay, s/veh	20.6
Intersection LOS	C

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	315	930	1055
Demand Flow Rate, veh/h	322	949	1076
Vehicles Circulating, veh/h	887	233	34
Vehicles Exiting, veh/h	223	976	1148
Ped Vol Crossing Leg, #/h	1	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	18.1	25.4	17.1
Approach LOS	C	D	C

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	322	949	1076
Cap Entry Lane, veh/h	558	1088	1333
Entry HV Adj Factor	0.978	0.980	0.980
Flow Entry, veh/h	315	930	1055
Cap Entry, veh/h	546	1066	1306
V/C Ratio	0.577	0.872	0.807
Control Delay, s/veh	18.1	25.4	17.1
LOS	C	D	C
95th %tile Queue, veh	4	12	10

Intersection	
Int Delay, s/veh	3.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	0	145	210	850	925	15
Future Vol, veh/h	0	145	210	850	925	15
Conflicting Peds, #/hr	8	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	158	228	924	1005	16

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2409	1021	1029	0	-	0
Stage 1	1021	-	-	-	-	-
Stage 2	1388	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	36	287	675	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	231	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	23	285	670	-	-	-
Mov Cap-2 Maneuver	23	-	-	-	-	-
Stage 1	228	-	-	-	-	-
Stage 2	229	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.2	2.6	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	670	-	285	-	-
HCM Lane V/C Ratio	0.341	-	0.553	-	-
HCM Control Delay (s)	13.1	-	32.2	-	-
HCM Lane LOS	B	-	D	-	-
HCM 95th %tile Q(veh)	1.5	-	3.1	-	-

Intersection						
Int Delay, s/veh	5.5					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	150	100	350	50	50	135
Future Vol, veh/h	150	100	350	50	50	135
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	163	109	380	54	54	147

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	434	0	-	0	842	407
Stage 1	-	-	-	-	407	-
Stage 2	-	-	-	-	435	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1126	-	-	-	334	644
Stage 1	-	-	-	-	672	-
Stage 2	-	-	-	-	653	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1126	-	-	-	283	644
Mov Cap-2 Maneuver	-	-	-	-	283	-
Stage 1	-	-	-	-	569	-
Stage 2	-	-	-	-	653	-

Approach	EB	WB	SB
HCM Control Delay, s	5.2	0	17.8
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1126	-	-	-	479
HCM Lane V/C Ratio	0.145	-	-	-	0.42
HCM Control Delay (s)	8.7	0	-	-	17.8
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.5	-	-	-	2

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	100	50	50	995	770	335
Future Vol, veh/h	100	50	50	995	770	335
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	109	54	54	1082	837	364

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2209	1019	1201	0	-	0
Stage 1	1019	-	-	-	-	-
Stage 2	1190	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 49	288	581	-	-	-
Stage 1	348	-	-	-	-	-
Stage 2	289	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 44	288	581	-	-	-
Mov Cap-2 Maneuver	182	-	-	-	-	-
Stage 1	316	-	-	-	-	-
Stage 2	289	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	66.5	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	581	-	207	-	-
HCM Lane V/C Ratio	0.094	-	0.788	-	-
HCM Control Delay (s)	11.8	-	66.5	-	-
HCM Lane LOS	B	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	5.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	5.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	180	10	20	860	655	175
Future Vol, veh/h	180	10	20	860	655	175
Conflicting Peds, #/hr	0	0	8	0	0	8
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	2	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	196	11	22	935	712	190

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1794	815	910	0	-	0
Stage 1	815	-	-	-	-	-
Stage 2	979	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 89	377	748	-	-	-
Stage 1	435	-	-	-	-	-
Stage 2	364	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 85	374	742	-	-	-
Mov Cap-2 Maneuver	262	-	-	-	-	-
Stage 1	418	-	-	-	-	-
Stage 2	361	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	53.4	0.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	742	-	266	-	-
HCM Lane V/C Ratio	0.029	-	0.776	-	-
HCM Control Delay (s)	10	-	53.4	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0.1	-	5.8	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	5	25	5	5	95	20	785	5	40	625	15
Future Vol, veh/h	5	5	25	5	5	95	20	785	5	40	625	15
Conflicting Peds, #/hr	0	0	34	34	0	0	30	0	35	35	0	30
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	5	27	5	5	103	22	853	5	43	679	16

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1757	1740	751	1758	1746	891	725	0	0	893	0	0
Stage 1	803	803	-	935	935	-	-	-	-	-	-	-
Stage 2	954	937	-	823	811	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	66	87	411	66	86	341	878	-	-	759	-	-
Stage 1	377	396	-	318	344	-	-	-	-	-	-	-
Stage 2	311	343	-	368	393	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	37	70	386	48	69	330	853	-	-	734	-	-
Mov Cap-2 Maneuver	37	70	-	48	69	-	-	-	-	-	-	-
Stage 1	348	348	-	292	316	-	-	-	-	-	-	-
Stage 2	200	316	-	295	345	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	44.2	36.1	0.2	0.6
HCM LOS	E	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	853	-	-	129	226	734	-	-
HCM Lane V/C Ratio	0.025	-	-	0.295	0.505	0.059	-	-
HCM Control Delay (s)	9.3	0	-	44.2	36.1	10.2	0	-
HCM Lane LOS	A	A	-	E	E	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	2.6	0.2	-	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	15	60	0	0	25	35	765	10	5	605	55
Future Volume (vph)	35	15	60	0	0	25	35	765	10	5	605	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1200	1900	1900	1200	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	
Frpb, ped/bikes		1.00	0.87			0.88	1.00	1.00			0.99	
Flpb, ped/bikes		0.94	1.00			1.00	0.99	1.00			1.00	
Frt		1.00	0.85			0.86	1.00	1.00			0.99	
Flt Protected		0.97	1.00			1.00	0.95	1.00			1.00	
Satd. Flow (prot)		1696	1378			1418	1755	1172			1152	
Flt Permitted		0.97	1.00			1.00	0.35	1.00			1.00	
Satd. Flow (perm)		1696	1378			1418	648	1172			1147	
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)	38	16	65	0	0	27	38	832	11	5	658	60
RTOR Reduction (vph)	0	0	55	0	0	23	0	0	0	0	2	0
Lane Group Flow (vph)	0	54	10	0	0	4	38	843	0	0	721	0
Confl. Peds. (#/hr)	30		41	41		30	46		68	68		46
Turn Type	Perm	NA	Perm			Perm	pm+pt	NA		Perm	NA	
Protected Phases		4					5	2			6	
Permitted Phases	4		4			8	2			6		
Actuated Green, G (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Effective Green, g (s)		17.6	17.6			17.6	94.4	94.4			86.5	
Actuated g/C Ratio		0.15	0.15			0.15	0.79	0.79			0.72	
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)		248	202			207	545	921			826	
v/s Ratio Prot							0.00	c0.72				
v/s Ratio Perm		0.03	0.01			0.00	0.05				0.63	
v/c Ratio		0.22	0.05			0.02	0.07	0.92			0.87	
Uniform Delay, d1		45.1	44.0			43.8	3.7	9.7			12.6	
Progression Factor		1.00	1.00			1.00	1.00	1.00			1.00	
Incremental Delay, d2		0.4	0.1			0.0	0.1	15.1			12.3	
Delay (s)		45.6	44.1			43.9	3.8	24.8			24.9	
Level of Service		D	D			D	A	C			C	
Approach Delay (s)		44.8			43.9			23.9			24.9	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection	
Intersection Delay, s/veh	16.5
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	461	516	315	603
Demand Flow Rate, veh/h	471	527	322	615
Vehicles Circulating, veh/h	505	349	532	600
Vehicles Exiting, veh/h	710	504	444	276
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	13.1	11.0	9.6	27.4
Approach LOS	B	B	A	D

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	471	527	322	615
Cap Entry Lane, veh/h	824	967	802	748
Entry HV Adj Factor	0.980	0.980	0.980	0.980
Flow Entry, veh/h	461	516	315	603
Cap Entry, veh/h	808	947	786	733
V/C Ratio	0.571	0.545	0.401	0.822
Control Delay, s/veh	13.1	11.0	9.6	27.4
LOS	B	B	A	D
95th %tile Queue, veh	4	3	2	9

Intersection	
Intersection Delay, s/veh	3.5
Intersection LOS	A

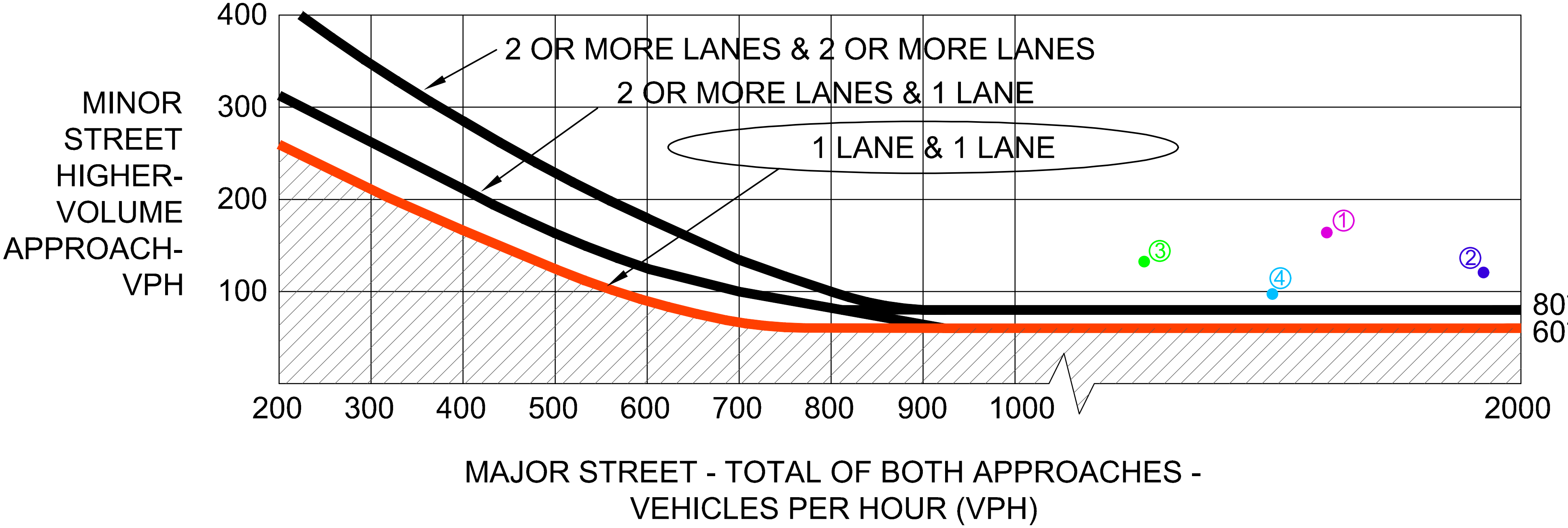
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	15	59	169	59
Demand Flow Rate, veh/h	15	60	173	60
Vehicles Circulating, veh/h	105	94	15	60
Vehicles Exiting, veh/h	15	94	105	94
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	3.3	3.7	3.2
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	15	60	173	60
Cap Entry Lane, veh/h	1240	1254	1359	1298
Entry HV Adj Factor	0.993	0.982	0.979	0.984
Flow Entry, veh/h	15	59	169	59
Cap Entry, veh/h	1232	1231	1330	1277
V/C Ratio	0.012	0.048	0.127	0.046
Control Delay, s/veh	3.0	3.3	3.7	3.2
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

APPENDIX D

FOUR-HOUR VEHICLE VOLUME SIGNAL WARRANT

Warrant 2, Four-Hour Vehicular Volume (70% Factor)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

① AM PEAK, (1650, 165)
② PM PEAK, (1935, 120)
③ 80% AM PEAK, (1320, 132)
④ 80% PM PEAK, (1548, 96)

KEALIA MAUKA HOMESITES TIAR	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII	APPENDIX
	FOUR HOUR TRAFFIC SIGNAL WARRANT FOR FUTURE YEAR 2027 KUHIO HIGHWAY/KEALIA ROAD	D

Appendix I

Hydrogeological Letter Report
Tom Nance Water Resource Engineering

April 2018

TNWRE
Tom Nance Water Resource Engineering

No. of pages: 3
Email: sezer@hhf.com
greg@tnwre.com
todd@tnwre.com

Original ☐ will ☑ will not be mailed to you.

April 5, 2018
18-077 | 18-24

MEMORANDUM

To: Scott Ezer – HHF Planners

From: Tom Nance

Subject: Potential Impact of Additional Use of the Two Kealia Water System Wells to Supply the Kealia Mauka Homesites Project

Introduction

The Kealia Mauka Homesites Project would consist of 235 residential lots situated between Kuhio Highway and Kealia Road. Water service would be provided by the private Kealia Water Company system. The system is regulated by the State Department of Health as PWS No. 423. It is supplied by two side-by-side wells identified as State Nos. 0618-009 and 0618-010 and also known as Kealia 1A and Kealia 2A, respectively. Construction and pump testing of both wells was completed in 2001.

Use of the wells has averaged between 30,000 and 40,000 gallons per day (GPD) since they were put into service in 2008. They presently supply the residential subdivision along Kaao and Hopoe Roads and about 35 houses in the Kealia Makai subdivision. The additional pumpage of the wells to supply the 235-lot project, when it is ultimately fully occupied, could vary between a year-round average of about 120,000 GPD to a summertime maximum of up to 180,000 GPD. The question has been raised regarding the potential impact that this additional use of groundwater could have on upgradient uses of the resource. In particular, a concern was raised regarding the impact on the irrigation supply for the lo'i located 1.1 miles inland of the wells (refer to Figure 1).

Groundwater Occurrence in the Vicinity of Kealia Wells 1A and 2A

Kealia Wells 1A and 2A are located within the area of a battery of seven wells developed and formerly used by Lihue Plantation. Table 1 provides summary information on the plantation's seven wells and Kealia Wells 1A and 2A. All nine of these wells were drilled through alluvial material comprised of various clays with some sand and coral to access the semi-confined basal groundwater which resides in the unweathered Koloa volcanics at depth below the alluvium. All nine wells are solid cased to depths between 80 to 130 feet below sea level. They draw water from the open boreholes below the solid casings. The open hole depths span from 80 to 235 feet below sea level. The piezometric head of the semi-confined groundwater tapped by these wells varies between eight (8) and 10 feet above sea level. When originally constructed, at least three of the seven plantation wells were free flowing under artesian pressure.

Potential Impact of Pumping Kealia Wells 1A and 2A on the Source of Irrigation Supply for the Lo'i Located 1.1 Miles Inland of the Wells

The Koloa volcanics from which Kealia Wells 1A and 2A draw water are generally moderate to poorly permeable, highly variable over short vertical and horizontal distances, and are often interbedded with nearly impermeable weathered soil layers which give rise to very different water levels and hydraulic capacities in wells only short distances apart. These differences are illustrated by two wells drilled a short distance apart on Hauaala Road and directly upgradient of the lo'i. Their locations are shown on Figure 2. Based on information on file with the CWRM, the water level in Well 0619-001 stands 66 feet above sea level and the well was finished to a depth of 60 feet below sea level. In sharp contrast, the water level in nearby Well 0619-003 stands 220 feet above sea level with the well depth stopped at 90 feet above sea level. In the Koloa volcanics, such differences over short distances are more the norm than the exception.

Using Google Earth and the location of the lo'i shown on Figure 1, the ground elevation at the lo'i is on the order of 20 to 25 feet above sea level. Its source of supply is not on this site. It is about 200 yards away on the other side of the private dirt road and on the order of tens of feet higher in elevation. I have not been to the source which would have required trespassing on private land, but have talked with an individual familiar with it. It is either a spring source as was represented in a public meeting or the discharge from the still active plantation irrigation system on the land immediately above.

If it is an actual spring source at that elevation, it would be a discharge of perched groundwater with no hydrologic connection to the semi-confined basal groundwater pumped by Kealia Wells 1A and 2A. the potential increase in pumpage of these wells would have no impact on the discharge rate of such a spring. If the supply is from the actively used surface water irrigation system on the land above, either as a direct connection or as a tailwater discharge, increased pumping of the basal groundwater would have no impact on its flowrate.

Attachments

ec: Greg Fukumitsu and Todd Yonamine – TNWRE Inc.

References

Kodani & Associates, LLC. 2017. Preliminary Engineering Report for Kealia Residential Subdivision. Consultant Report Prepared for HHF Planners (?)

MacDonald, G. A., D. A. Davis, and D. C. Cox. 1960. Geology and Ground-Water Resources of the Island of Kauai, Hawaii. Bulletin 13, Division of Hydrography, State of Hawaii.

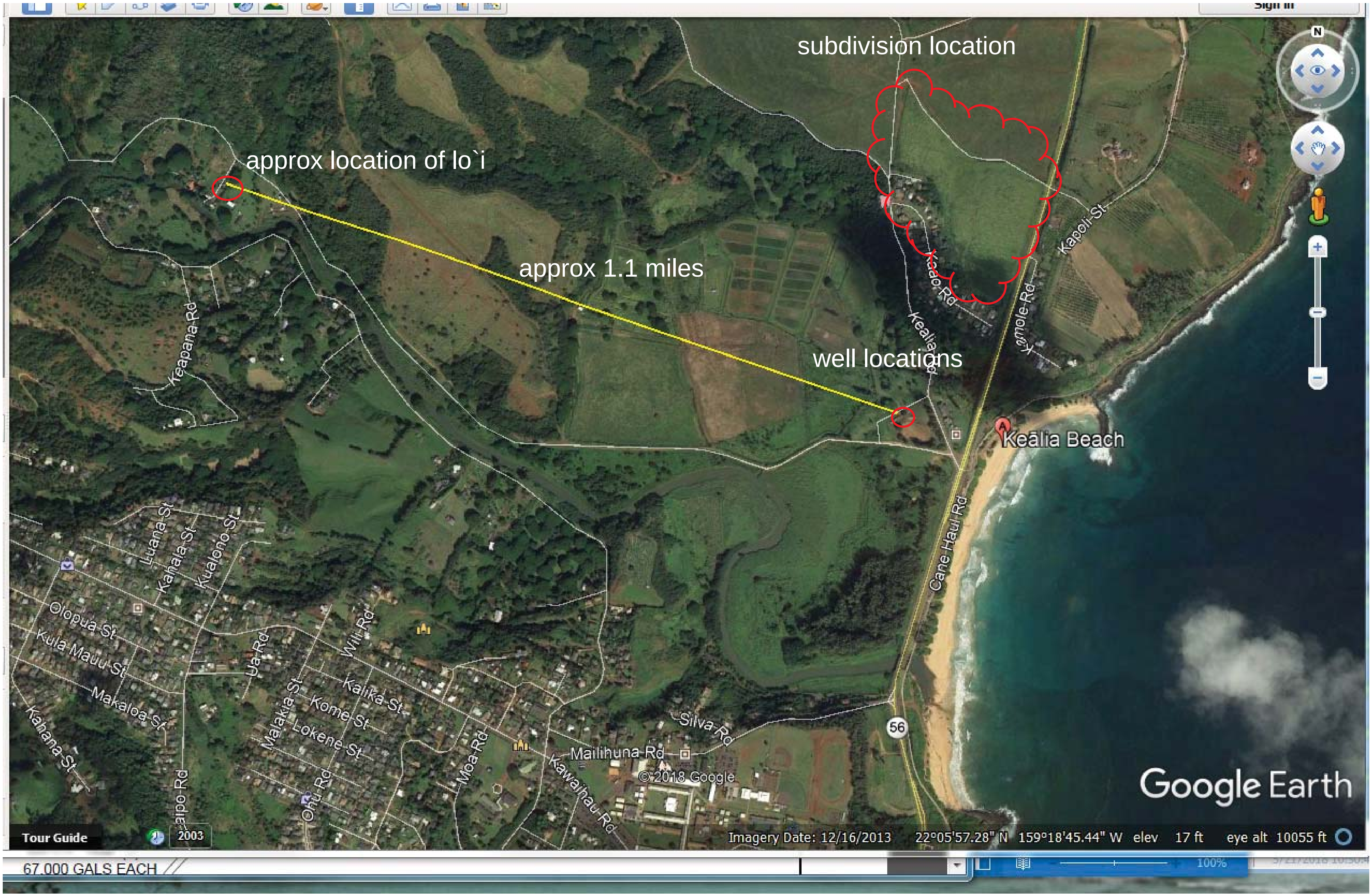


Figure 1

m:_18-077 | 18-24

KAPAA QUADRANGLE
HAWAII-KAUAI CO.
7.5-MINUTE SERIES (TOPOGRAPHIC)

Figure 2

Locations of Inland Wells 0619-001 and -003