Harry Kim
Mayor

Wilfred M. Okabe
Managing Director

William A. Kucharski
Director

Diane A. Noda
Deputy Director

FILE COPY
Aug 23 2018

RECEIVED
18 AUG 10 P3:30
OFC. OF ENVIRONMENTAL QUALITY CONTROL

County of Hawai'i
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086

August 7, 2018

Mr. Scott J. Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

Re: Draft Environmental Assessment and Anticipated Finding of No Significant Impact for Proposed East Hawai'i Organics Facility, Kea'au, Hawai'i Tax Map Key (3) 1-6-003:090

Dear Director Glenn:

With this letter, the County of Hawai'i Department of Environmental Management, hereby transmits the Draft Environmental Assessment and Anticipated Finding of No Significant Impact (DEA-AFONSI) for the proposed East Hawai'i Organics Facility for publication in the next available edition of *The Environmental Notice*.

Enclosed is a completed OEQC Publication Form, one copy of the DEA-AFONSI, three Adobe Acrobat PDF files of the same on a CD, and an electronic copy of the Publication Form in MS Word.

If there are any questions, please contact Gene Quiamas, Solid Waste Division Project Manager, at (808) 961-8270 or via email at gene.quiamas@hawaiicounty.gov, or Gregory Goodale, Solid Waste Division Chief, at (808) 961-8515 or via email at gregory.goodale@hawaiicounty.gov

Sincerely,

William A. Kucharski
Director

WK:mef
Enclosures:
1. OEQC Publication Form
2. DEA-AFONSI (1 hard copy)
3. CD containing OEQC Publication Form (in MS Word) and DEA-AFONSI (in Adobe PDF, 3 copies)

cc: Greg Goodale, SWD Chief
Jennifer Scheffel, SSFM International

19-070

AGENCY
PUBLICATION FORM

Project Name:	East Hawaii Organics Facility
Project Short Name:	East Hawaii Organics Facility
HRS §343-5 Trigger(s):	(1) Propose the use of state or county lands or the use of state or county funds
Island(s):	Hawaii
Judicial District(s):	Puna
TMK(s):	1-6-003:090
Permit(s)/Approval(s):	Water Commitment Approval Fire Response Plan Approval Plan Approval Grading/Grubbing Permit Building Permit Noise Permit/Variance National Pollutant Discharge Elimination System (NPDES) Permit Solid Waste Management Permit Individual Wastewater System Permit
Proposing/Determining Agency:	County of Hawaii Department of Environmental Management
Contact Name, Email, Telephone, Address	Gene Quiamas, Solid Waste Division Project Manager Gene.quiamas@hawaiicounty.gov (808) 961-8270 345 Kekuanaoa Street, Suite 41 Hilo, HI 96720
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	SSFM International
Contact Name, Email, Telephone, Address	Jennifer M. Scheffel jscheffel@ssfm.com (808) 356-1273 99 Aupuni Street, Suite 202 Hilo, HI 96720

Status (select one)	**Submittal Requirements**
__X__ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a

19-070

	searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary

The County of Hawai'i Department of Environmental Management Solid Waste Division proposes to construct an organics composting facility in Kea'au, Puna District, Island of Hawai'i. An Environmental Assessment is being prepared to comply with Chapter 343 of the Hawai'i Revised Statutes and Title 11, Chapter 200 of the Hawai'i Administrative Rules.

The Proposed Action includes the construction and operation of an organics composting facility in Kea'au in the Puna District on the north side of the W.H. Shipman Business Park. The facility would comprise approximately 3 acres within the approximately 40-acre parcel. Access to the facility would be via Kipimana Street, the primary road within the W.H. Shipman Business Park.

The Proposed Action is intended to divert green waste and designated organic materials from the South Hilo Sanitary Landfill and the West Hawai'i Sanitary Landfill by establishing Hawai'i County's first municipal composting operation to be named East Hawai'i Organics Facility. This is especially important since the South Hilo Sanitary Landfill is expected to reach its permitted maximum capacity within the next two years, and the County has initiated final closure procedures in compliance with State and Federal regulatory requirements on landfill closures.

19-070

East Hawai‘i Organics Facility

Draft Environmental Assessment

Puna District, Hawai‘i Island

Prepared for:

County of Hawai‘i
Department of Environmental Management
345 Kekūanāo‘a Street, Suite 41
Hilo, Hawai‘i 96720

Prepared by:

SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawai‘i 96720

August 2018

This page intentionally left blank.

Project Summary

Project Name	East Hawai‘i Organics Facility
Location	Kea‘au, Island of Hawai‘i
District	Puna
Project Site Tax Map Key	1-6-003:090
Landowner	W.H. Shipman
Project Site Existing Uses	The project site is in an undeveloped section of a commercial business park. The land adjacent to the project area, within the same TMK, is currently used for commercial agriculture and producing papaya. The 40-acre area proposed for use by the Proposed Action, consists mainly of mixed, non-native vegetation, which was likely altered when the land was converted to agriculture.
State Land Uses	Urban
County of Hawai‘i Zoning	MG-20, General Industrial
Proposed Action	The Proposed Action includes the construction and operation of an organics composting facility in Kea‘au in the Puna District on the north side of the W.H. Shipman Business Park. The facility would comprise a 3-acre site within an approximately 40-acre portion of Tax Map Key (TMK) [3] 1-6-003:090. Access to the facility would be via Kipimana Street, the primary road within the W.H. Shipman Business Park.
Anticipated Impacts	The Proposed Action would have beneficial impacts by diverting organics from the landfill and by providing mulch and compost to support agricultural operations.
Proposing Agency	County of Hawai‘i Department of Environmental Management (DEM)
Anticipated Determination	Finding of No Significant Impact (FONSI)
Project Site Permits/ Approvals Required	See **Section 1.5**
EA Preparer	SSFM International 99 Aupuni Street, Suite 202 Hilo, Hawai‘i 96720 Contact: Jennifer Scheffel (808) 356-1273
Individuals, Community Groups, and Agencies Consulted	See **Section 6**

This page intentionally left blank.

Table of Contents

1. Project Description 1-1
1.1. Introduction 1-1
1.2. Project Background 1-1
1.3. Purpose and Need for the Proposed Action 1-1
Purpose of the Proposed Action 1-1
Need for the Proposed Action 1-2
1.4. Project Schedule and Construction Costs 1-2
1.5. Permits and Approvals Required for the Proposed Action 1-2
1.6. Anticipated Findings and Determinations 1-3
2. Proposed Action and Alternatives 2-1
2.1. No-Action Alternative 2-1
2.2. Proposed Action 2-1
Project Location and Site Characteristics 2-1
Service Area 2-1
Operations 2-1
Volume 2-1
Accepted Waste 2-4
Environmental Controls 2-4
Site Plan 2-6
3. Affected Environmental and Potential Impacts 3-1
3.1. Climate and Air Quality 3-1
Existing Conditions 3-1
Potential Impacts 3-3
Minimization and Mitigation Measures 3-3
3.2. Noise 3-4
Existing Noise Environment 3-5
Potential Impacts 3-5
Minimization and Mitigation Measures 3-6
3.3. Geology and Soils 3-7
Existing Conditions 3-7
Potential Impacts 3-7
Minimization and Mitigation Measures 3-7
3.4. Natural Hazards 3-10
Existing Conditions 3-10
Potential Impacts 3-10
Minimization and Mitigation Measures 3-11
3.5. Water Resources 3-11
Existing Conditions 3-11
Potential Impacts 3-11
Minimization and Mitigation Measures 3-12
3.6. Biological Resources 3-12
Existing Conditions 3-12

Potential Impacts 3-16
Minimization and Mitigation Measures 3-16
3.7. Cultural and Historic Resources 3-18
Existing Conditions 3-18
Potential Impacts 3-19
Minimization and Mitigation Measures 3-19
3.8. Socioeconomics 3-19
Existing Socioeconomic Characteristics 3-19
Potential Impacts 3-19
Minimization and Mitigation Measures 3-20
3.9. Public Facilities and Services 3-20
Existing Facilities and Services 3-20
Potential Impacts 3-21
Minimization and Mitigation Measures 3-22
3.10. Transportation and Traffic 3-22
Existing Transportation System 3-22
Potential Impacts 3-23
Minimization and Mitigation Measures 3-23
3.11. Visual Resources 3-23
Existing Scenic and Visual Environment 3-23
Potential Impacts 3-23
Minimization and Mitigation Measures 3-24
3.12. Secondary and Cumulative Impacts 3-24
3.13. Irretrievable and Irreversible Commitment of Resources 3-24
4. Relationship to Land Use Plans and Policies 4-1
4.1. State of Hawai‘i Planning Documents 4-1
The Hawai‘i State Plan 4-1
State Land Use Law 4-2
4.2. County of Hawai‘i Planning Documents 4-4
County of Hawai‘i General Plan 4-4
County of Hawai‘i Special Management Area 4-8
5. Findings and Conclusion 5-1
5.1. Significance Criteria 5-1
5.2. Anticipated Finding of No Significant Impact 5-3
6. Agencies and Organizations Consulted 6-1
6.1. Pre-Assessment Consultation 6-1
Federal 6-1
State of Hawai‘i 6-1
County of Hawai‘i 6-1
Non-Governmental Organizations 6-2
Adjacent Landowners and Tenants 6-2
7. List of Contributors 7-1
8. References 8-1

List of Figures

Figure 2-1. Project Location Map 2-2
Figure 2-2. Project Site and Composting Facility 2-3
Figure 2-3. GORE™ Cover Active Composting System Schematic 2-5
Figure 2-4. Typical Process Flow Diagram 2-6
Figure 2-5. Conceptual Site Plan 2-7
Figure 2-6. Receiving Building Cross-Section 2-8
Figure 2-7. Receiving Building Elevations 2-9
Figure 3-1. Average Low and High Temperatures in Hilo, Hawai‘i 3-1
Figure 3-2. Hawai‘i Maximum Permissible Sound Levels for Various Zoning Districts 3-6
Figure 3-3. Geological Units 3-8
Figure 3-4. Soils 3-9
Figure 4-1. State Land Use Districts 4-3
Figure 4-2. Land Use Pattern Allocation Guide (LUPAG) 4-7
Figure 4-3. County of Hawai‘i 4-9

List of Tables

Table 1-1. Permits and Approvals Required for the Proposed Action 1-2
Table 3-1. State of Hawai‘i and National Ambient Air Quality Standards 3-2
Table 3-2. Federally and State Threatened and Endangered Species That Could Occur in the Project Area 3-14
Table 3-3. Birds Observed In and Near the Project Site 3-15
Table 7-1. Contributors to the Environmental Assessment 7-1

Appendices

Appendix A Pre-Assessment Consultation Letters and Responses
Appendix B New Compost Facility Siting Study
Appendix C GORE™ Technology Specifications
Appendix D Biological Resources Survey Report
Appendix D Cultural Impact Assessment
Appendix F Archaeological Literature Review and Field Investigation
Appendix G Traffic Impact Assessment Report
Appendix H “Need for the Project” Documentation

This page intentionally left blank.

Acronyms

AAQS	Ambient Air Quality Standards
BMPs	best management practices
CAA	Clean Air Act
dB	decibel
DEM	Department of Environmental Management
DOH	Department of Health
EA	Environmental Assessment
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
HAR	Hawai‘i Administrative Rules
HRS	Hawai‘i Revised Statutes
LOS	level of service
LUPAG	Land Use Pattern Allocation Guide
MBTA	Migratory Bird Treaty Act
mgd	million gallons per day
mph	miles per hour
NAAQS	National Ambient Air Quality Standards
ROD	Rapid ‘Ōhi‘a Death
SR	State Route
SWCA	SWCA Environmental Consultants
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

This page intentionally left blank.

Glossary

Aerobic Treatment	Process by which microbes decompose complex organic compounds in the presence of oxygen.
Biodegradable	Capable of decomposing under natural conditions.
Biofilter	Odor removing air filter system that is typically constructed from woody medium such as shredded wood or bark and stable compost. The odor causing compounds emanating from compost are organic and subject to destruction by the microbes found in the woody/finished compost substrate. The air is pumped into the bottom layer of the material and the odorous compounds are consumed so that non-odorous air is exhausted from the filter medium.
Biosolids	Organic matter recycled from sewage, especially for use in agriculture.
Compost	A humus or soil-like material created from aerobic, microbial decomposition of organic materials such as food scraps, yard trimmings, and manure.
Compostable Waste	Organic waste that can be decomposed and recycled to make nutrient-rich fuel for the soil.
Composting Facility	An offsite facility where the organic component of municipal solid waste is decomposed under controlled conditions.
Decomposition	The breakdown of matter by bacteria and fungi, changing the chemical makeup and appearance of materials.
Food waste	Uneaten food and food preparation wastes from residences and commercial establishments such as grocery stores, restaurants, produce stands, institutional cafeterias and kitchens, and industrial sources like employee lunchrooms.
Green waste	Waste that is biodegradable. Can be composed of garden, park, or agricultural waste, as well as domestic and commercial food waste.
Mulch	A layer of material (wood chips, straw, leaves, etc.) placed around plants to hold in moisture, prevent weed growth, and enrich or sterilize the soil.
Organic Matter	Carbonaceous waste contained in plant or animal matter and originating from domestic or industrial sources.
Organic Waste	Material that is biodegradable and comes from either a plant or animal.

This page intentionally left blank.

1. Project Description

1.1. Introduction

The County of Hawai‘i Department of Environmental Management (DEM) Solid Waste Division proposes to construct an organics composting facility in Kea‘au, Puna District, Island of Hawai‘i. An Environmental Assessment (EA) is being prepared to comply with Chapter 343 of the Hawai‘i Revised Statutes (HRS) and Title 11, Chapter 200 of the Hawai‘i Administrative Rules (HAR).

1.2. Project Background

Over the past 15 years, the County of Hawai‘i has passed several resolutions with goals to divert solid waste from landfills and to adopt Zero Waste goals. To help achieve these goals, the East Hawai‘i Organics Facility project was proposed to be developed on a site previously designated as expansion of the South Hilo Sanitary Landfill via Governor’s Executive Order in Waiākea Homesteads, South Hilo District. A Draft EA was published for the proposed project in September 2016. The Draft EA was subsequently withdrawn in April 2017 “due to concerns that the location of the proposed facility could impose additional impacts on the local communities, many of whom claim a disproportionate share of undesirable land uses.”

DEM proceeded to identify three potential sites in the Puna District: two adjacent to the W.H. Shipman Business Park and one adjacent to the Kea‘au Transfer Station. A Siting Study was undertaken to evaluate whether the three sites meet pre-defined project criteria, the County’s functional and operational requirements, and factors identified in HAR 11-58.1. The Siting Study was completed in March 2018 and identified the top ranked site, which is included as the Proposed Action in this Draft EA as described in **Section 2.2**. The complete Siting Study is included as **Appendix B**.

1.3. Purpose and Need for the Proposed Action

Purpose of the Proposed Action

The Proposed Action is intended to divert green waste and designated organic materials from the South Hilo Sanitary Landfill and the West Hawai‘i Sanitary Landfill by establishing Hawai‘i County’s first municipal composting operation to be named East Hawai‘i Organics Facility. This is especially important since the South Hilo Sanitary Landfill is expected to reach its permitted maximum capacity within the next two years, and the County has initiated final closure procedures in compliance with State and Federal regulatory requirements on landfill closures. The *South Hilo Sanitary Landfill Final Closure* Final EA was published on February 8, 2018.

The Purpose of the Proposed Action is to efficiently and economically divert green waste and other organic or compostable waste from the County landfills. With the closure of the South Hilo Sanitary Landfill, the Proposed Action would aid in extending the life of the County’s only remaining landfill, the West Hawai‘i Sanitary Landfill. The Proposed Action would also create compost and mulch to support agriculture. Mulch and compost are valued soil amendments to support subsistence and commercial agriculture. This composting facility would accept compostable waste from residents, commercial businesses, and government agencies.

Need for the Proposed Action

In 2003, the County passed a resolution with a goal to divert 50% of the solid waste from landfills by 2008 and 80% by 2013 (Council Resolution No. 28-03). In 2007, the County passed a resolution to adopt Zero Waste goals (Council Resolution No. 356-07). In 2008, the county passed a resolution to develop an ordinance and implement a plan to prohibit food, paper, and compostable organics from Hawai'i County landfills by 2012 (Council Resolution No. 826-08). The *County of Hawai'i Integrated Resources and Solid Waste Management Plan Update, The Path to Zero Waste* (DEM, 2009) identified that 54% of the waste disposed at the landfills was organic. These documents are provided in **Appendix H**.

1.4. Project Schedule and Construction Costs

The Proposed Action is expected to cost approximately $10.5 million to construct. The estimated time to construct the full facility is 1.5 to 2 years after issuance of the notice to proceed. The existing green waste mulching site adjacent to the South Hilo Sanitary Landfill would remain in place until the Proposed Action is fully operational. At that time, the existing green waste mulching site adjacent to the South Hilo Sanitary Landfill would be relocated to the project site.

1.5. Permits and Approvals Required for the Proposed Action

In addition to the environmental disclosure requirements of HRS Chapter 343, implementation of the Proposed Action would require coordination with state and county agencies for permits or approvals as presented in

Table 1-1. Permits and Approvals Required for the Proposed Action

Permit or Approval	Administrative Authority
Water Commitment Approval	County of Hawai'i Department of Water Supply
Fire Response Plan Approval	County of Hawai'i Fire Department
Plan Approval	County of Hawai'i Planning Department
Grading/Grubbing Permit	County of Hawai'i Department of Public Works
Building Permit	County of Hawai'i Department of Public Works
Noise Permit/Variance	State of Hawai'i Department of Health, Indoor and Radiological Health Branch
National Pollutant Discharge Elimination System	State of Hawai'i Department of Health, Clean Water Branch
Solid Waste Management Permit	State of Hawai'i Department of Health, Solid and Hazardous Waste Division
Individual Wastewater System Permit	State of Hawai'i Department of Health, Clean Water Branch

1.6. Anticipated Findings and Determinations

Based on the significance criteria set forth in Hawai‘i Administrative Rules (HAR) 11-200 and discussed in **Section 5.1**, it is anticipated that the Proposed Action will not have a significant effect on the environment and that a Finding of No Significant Impact (FONSI) will be filed with the State of Hawai‘i Office of Environmental Quality Control following the public comment period.

This page intentionally left blank.

2. Proposed Action and Alternatives

2.1. No-Action Alternative

Under the No-Action Alternative, the proposed organics composting facility would not be constructed. Without the Proposed Action, which is discussed below in **Section 2.2**, the County would not be able to meet their Zero Waste goal, and the support for agriculture through the production of affordable, quality-controlled compost would not occur.

2.2. Proposed Action

Project Location and Site Characteristics

The Proposed Action includes the construction and operation of an organics composting facility in Kea‘au in the Puna District on the north side of the W.H. Shipman Business Park. The facility would comprise approximately 3 acres within the approximately 40-acre portion of Tax Map Key (TMK) [3] 1-6-003:090. Access to the facility would be via Kipimana Street, the primary road within the W.H. Shipman Business Park. **Figure 2-1** identifies the location for the Proposed Action. **Figure 2-2** identifies the proposed 3-acre facility within the 40-acre site. The final location of the facility will be determined after topographic survey of the site has been completed to determine the area with the least amount of impacts and site development costs.

The project site is in an undeveloped section of a commercial business park. The land adjacent to the project area, within the same TMK, is currently used for commercial agriculture and producing papaya. The 40-acre area proposed for use by the Proposed Action consists mainly of mixed, non-native vegetation, which was likely altered when the land was converted to agriculture.

Service Area

The Proposed Action is intended to divert green waste and designated organic materials from the South Hilo Sanitary Landfill, which is slated for closure, and the West Hawai‘i Sanitary Landfill. Compostable waste would be accepted from residents, commercial businesses, and government agencies.

Operations

The Proposed Action would be designed by the County with assistance from the current Operator, to be constructed by a Contractor under contract to the County, and operated by the current Operator under contract with the County of Hawai‘i. Mulch and compost would be hauled by the contractor to various locations island-wide for sale. A minimum volume of mulch would remain on-site and be made available for free to the residents of the county.

Volume

Projected composting volumes would begin at 28,000 tons per year (77 tons per day, 2,320 tons per month) and increase volumes up to 35,000 tons per year (96 tons per day, 2,900 tons per month). The project volumes include organics transferred from the West Hawai‘i Organics Facility to be composted at the East Hawai‘i Organics Facility. It is estimated that up to 18,000 tons of organics would be transferred each year. The amount and type of accepted organics would be limited to that amount that is within the design capacity of the facility.

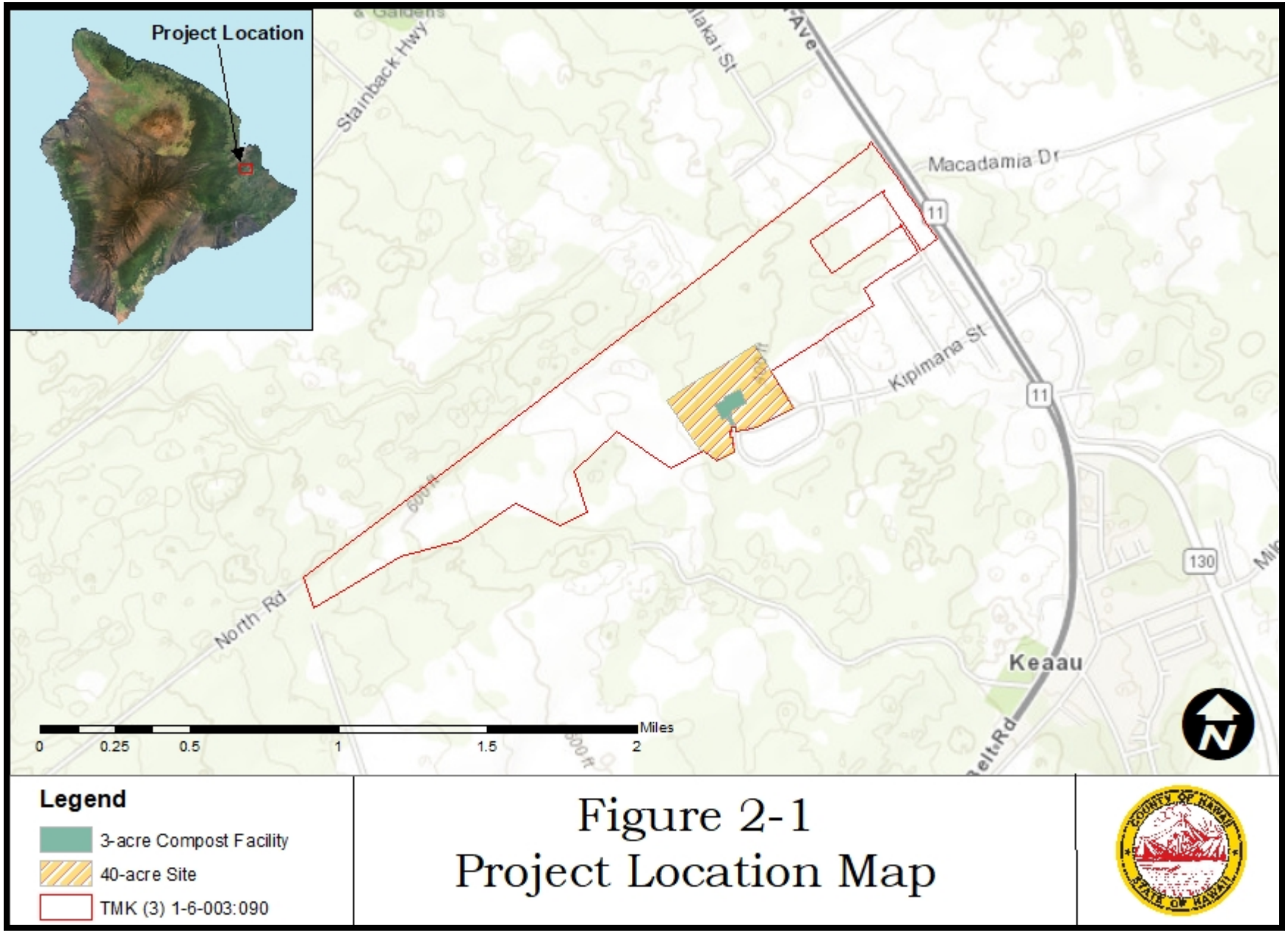
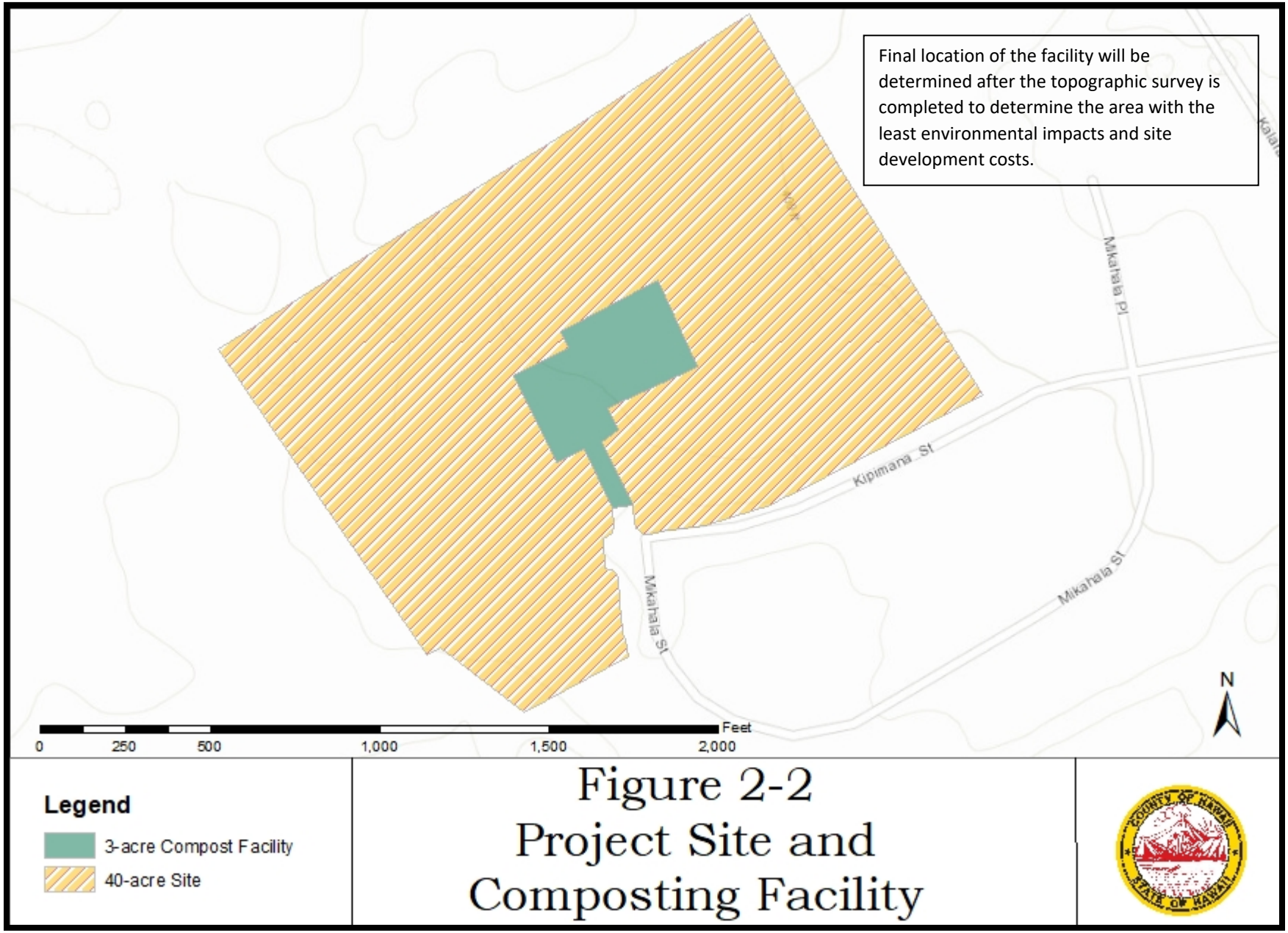


Figure 2-1
Project Location Map


Final location of the facility will be determined after the topographic survey is completed to determine the area with the least environmental impacts and site development costs.
Kipimana St
Mikahala St
Mikahala Pl
Mikahala St
N
0
250
500
1,000
1,500
2,000
Feet
Legend
3-acre Compost Facility
40-acre Site
Figure 2-2
Project Site and
Composting Facility
COUNTY OF HAWAI'I
STATE OF HAWAI'I

Accepted Waste

The Proposed Action would include diversion of green waste and untreated wood pallets, which would be ground or chipped into mulch, as well as a full range of organic materials (e.g., food, paper, compostable plastics) that would be processed into compost. Compostable materials that would be accepted include the following:

- Yard waste
- Pre- and post-consumer food waste from commercial and residential sources
- Uncontaminated, untreated, and unpainted wood wastes, such as wooden pallets, dimensional lumber, crates, chips, and sawdust
- Coffee grounds
- Produce
- Compostable paper fiber
- Compostable plastic packaging
- Cardboard
- Grain (flour or grain material from commercial sources)
- Sod
- Stumps

Biosolids would not be accepted.

Green waste and untreated wood pallets would be ground and chipped into mulch before mixing with the other organics. A portion of the mulch would be treated for invasive species (e.g., little fire ants) and made available for distribution to the public.

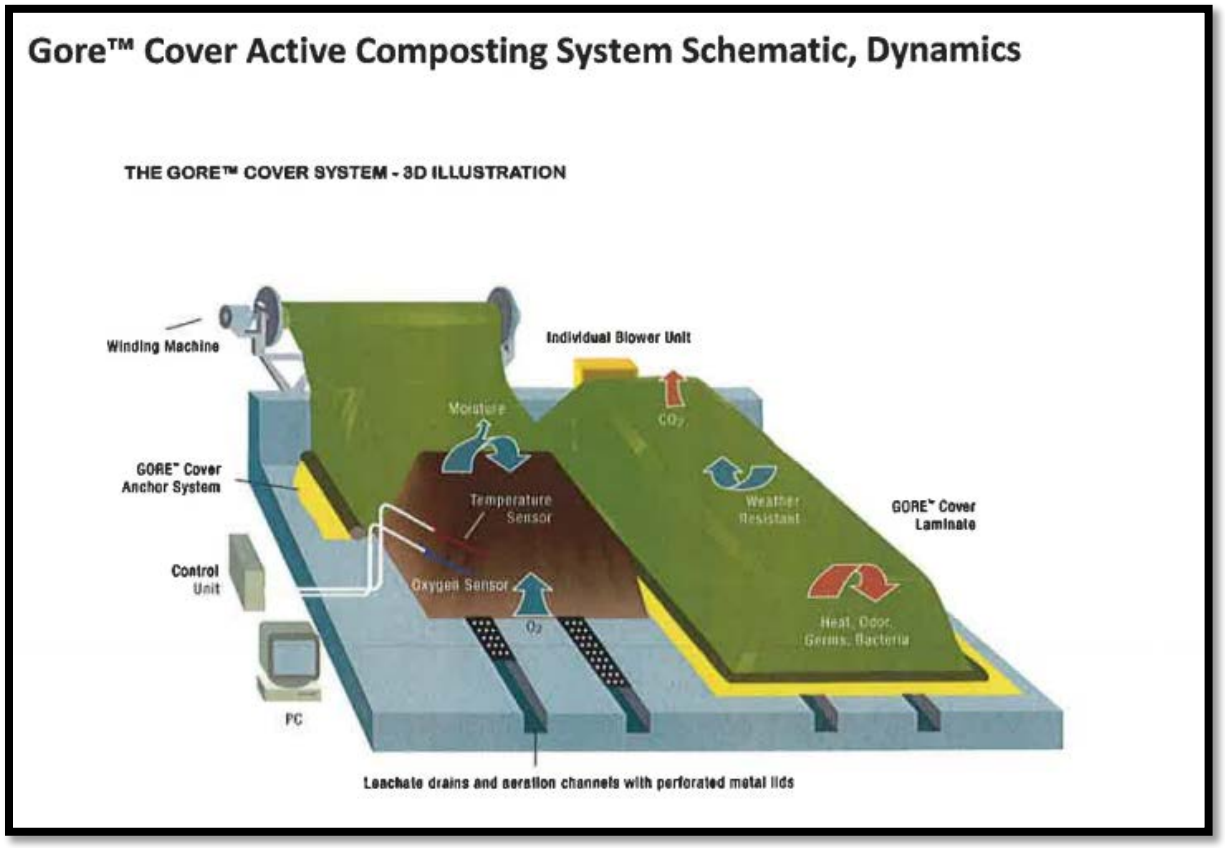
Environmental Controls

The compost operation would be an in-vessel (i.e., covered) operation. The proposed technology is the GORE™ Cover System, an EPA-approved "in-vessel" composting system as shown in **Figure 2-3** and described in **Appendix C**. In-vessel composting minimizes the environmental impacts such as odor, pests, and dust and decreases the time needed to make compost.



GORE Cover System

Figure 2-3. GORE™ Cover Active Composting System Schematic

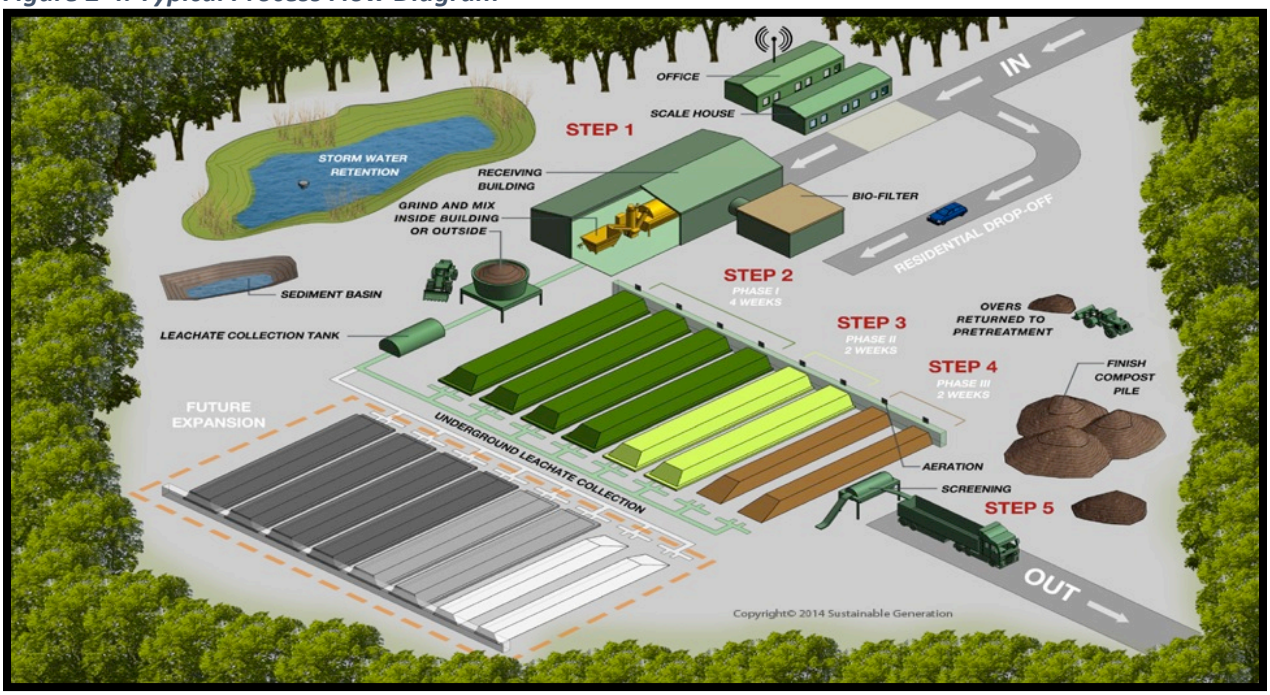


The proposed facility would be designed with the following mitigation measures to minimize environmental impacts:

- To mitigate operational noise affecting existing or future residences, the receiving building would be enclosed and any openings in the building would be directed away from residences.
- To mitigate storm water impacts, onsite drainage design would incorporate low-impact development (LID) practices, such as vegetated buffer or filter strips; open, vegetated channels; and infiltration.
- To mitigate potential impacts to seabirds, the design would specify shielded outdoor lights in conformance with Hawai'i County Code Chapter 14, Article 9, Outdoor Lighting Requirements.
- To protect low-flying, foraging bats, barbed wire would not be used for fencing.
- An Individual Wastewater System permit approved by the State of Hawai'i Department of Health (DOH) would ensure that the office building's septic tank and leach field system have adequate capacity.

Figure 2-4 shows a typical composting facility process, including environmental controls.

Figure 2-4. Typical Process Flow Diagram



Source: Sustainable Generation Copyright 2018

Site Plan

The conceptual site plan, shown in **Figure 2-5**, consists of the following components:

- Approximately 40 acres, which includes setbacks, buffers, and room for future expansion.
- Within the 40 acres, approximately 3 acres of graded, paved, or graveled surface encompassing the primary site operations.
- A multi-bay enclosed receiving building (approximately 50 by 100 feet) for use as a tipping floor and for waste handling (see **Figure 2-6** and **Figure 2-7**).
- A biofilter for treatment of air exhaust from the enclosed receiving building.
- A concrete surface (approximately 160 by 230 feet) for placement of compost windrows under a series of membrane covers.
- A stockpile area for finished compost.
- An access road, which may include pavement, curbs, and drainage.
- Utilities, such as water and electricity.
- An on-site septic system for the office building.
- Leachate collection systems for containerization of runoff from waste handling areas.
- An area for grinding green waste and untreated wood pallets.
- A truck scale for weighing.
- On office building and onsite parking.
- Portable structure(s), such as shipping container(s), to support operations.

Figure 2-5. Conceptual Site Plan

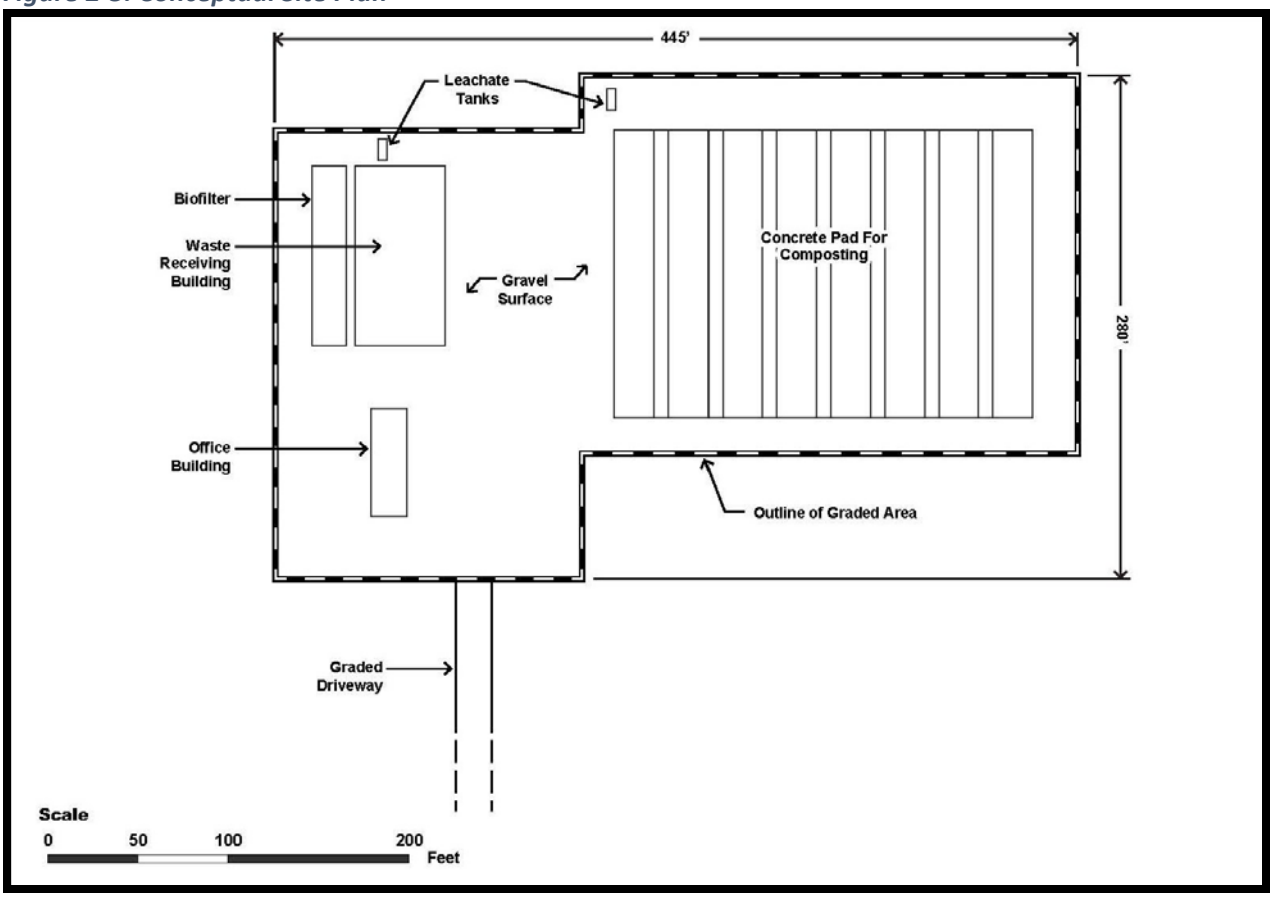


Figure 2-6. Receiving Building Cross-Section

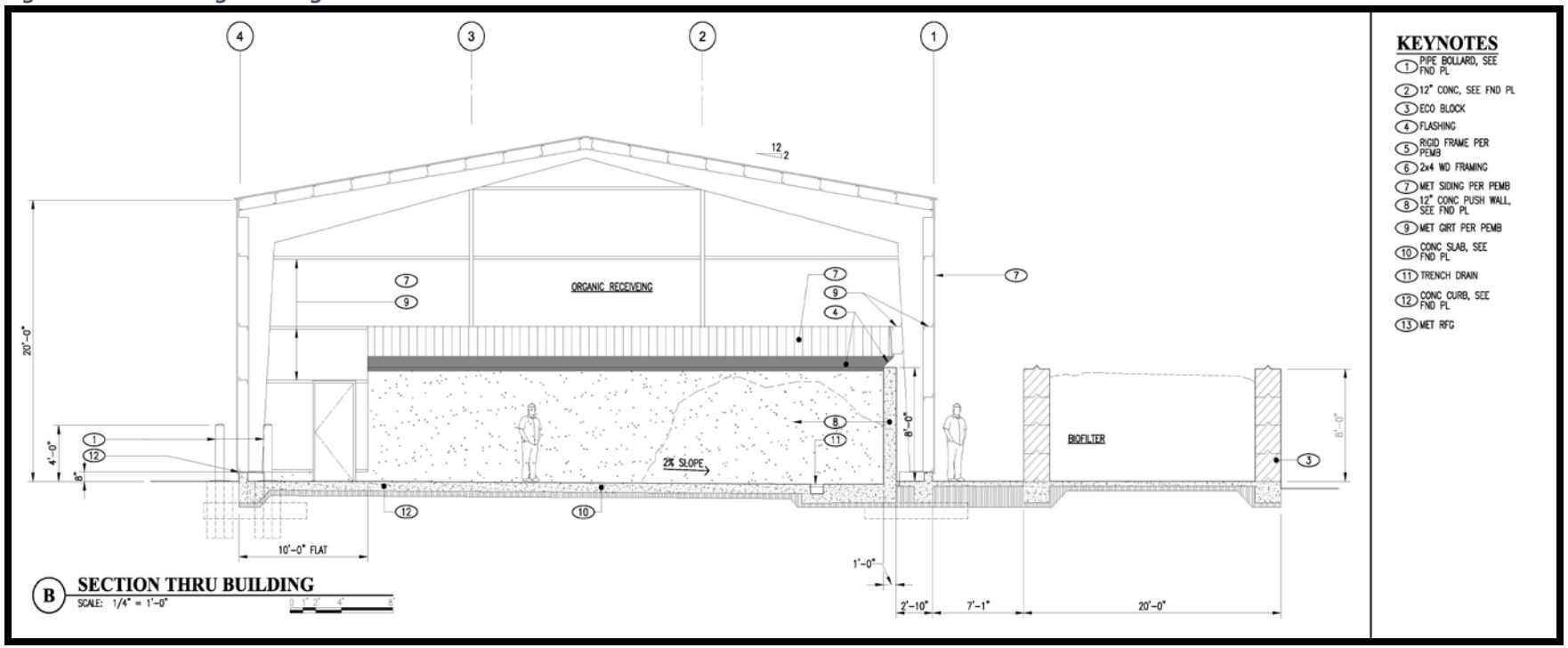
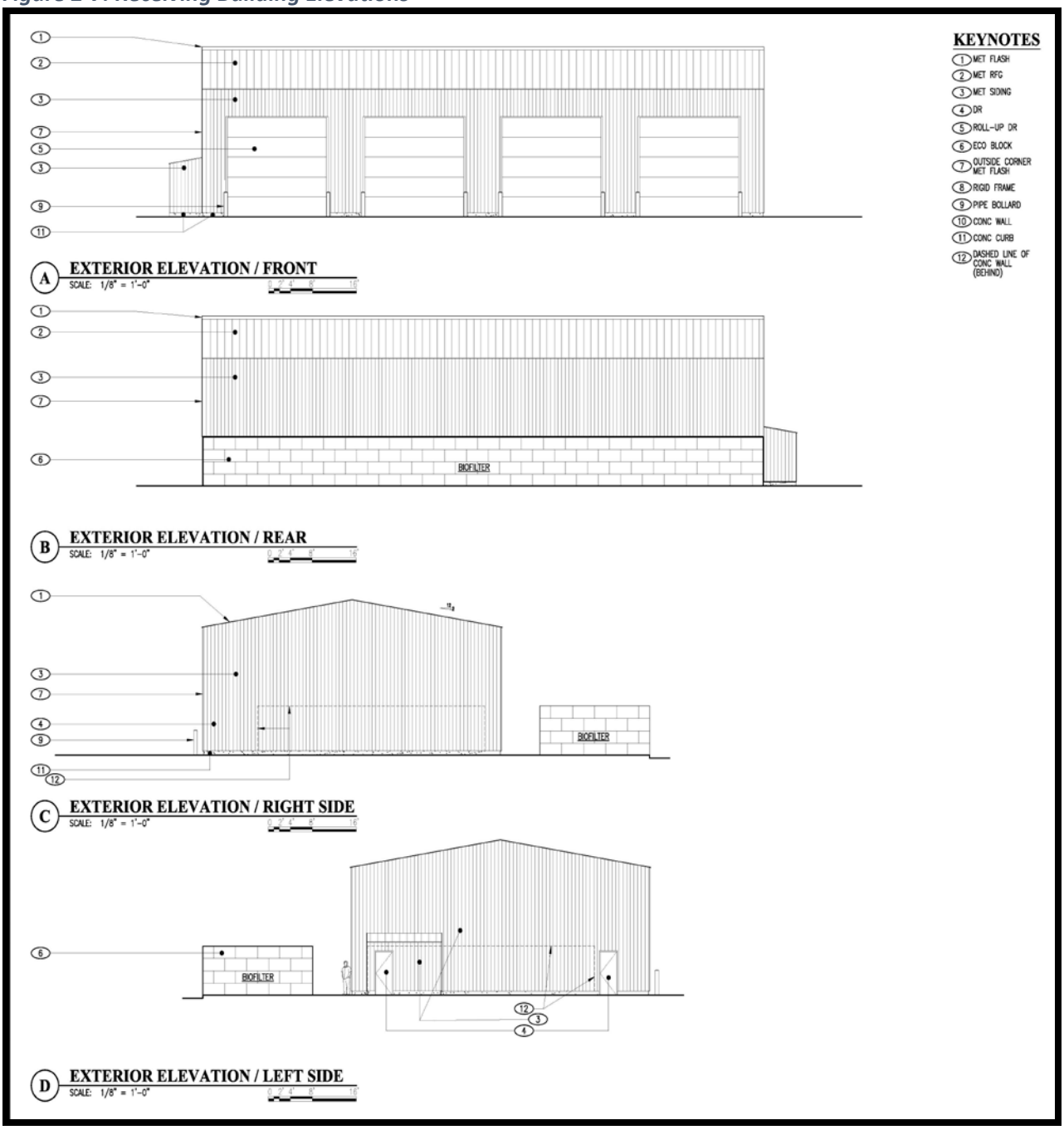


Figure 2-7. Receiving Building Elevations



This page intentionally left blank.

3. Affected Environmental and Potential Impacts

3.1. Climate and Air Quality

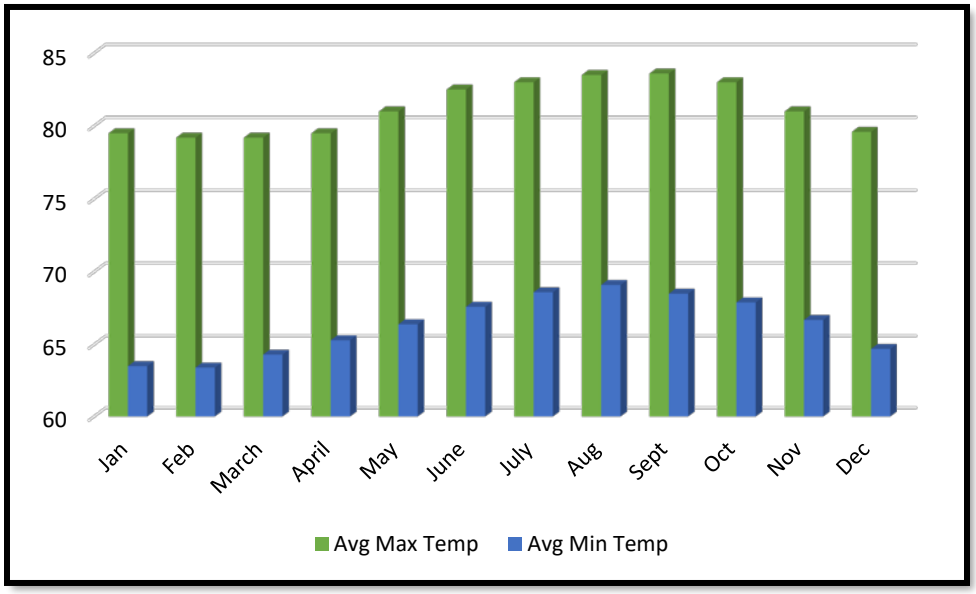
Existing Conditions

Climate

The Proposed Action is located south of Hilo in the Puna District on the island of Hawai'i. The Puna District features a tropical rainforest climate with substantial rainfall throughout the year. Temperature and rainfall in the district vary with altitude with cooler temperatures and more rain at higher elevations. Temperatures in this area are moderate and equable throughout the year. This reflects the small seasonal variation in the energy received from the sun and the tempering effect of the surrounding Pacific Ocean. Being situated in the tropics, Hawai'i has a relatively uniform day length and temperature throughout the year.

The Hilo area has an average high temperature of 81.2 degrees Fahrenheit (°F) and an average low temperature of 66.4°F. As shown in **Figure 3-1**, the warmest months are August and September with average high temperatures of 83.5°F and 83.7°F, respectively. The coolest months are February and March with an average high temperature of 79.2°F. Hilo receives approximately 128.4 inches of annual rainfall (WRCC, 2016). The project site has an average annual temperature of 71.2°F (UH-Mānoa, 2014).

Figure 3-1. Average Low and High Temperatures in Hilo, Hawai'i



Hilo is located on the east side of Hawai'i Island and receives approximately 127 inches of rain annually. The mean annual rainfall at the project site is approximately 150.0 inches (UH-Mānoa, 2011).

Air Quality

The Clean Air Act of 1972 and its 1990 Amendments (CAA) and subsequent legislation regulate air emissions from area, stationary, and mobile sources. Both the U.S. Environmental Protection Agency

(USEPA) and the State of Hawai'i have instituted Ambient Air Quality Standards (AAQS) to maintain air quality in the interest of public health and secondary public welfare.

At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. The Hawai'i AAQS are in some cases considerably more stringent than the comparable National Ambient Air Quality Standards (NAAQS). In particular, the Hawai'i 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. **Table 3-1** illustrates the NAAQS and State AAQS and the units of measure (micrograms per cubic meter, $\mu g/m^3$ and parts per million, ppm). The State of Hawai'i has been an attainment area for the last several decades.

Table 3-1. State of Hawai'i and National Ambient Air Quality Standards

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter <10 microns (PM_{10})	$\mu g/m^3$	Annual 24 Hours	- 150[a]	- 150[a]	50 150[b]
Particulate Matter <2.5 microns ($PM_{2.5}$)	$\mu g/m^3$	Annual 24 Hours	12[c] 35[d]	15[c] 35[d]	- -
Sulfur Dioxide (SO_2)	ppm	Annual 24 Hours 3 Hours 1 Hour	- - - 0.075[e]	- - 0.5[b] -	0.03 0.14[b] 0.5[b] -
Nitrogen Dioxide (NO_2)	ppm	Annual 1 Hour	0.053 0.100[f]	0.053 -	0.04 -
Carbon Monoxide (CO)	ppm	8 Hours 1 Hour	9[b] 35[b]	- -	4.4[b] 9[b]
Ozone (O_3)	ppm	8 Hours	0.070[g]	0.070[g]	0.08[g]
Lead	$\mu g/m^3$	3 Months Quarter	0.15[h] 1.5[i]	0.15[h] 1.5[i]	- 1.5[i]
Hydrogen Sulfide	ppb	1 Hour	-	-	25[b]

Notes:
[a]Not to be exceeded more than once per year on average over three years.
[b]Not to be exceeded more than once per year.
[c]Three-year average of the weighted annual arithmetic mean.
[d]98th percentile value averaged over three years.
[e]Three-year average of fourth-highest daily 1-hour maximum.
[f]98th percentile value of the daily 1-hour maximum averaged over three years.
[g]Three-year average of annual fourth-highest daily 8-hour maximum.
[h]Rolling 3-month average.
[i]Quarterly average.
Source: DOH, 2015.

Air quality in the Hilo area is generally considered to be good due to the prevailing northeasterly tradewinds that tend to disperse pollutants toward the mountains of Mauna Kea and Mauna Loa. However, the amount of particulates and other air pollutants can increase significantly during periods when the winds shift to a southwesterly direction. Air flow from this direction carrying vog can lead to an increase in pollution and a decrease in visibility. Existing air pollutant sources in the vicinity of the project site include non-stationary transportation emissions from vehicular activity and stationary industrial uses within the W.H. Shipman Business Park.

Potential Impacts

Construction

Only short-term construction-related impacts to air quality are anticipated with implementation of the Proposed Action. During construction, potential emission sources that may affect air quality at the East Hawai'i Organics Facility include the following:

- Diesel and/or gasoline-powered construction equipment and motor vehicles would contribute to additional CO and CO_2 in the air.
- Fugitive dust emissions resulting from grading and grubbing.

Because levels of criteria pollutants in Hawai'i are consistently below Federal and State AAQS, and because the prevailing trade winds rapidly carry pollutants offshore limiting the effect on receptors, increases in levels of criteria pollutants at the project sites from construction activities are not expected to be significant. It is not anticipated that Federal or State AAQS would be exceeded during construction activities.

Operation

Climate

As previously stated, the project site receives approximately 150 inches of rain per year. The proposed composting facility would be covered. Therefore, it would not be affected by the high rainfall. Rainwater collected from the composting platforms would flow into a stormwater drainage system.

Air Quality

Long-term negative impacts related to air quality due to the composting facility are not expected. Odors would be controlled through the use of the GORE™ Cover System. Properly managed aerobic composting methods would not generate odorous compounds. Measures to avoid anaerobic conditions forming within piles of organic material would be employed, as discussed below.

There would be minimal dust generated during grinding of green waste. Loads of materials leaving the facility would generally be moist and covered and not generate dust. Measures to control dust during operation are provided below.

Minimization and Mitigation Measures

Construction

Although the potential for fugitive dust is low due to the wet climate and low wind speeds of the area, adequate dust control measures would be employed, particularly during construction during low-rainfall periods. Dust control would be accomplished by frequent watering of unpaved roads within the project site and areas of exposed soil surfaces. Completed areas within the project site would be landscaped as

soon as it is feasible. Dust control measures would comply with applicable provisions of HAR Section 11-60.1-33 and Chapter 10 (Erosion and Sedimentation Control), Hawai‘i County Code. Measures to control dust during construction may include, but not be limited to, the following:

- Providing an adequate water source at the site prior to start-up of construction activities.
- Watering the construction site during periods of drought or high winds and all dry conditions.
- Landscaping and rapid covering of bare areas, including slopes, starting from the initial grading phase.
- Limiting disturbance areas to those in the immediate zone of construction to limit the amount of time that areas would be subject to erosion.
- Providing adequate dust control measures during weekends, after hours, and before daily start-up of construction activities.
- Installing silt screens in areas of disturbance.

Additionally, contractors would be required to maintain equipment with emissions controls.

Operation

The odor prevention strategy would include the following measures:

- A covered receiving area (i.e., tipping building) for all incoming food wastes. The tipping building would be equipped with odor control technology that vents emissions from the fresh material through a biofilter.
- Immediately sorting and blending the feedstocks upon delivery prior to shredding.
- The collection strategy would include moving as much of this activity into the tipping building, which would have biofiltered air.
- Proper use of the GORE™ Cover System, which would optimize the aerobic decomposition of the feedstocks and prevent anaerobic conditions from developing.
- During the composting process, variables such as oxygen content, porosity, temperature, moisture percent, and time would be maintained within specific levels to effectively compost the feedstock.
- Each heap would be placed on a “positive aeration system”, which would pump air through the composting feedstock to supply oxygen.
- The membrane laminate of the GORE™ Cover System would be secured using tarpaulin retainers that would contain any odor.

The following measures would be employed to minimize dust during operation of the composting facility:

- Fugitive dust on access roads and internal roads would be minimized by use of a water truck and/or sprinklers.
- Loads of materials leaving the composting facility would be sprayed water and covered.

3.2. Noise

Noise is defined as unwanted sound and is one of the most common environmental issues of concern to the public. A number of factors affect sound as it is perceived by the human ear. These include the actual level of the sound (i.e., noise), the frequencies involved, the period of exposure to the noise, and changes

or fluctuations in the noise levels during exposure. The accepted unit of measure for noise levels is the decibel (dB).

The State of Hawaii regulates noise exposure in the following statutes and rules:

- HRS, Section 342F – Noise Pollution
- HAR, Section 11-46 – Community Noise Control
- HAR, Section 12-200.1 – Occupational Noise Exposure

The State of Hawai'i Community Noise Control Rule (HAR Chapter 11-46) defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to stationary noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most moving sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to construction activities, which may not be stationary.

The maximum permissible noise levels are enforced by the DOH for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in **Figure 3-2**. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

The Proposed Action is located in zone MG-20, General Industrial District (minimum land area of 20,000 square feet required for each building site), which is in Class C.

Existing Noise Environment

The project site is located within a developed area that is characterized by the sounds of human activity from industrial uses such as agricultural processing and from motor vehicles traveling along Mamalahoa Highway (State Route [SR] 11). The Puna District is primarily an agricultural area that produces products for export and for local consumption. Background noise sources include vehicular traffic along Kipimana Street and other established routes within the W.H. Shipman Business Park. Other ambient noise is associated with human activities that occur during business hours at nearby developed areas within the business park. There are no sensitive receptors within 1,000 feet of the project site.

Potential Impacts

Construction

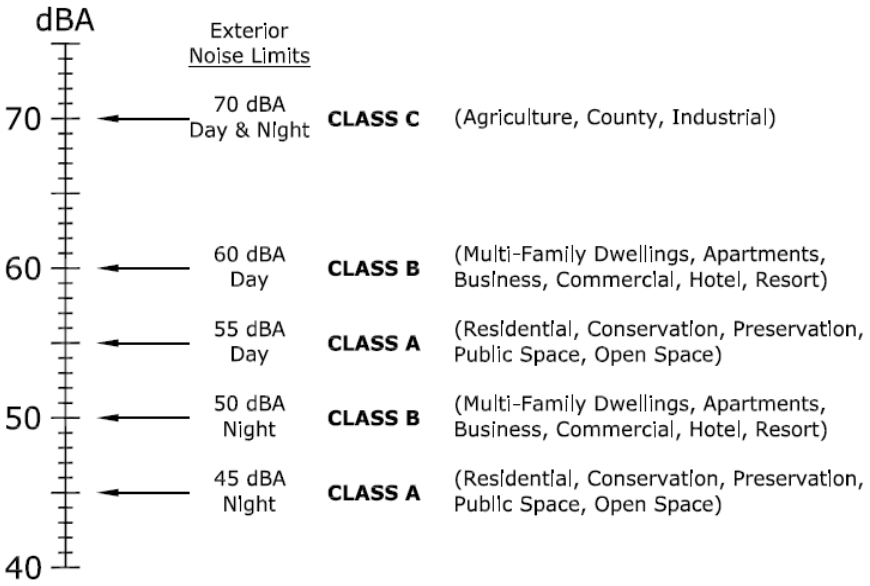
During the construction phase, there may be temporary noise impacts associated with the operation of heavy construction machinery, paving equipment, and material transport vehicles. The measures provided below would be implemented to minimize noise impacts during construction.

Operation

Noise levels comparable to those associated with the Proposed Action already exist in the vicinity of the project site within the W.H. Shipman Business Park. As previously stated, there are no sensitive receptors within 1,000 feet of the project site. Therefore, noise impacts during operation are not expected to be less than significant.

Figure 3-2. Hawai'i Maximum Permissible Sound Levels for Various Zoning Districts

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



Minimization and Mitigation Measures

Noise generated from construction activities and the use of machinery would be minimized by implementing the following measures:

- Requiring contractors to adhere to state and county noise regulations.
- Construction activities would be conducted on weekdays and in daytime hours.
- In the event that work occurs after normal working hours (i.e., at night or on weekends), or if permissible noise levels are exceeded, appropriate permitting and monitoring, as well as development of administrative and engineering controls, would be employed.

3.3. Geology and Soils

Existing Conditions

The Island of Hawai‘i is the largest and youngest landmass of the Hawaiian Islands chain. The project site is located on the eastern side of the island south of Hilo. The project site is undeveloped and located north of the W.H. Shipman Business Park. The land adjacent to the project site is currently used for agriculture (papaya).

As shown on **Figure 3-3**, the project site is located on the Qk3 geological unit, which is Kau Basalt associated with recent volcanism of Mauna Loa. Kau Basalt has a moderately low to moderate erosion resistance (NPS, 2009).

As shown on **Figure 3-4**, the project site is located on rPAE, Papai extremely stony muck, 3 to 25 percent slopes. This soil type is part of the Papai series, which consists of well-drained, thin, extremely stony organic soils over fragmental Aa lava. Permeability of rPAE is rapid, runoff is slow, and the erosion hazard is slight. It has a high shrink-swell potential and the corrosivity of untreated steel and concrete is low (USDA-SCS, 1973).

Potential Impacts

Construction

Short term soil impacts may include the potential for soil erosion and the generation of dust during grading and construction. All construction activities would comply with all applicable federal, state, and county regulations and rules for erosion control. Any grading would be in conformance with the Hawai‘i

Operation

The Proposed Action would be properly designed with respect to subsurface conditions and geotechnical concerns within the footprint of the construction area. Areas affected by the Proposed Action would be stabilized and either paved or landscaped, which would reduce the long-term potential for erosion and sediment transport. The Proposed Action would have no adverse impacts on the underlying geology and soils at the project site.

Minimization and Mitigation Measures

The following measures would be implemented to minimize impacts to geology and soils:

- All activities would comply with the requirements of Hawai‘i County Code, Chapter 10, Erosion and Sedimentary Control.
- All development-generated runoff would be disposed of on site and not directed toward any adjacent properties.
- Any grading would be in conformance with the Hawai‘i County Grading Ordinance and recommendations of the geotechnical engineer.
- On-site fill would be used wherever possible.
- Fill slopes would not exceed 2:1.

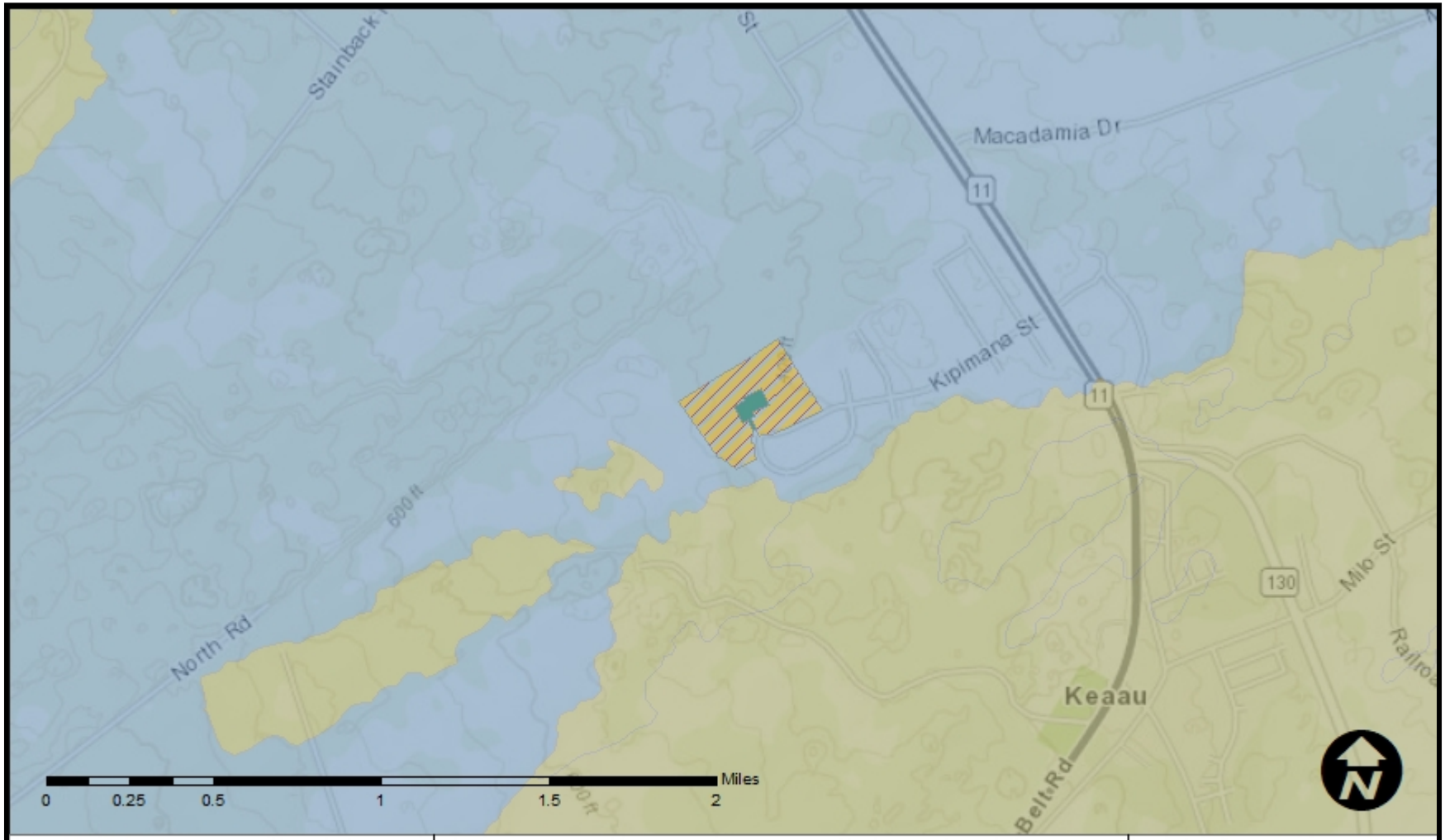
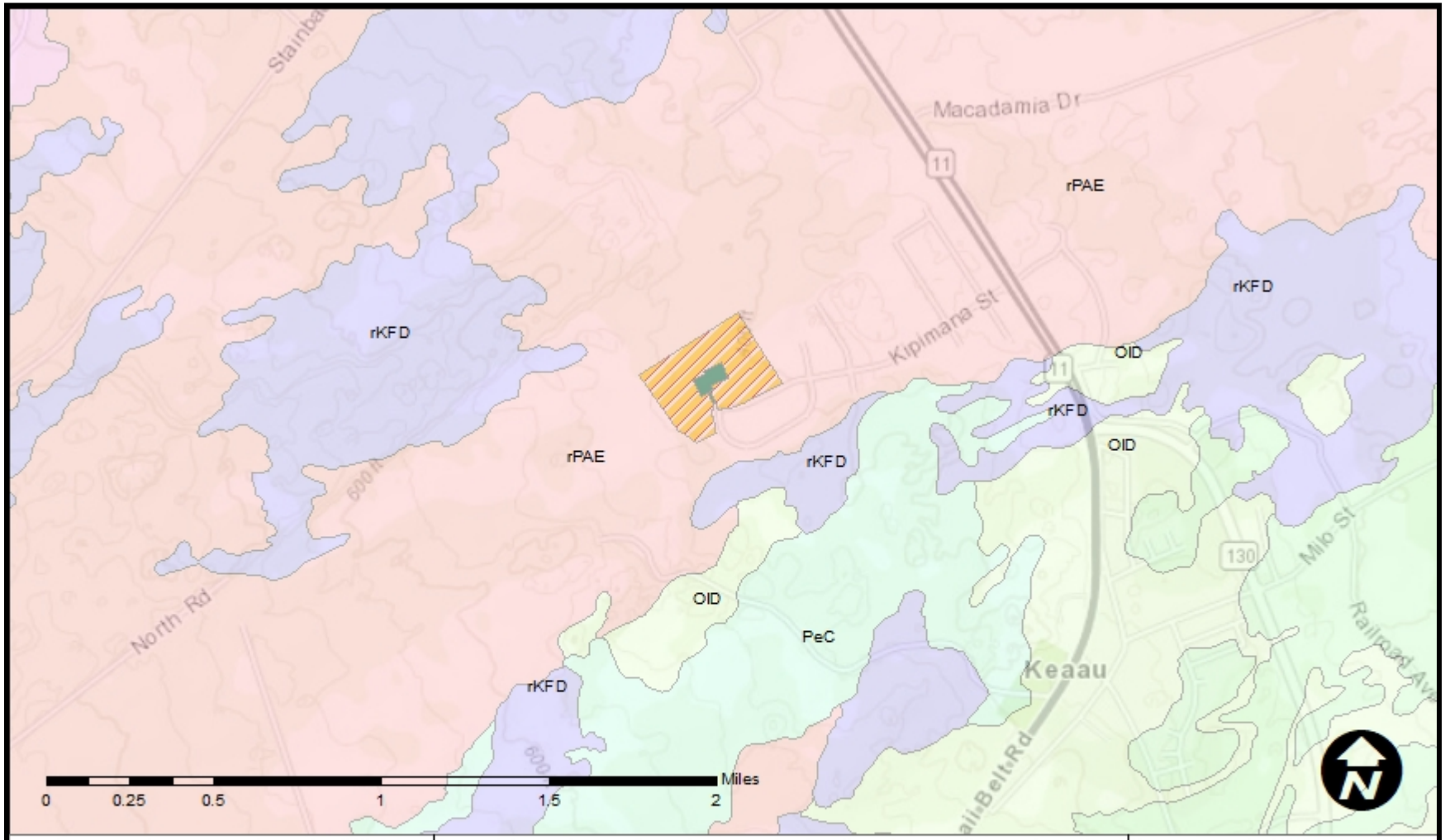


Figure 3-3
Geological Units



Legend

Compost Facility

Compost Facility 40-acre Site

Figure 3-4
Soils

Source: USDA-NRCS, Unk.

3.4. Natural Hazards

Hawai'i Island is susceptible to potential natural hazards, such as flooding, hurricanes, volcanic hazards, and earthquakes. The State of Hawai'i Department of Defense, Office of Civil Defense operates a system of civil defense sirens throughout the state to alert the public of emergencies and natural hazards, particularly tsunamis and hurricanes. The closest siren to the project site is located at Kea'au Shipman Park, approximately 1.2 miles southeast of the project site (State of Hawai'i Department of Defense, 2018). As per the State of Hawai'i Department of Defense, Office of the Director of Emergency Management/Civil Defense, there is insufficient siren coverage for the project area (Travis, T., 2018). DEM will coordinate with the Office of Civil Defense to determine the best location for a siren site on the property.

Existing Conditions

The project site is not located within a flood hazard zone or the tsunami evacuation zone. Natural hazards that may threaten the project site include hurricanes, earthquakes, and volcanic activity.

In August 2014, Tropical Storm Iselle brought torrential rainfall and high winds that resulted in downed trees, widespread power outages, damaged homes, and blocked roadways. The Island of Hawai'i has not been in the direct path of a hurricane since recordation began in 1950. However, models indicate that the island has a long-term hurricane hazard risk greater than any of the other islands for a direct hit.

Recent earthquakes have been associated with the ongoing lava flow from Kīlauea in the Puna District. These earthquakes are mostly occurring at the Kīlauea summit approximately 25 miles from the project site and are generally not felt at the project site.

Volcanic activity is prevalent on the Island of Hawai'i and activity associated with Kīlauea Volcano has been continuous since 1983. The project site is located within Lava Zone 3, which represents areas that have had one to five percent of the land area covered by lava or ash since 1800. The current eruption is occurring along the East Rift Zone in south Puna District in Lava Zone 1.

Potential Impacts

Construction

Natural hazards cannot be controlled; rather, they can only be remediated for after the events occur. Construction of the East Hawai'i Organics Facility would not create conditions that would exacerbate natural hazards. The County of Hawai'i Civil Defense Agency is responsible for administering and operating the various local, state, and federal civil defense programs for the county. In the event of a hurricane or tsunami, watches and/or warnings are issued by the Central Pacific Hurricane Center and the Pacific Tsunami Warning Center, respectively. In the event of a hurricane or tsunami, construction would halt until such time as the warning is lifted and proper evacuation procedures would be followed.

Operation

The Proposed Action would be designed to withstand the level of forces necessary to minimize the likelihood that an extreme event such as a hurricane would damage the facility. During hurricanes, uncovered compost and mulch would remain onsite. In the event that any material blows off site, these are light, organic materials that would not cause injury or property damage. Upon the end of the event, the project site could serve as a temporary debris storage and reduction site to aid in the recovery phase

of a natural disaster event, which would be a beneficial impact. The Proposed Action does not involve habitable uses nor would it encourage such uses. In the event of a hurricane warning, workers would follow civil defense instructions regarding evacuations.

Due to the location of the site, impacts associated with tsunamis, flooding, or volcanic activities are not expected.

Minimization and Mitigation Measures

To minimize the potential hazards from earthquakes and hurricanes, the following structural design elements would be implemented:

- Structural elements in the proposed Composting Facility would be designed in accordance with the 2006 International Building Code (IBC) as amended by the State of Hawai'i Building Code. The 2006 IBC provides minimum design criteria to address the potential for damage due to seismic and hurricane forces.

3.5. Water Resources

Existing Conditions

The project site is located within the Kea'au Aquifer System Area that is part of the Northeast Mauna Loa Aquifer Sector Area. Groundwater within this aquifer exists primarily as basal groundwater followed by high level dike and perched water. The sustainable yield for the Kea'au Aquifer System Area is 393 million gallons per day (mgd). The project site is located above the Underground Injection Control line, which means that the underlying aquifer is considered a drinking water source (DOH, 2018).

There are no freshwater streams, rivers, ponds, or other open water bodies within or adjacent to the project site. There are also no wetlands present. Stormwater runoff from the project site flows in the direction of the existing grade and naturally percolates into groundwater.

Potential Impacts

Construction

Construction of the Proposed Action would include grading and site preparation for the composting facility. Short-term construction activities may include minor soil loss and erosion. Grading and grubbing activities would be limited to the area necessary for construction of the facilities to minimize erosion potential. Construction activities are not likely to introduce to, nor release from the soil any materials which could adversely affect groundwater. Dewatering activities are not anticipated for this project. Construction of the Proposed Action would have no effects to surface waters and wetlands since there are none on or near the site, and construction of the Proposed Action is not expected to have adverse effects to groundwater.

Operation

Potable water for the Proposed Action would be supplied by the County of Hawai'i Department of Water Supply's (DWS) Hilo Water System, which draws water from a series of groundwater wells, as discussed in **Section 3.9**. According to the *Hawai'i County Water Use and Development Plan* (Fukunaga & Associates, 2010), the existing and projected groundwater withdrawals, including DWS' Hilo Water System, are substantially below the sustainable yield of the Northeast Mauna Loa Aquifer Sector. Therefore, groundwater use associated with the Proposed Action would be less than significant.

The composting facility would include a storm drainage system utilizing retention ponds. To the extent practicable, the Proposed Action would be designed to maintain post-development peak runoff rate and average volume at levels that are similar to pre-development rates. The facility would utilize infiltration practices, vegetated open channel practices, and filtering practices defined in the USEPA's guidance document, *National Management Measures to Control Nonpoint Source Pollution from Urban Areas* (2005).

Minimization and Mitigation Measures

The following measures would be implemented during construction of the Proposed Action to minimize impacts to water resources:

- DEM would obtain coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for stormwater discharge associated with construction activities. As part of the permit process, DEM would prepare a construction site Best Management Practices (BMP) Plan that would include an erosion and sediment control plan, a site-specific plan to minimize erosion or soil and discharge of other pollutants into state waters, and descriptions of measures that would minimize the discharge of pollutants via stormwater after construction is complete. BMPs would be installed prior to ground-disturbing activities.
- All activities would comply with the requirements of Hawaii County Code, Chapter 10, Erosion and Sedimentary Control. DEM would obtain Grading and Grubbing Permits from the County of Hawai‘i Department of Public Works. The contractor would be required to comply with the General Provisions for the permits, as well as the standard permit conditions.

The following measures would be implemented to minimize impacts to water resources from operation of the Proposed Action:

- The facility would be designed to comply with the latest County of Hawai‘i *Storm Drainage Standards and Standard Details for Public Works Construction.*

3.6. Biological Resources

Existing Conditions

SWCA Environmental Consultants (SWCA) conducted a biological resources survey for the Proposed Action in April 2018 (see **Appendix D**). This effort included the following:

- A literature review.
- A desktop analysis to determine if habitat for Migratory Bird Treaty Act (MBTA), Endangered Species Act (ESA), and HRS Chapter 195-D protected species may be present at or in the vicinity of the project site. This included review of aerial imagery, the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation website (USFWS, 2018a), and the USFWS Environmental Conservation Online System (USFWS, 2018b).
- A flora and fauna survey of the 40-acre site.

Flora

SWCA conducted a pedestrian flora (botanical) survey to document all vascular plant species and vegetation types present within the survey area. Areas more likely to support native plants (e.g., rocky outcrops, gulches, and shady areas) were more intensely examined.

No federally or state-listed threatened, endangered, or candidate plant species or rare native Hawaiian plant species were observed in the survey area. A total of 74 plant species were recorded, of which three are native to the Hawaiian islands: ‘ōhi‘a (*Metrosideros polymorpha),* forked fimbry (*Fimbristylis dichotoma),* and uluhe (*Dicranopteris linearis).* All three native species are common.

Vegetation in the survey area consists of two vegetation types: mixed non-native forest and cultivated fields. Mixed non-native forest is characterized by a mix of non-native trees with a non-native understory. The vegetation is heterogenous and includes a matrix of parasol leaf tree (*Macaranga tanarius),* albizia (*Falcataria moluccana),* gunpowder tree (*Trema orientalis),* and wedelia (*Sphagneticola trilobata).* Gaps in the vegetation created by roads or other edges are dominated by Guinea grass (*Megathyrsus maximus* var. *maximus).*

Portions of the project site and survey area are used for growing papaya (*Carica papaya).* The canopy in these areas is entirely occupied by papaya, with a low-growing understory or diverse herbaceous weeds, including artillery plant (*Pilea microphylla)* and yellow wood sorrel (*Oxalis corniculata).*



Mixed non-native forest vegetation type



Cultivated fields of papaya

Rapid ‘Ōhi‘a Death (ROD) is a fungal disease (*Ceratocystis* fungus) that has affected ‘ōhi‘a trees on the islands of Hawai‘i and Kauai. Trees infected with ROD die within days or weeks of infection. The fungus grows in the sapwood of infected trees, and humans are thought to be a main vector because we move infected wood, contaminated tools, gear, and vehicles from one location to another.

Fauna

SWCA conducted a pedestrian fauna (animal) survey to document all animal species present within the survey area. No federally or state-listed threatened, endangered, or candidate species were observed in the survey area. A total of 23 animal species were recorded, of which only two are native to the Hawaiian Islands: Hawaiian short-eared owl (*Asio flammeus sandwichensis)* and green darner dragonfly (*Anax junius).*

Threatened and Endangered Species

Based on current distribution and habitat requirements, six federally and state-listed species could occur in the survey area. These species and their potential to occur within the project area are provided in **Table 3-2**.

Table 3-2. Federally and State Threatened and Endangered Species That Could Occur in the Project Area

Species	Status	Potential for Occurrence in the Project Area
Hawaiian hawk *(Buteo solitarus)*	FE, SE	May occur in the project area. Suitable foraging and nesting habitat is present.
Hawaiian goose *(Branta sandvicensis)*	FE, SE	May occur in the project area. Suitable foraging and nesting habitat is present.
Band-rumped storm-petrel *(Oceanodroma castro)*	FE, SE	Unlikely to occur in the project area. May fly over the area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the project area.
Hawaiian petrel *(Pterodroma sandwichensis)*	FE, SE	Unlikely to occur in the project area. May fly over the area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the project area.
Newell's shearwater *(Puffinus newelli)*	FT, ST	Unlikely to occur in the project area. May fly over the area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the project area.
Hawaiian hoary bat *Lasiurus cinereus semotus)*	FE, SE	May occur in the project area. Hawaiian hoary bats have been documented roosting in tree species that occur in the project area.

FE = Federally Endangered; FT = Federally Threatened, SE = State Endangered, ST = State Threatened

The Hawaiian hawk is known to nest in trees that are typically 33 to 80 feet in height with nests typically located approximately 11 to 60 feet above the ground. Nests are constructed on stable platforms such as on top of birds-nest ferns (*Aspenium nidus),* on thick branches, and at the intersections of trunks and branches. The Hawaiian hawk nests from March through September, and the chick fledges after seven or eight weeks. The Hawaiian hawk feels largely on introduced animals such as rats, lizards, and game birds, as well as invertebrates such as insects.

The nēnē is an inhabitant of shrubland, grassland, coastal dunes, lava plains, and related anthropogenic habitats such as pasture and golf courses from sea level to approximately 7,900 feet. The nēnē breed from August to April, and most eggs are laid between November and January. Goslings remain with their parents until the next breeding season. The nēnē is a herbivore that eats leaves, seeds, fruit, and flowers of grasses and shrubs.

Major threats to seabirds include the attraction of adults and newly fledged juveniles to bright lights while transiting between their nest sites and the ocean. Juvenile birds are particularly vulnerable to light attraction and are sometimes grounded when they become disoriented by lights. Grounded seabirds are vulnerable to mammalian predators or vehicle strikes.

The potential for the presence of the Hawaiian hoary bat was assessed based on the presence of suitable habitat and vegetation types. The Hawaiian hoary bat has been documented roosting in 'ōhi'a and avocado trees and could roost in other tree species with similar structure, such as the African tulip and papaya trees. The Hawaiian hoary bat could also forage over the mixed non-native secondary forest and cultivated fields throughout the project area.

Birds

A total of 10 bird species were documented during the fauna survey. All bird species observed in the survey area are species commonly found in disturbed, low- to mid-elevations on Hawai'i Island, and nine are non-native introductions. The IPaC resource query for the project listed 12 MBTA-protected bird species that could occur in the study area (USFWS, 2018). As shown in **Table 3-3**, only two species protected under the MBTA were observed during the survey. However, based on geographic location and available habitat, the following additional MBTA-protected species may occur within or nearby the project area: Hawai'i amakihi (*Chlorodrepanis virens),* cattle egret (*Bubulcus ibis),* and Pacific golden plover (*Pluvialis fulva).*

Table 3-3. Birds Observed In and Near the Project Site

Common Name	Scientific Name	Status	MBTA
Chinese hwamei	*Garrulax canorus*	Non-native	--
Common myna	*Acridotheres tristis*	Non-native	--
Common waxbill	*Estrilda astrild*	Non-native	--
Japanese white-eye	*Zosterops japonicas*	Non-native	--
Hawaiian short-eared owl	*Asio flammeus sandwichensis*	Endemic	X
House finch	*Haemorhous mexicanus*	Non-native	--
Northern cardinal	*Cardinalis cardinalis*	Non-native	X
Nutmeg manikin	*Lonchura punctulata*	Non-native	--
Spotted dove	*Streptopelia chinensis*	Non-native	--
Zebra dove	*Geopelia striata*	Non-native	--

Mammals

Mammals detected during the survey include the Indian mongoose (*Herpestes javanicus)* and feral pig (*Sus scrofa).* No other mammals were observed, although the feral cat (*Felis catus)*, rat (*Rattus* sp.), and mouse (*Mus musculus)* could be expected to occur.

Terrestrial Reptiles and Amphibians

There are no native terrestrial reptiles or amphibians native to Hawai'i. One reptile, the gold dust day gecko (*Phelsuma laticauda).* And one amphibian, the coqui frog (*Eleutherodactylus coqui),* were observed during the survey.

Insects and Other Invertebrates

Only one native invertebrate was observed during the survey: the green darner dragonfly. Eight other species of terrestrial invertebrates were observed, which are all non-native, introduced species: giant African snail (*Achatina fulica),* small cabbage white butterfly (*Pieris rapae),* spring azure butterfly (*Celastrina ladon),* mosquito (*Aedes* sp.), wasp (*Evaniidae* sp.), Asian spiny-backed spider (*Gasteracantha mammosa),* seven-spotted lady beetle (*Coccinella septempunctata),* and one unidentified hawk or sphinx moth.

Little fire ant (*Wasmannia auropunctata)* is an invasive species known to occur throughout Hawai'i Island. The little fire ant does not build mounded dirt nests; rather, it nests in a variety of habitats including in trees, around potted plants, irrigation lines, and in electrical boxes. The often sting on neck, arms, and torso as they fall on people from above.

Potential Impacts

Construction

Construction of the Proposed Action is not expected to have a significant adverse effect on flora (botanical) resources since vegetation in the project area is disturbed from previous and current land activities. Weedy, non-native plant species are common in the project area, most of which are widespread on Hawai'i Island. However, some species within the project area are highly invasive and not common in every region of Hawai'i Island or on other islands where significant resources are spent on their eradication, such as miconia and cane tibouchina (*Tibouchina herbacea).* Construction activities could spread these invasive species, as well as ROD and little fire ant, to new areas through the movement of vehicles and materials. Minimization measures would be employed to avoid the unintentional introduction or transport of terrestrial invasive species.

Construction of the Proposed Action may temporarily displace fauna species. However, construction would be short-term and temporary, and fauna species are expected to find suitable foraging and nesting habitat nearby.

Operation

Operation of the Proposed Action would have no impact to existing vegetation since there would be no additional clearing. Operation of the Proposed Action is also not expected to adversely affect fauna resources. The commercial and industrial activities that occur near the project site make it fairly unlikely that listed fauna species would frequent the area. However, minimization measures have been provided for each species identified with the potential to occur within the project area. With the implementation of minimization measures, the Proposed Action would not have significant impacts to listed fauna species. Operation of the Proposed Action could lead to the spread of ROD and little fire ant. Measures to minimize this potential impact, as discussed below, would be implemented.

Minimization and Mitigation Measures

Invasive Flora Species

The following measures would be implemented to minimize the spread of invasive species:

- All construction equipment and vehicles would be washed and inspected before entering the project area.
- Construction materials would be washed and/or visually inspected (as appropriate) for excessive debris, plant materials, and invasive or harmful non-native species.
- Inspection and leaning activities would be conducted at a designated location. The inspector would be a qualified botanist and/or entomologist who is able to identify invasive species that are of concern relevant to the point of origin of the equipment, vehicle, or material.
- When possible, raw materials (e.g., fill and construction materials) would be purchased from a local supplier to avoid introducing non-native species not present on the island.
- Native Hawaiian plants and/or non-invasive plants would be used in all landscaping.

Little Fire Ant

The following measures would be implemented to minimize the potential spread of little fire ant:

- All mulch would be treated prior to being made available to the public.
- Prior to full operations, mulch generated from the processing of green waste and untreated pallets would be placed in open windrows to compost the material for a minimum of 15 days at internal temperatures of a minimum of 131 degrees Fahrenheit. The mulch would be turned inside and out a minimum of five times during the 15 day treatment to maintain aerobic conditions within the pile and to control internal temperatures.
- When the in-vessel composting system is in place, the same process will occur in-vessel, but the results can be obtained within a 72-hour period instead of 15 days.

In addition to these measures, DEM will consult with the DLNR Division of Forestry and Wildlife regarding BMPs to minimize the spread of little fire ant as the project progresses.

Rapid 'Ōhi'a Death

DEM will continue to consult with the DLNR Division of Forestry and Wildlife regarding BMPs to minimize the spread of ROD as the project progresses.

Hawaiian Hawk

The following measures would be implemented to minimize impacts to the Hawaiian hawk:

- A nest survey would be conducted by a qualified biologist using appropriate survey methods within 10 days prior to construction if construction occurs during the Hawaiian hawk breeding season (March through September). The survey would focus on large trees that could provide nesting habitat.
- If an active Hawaiian hawk nest is discovered, no construction would occur within 1,600 feet of the next until the chicks fledge or the nest is otherwise abandoned. Construction may take place outside of this buffer as long as activities would not destroy the nest or cause the birds to prematurely abandon the nest.
- If a Hawaiian hawk individual is detected in the area during ongoing construction activities, all activities within 100 feet of the bird would cease and the bird would not be approached. Work may continue when the bird has left the area on its own.

Hawaiian Goose

The following measures would be implemented during construction to minimize potential impacts to the Hawaiian goose:

- All regular on-site staff would be trained to identify Hawaiian geese and would know the appropriate steps to take if Hawaiian geese are present on-site.
- If a Hawaiian goose is found in the area during on-going construction activities, all activities within 100 feet of the bird would cease and the bird would not be approached. Work may continue when the bird has left the area on its own.
- If a nest is discovered, the USFWS would be contacted. A 100-foot buffer would be established and maintained around all active nests and broods until the goslings have fledged. No disruptive activities would occur within this buffer.

Seabirds

The following measures would be implemented to minimize potential impacts to seabirds:

- Construction activities would be restricted to daylight hours to the extent practicable during the seabird peak fallout period (September 15 to December 15) to avoid the use of nighttime lighting that could attract seabirds.
- All outdoor lights would be shielded to prevent upward radiation.
- Outside lights not needed for security and safety would be turned off from dusk through dawn during the fledging fallout period (September 15 to December 15).

Hawaiian Hoary Bat

The following measures would be implemented during construction to minimize potential impacts to the Hawaiian hoary bat:

- Any fences that are erected as part of the project would have barbless to-strand wire to prevent entanglements of the Hawaiian hoary bat with the barbed wire.
- No trees taller than 15 feet would be trimmed or removed between June 1 and September 15 when juvenile bats that are not yet capable of flying may be roosting in the trees.

3.7. Cultural and Historic Resources

Existing Conditions

Cultural Practices and Traditional Uses

A Cultural Impact Assessment was prepared for the Proposed Action and is included in **Appendix E**. This report identified that the Kea'au Ahupua'a and the Puna District are described in many traditional accounts. Some legendary accounts describe Puna as a fertile and rich land that was beloved by the deity Kāne. Most of Puna has been altered by year of ongoing volcanic activity. However, *kīpuka* (vegetated oasis surrounded by lava) containing deep soils and lush vegetation can still be found. Historical accounts describe densely populated settlements scattered along the Puna coastline, where *hala* groves, depressions found in the undulating terrain, and treetops were planted with crops.

Following the arrival of Captain James Cook, foreign interest in Puna grew and there was a shift to a Euro-American style of land tenure. By the turn of the 20th century, William H. Shipman and his wife, Mary, were the sole owners of the Kea'au Ahupua'a, which was experiencing economic changes associated with the booming sugar, lumber, and agricultural industries.

The consultation process for the Proposed Action identified no specific traditional cultural practices existing or having taken place within the study area. However, there is the concern over the spread of invasive pests, such as little fire ants, and diseases such as ROD into and from the facility. Measures to minimize this potential impact are discussed in **Section 3.6**.

Archaeological and Historic Resources

An archaeological literature review and field investigation was conducted in March 2018 at the project site (see **Appendix F**). Background research indicated that the project area lands were generally used during the pre-Contact period primarily for scattered swidden agriculture and associated temporary habitation. In the historic era, the project area and surrounding lands were heavily disturbed by cattle grazing and sugarcane cultivation. Additional mechanical alterations of grubbing and bulldozing related

to modern agricultural use in the 1980s changed the landscape in the vicinity of the project site. Given the history of known land use in the area, little in the way of archaeological findings was anticipated.

No archaeological features were identified during the field inspection. The project site has been completely disturbed in the modern era, and approximately half of the project area is presently planted in commercial papaya.

Potential Impacts

Construction and operation of the Proposed Action is not expected to have a significant cultural impact due to the lack of any ongoing traditional practices associated with the project site.

Based on the findings during the archaeological literature review and field inspection, construction and operation of the Proposed Action is not expected to affect any historic properties. Any pre-Contact and/or historic era subsurface deposits that may have once been present are likely to have been obliterated by bulldozing and plowing for agricultural plantings in the modern era. Undetected lava tubes may be present and can contain cultural materials and modifications including human burials. However, no lava tube openings were found in the project area and no lava tubes have been documented in the near vicinity of the project site.

Minimization and Mitigation Measures

To minimize impacts to previously unidentified archaeological and/or historic resources, the following measure would be implemented:

- Should historic remains such as artifacts, burials, concentrations of shell or charcoal be encountered during construction activities, work shall cease immediately in the immediate vicinity of the find and the find shall be protected from further damage. The contractor shall immediately contact the State Historic Preservation Division, which will assess the significance of the find and recommend an appropriate mitigation measure, if necessary.

3.8. Socioeconomics

Existing Socioeconomic Characteristics

The Puna District has been identified as an area "that is experiencing the fastest rate of growth of all the districts in the County of Hawai'i (County of Hawai'i Planning Department, 2008). Strong population growth is expected to continue as a result of affordability of residential parcels in the district. In 2010, the population of the Puna District was 45,326. In addition, the Puna District has a high presence of Environmental Justice target populations (i.e., minorities and low-income). All neighborhoods in the district have at least one under-represented minority population that is at a level higher than that of the County of Hawai'i (U.S. Census, 2010). In addition, approximately 20.8% of the residents of the Puna District are living below the poverty level as per the 2012-2016 American Community Survey Five-Year Estimates (U.S. Census, 2016).

Potential Impacts

Construction

Construction of the Proposed Action may provide short-term economic benefits in the form of construction jobs and materials procurement.

Operation

Operation of the Proposed Action may provide some long-term employment benefits from the hiring of new heavy equipment operators and mechanics. These benefits would not be significant relative to the overall economy of the island.

The Proposed Action would not affect growth of the surrounding population. Therefore, the Proposed Action would have no impacts on the population of the area.

Minimization and Mitigation Measures

No minimization or mitigation measures are proposed or expected to be required.

3.9. Public Facilities and Services

Existing Facilities and Services

Parks and Recreational Areas

The nearest park/recreational area to the project site is the Kea‘au Shipman Park, which is located approximately 1.2 miles southeast of the project site. This park is operated by the County of Hawai‘i Department of Parks and Recreation and offers an array of outdoor activities (W.H. Shipman, 2012).

Panaewa Rainforest Zoo is located approximately 1.8 miles northwest of the project site. This 12-acre zoo is operated by the County of Hawai‘i Department of Parks and Recreation and is the only natural tropical rainforest zoo in the United States. The zoo houses more than 75 animal species and the gardens include over 100 varieties of palm, as well as a lily pond and an extensive collection of orchids, clumping bamboos, and tropical Rhododendrons (County of Hawai‘i Department of Parks and Recreation, 2011).

There are no other parks or recreation areas located within the vicinity of the Proposed Action.

Utilities

The W.H. Shipman Business Park received electrical power service from the Hawaiian Electric Light Company, Inc. (HELCO). Telecommunications service is provided by Hawaiian Telcom and Spectrum. Electrical power and communications infrastructure near the project site consists of overhead lines and underground duct lines along Kipimana Street.

Water service to W.H. Shipman Business Park is provided by the County of Hawai‘i DWS. As per a letter from DWS dated April 12, 2018, there is an existing service lateral on Kipimana Street that was installed for the subject parcel. This lateral is capable of accommodating a 1-inch meter, which is limited to an average usage of 800 gallons per day or two equivalent units of water. There is an existing 16-inch waterline along Kipimana Street.

Municipal wastewater collection and treatment facilities on the Island of Hawai‘i are administered by the DEM. There is no public sewer system in the project area; therefore, wastewater treatment issues would be handled by installation of a new on-site septic system and leach field. It is estimated that the approximate size of the septic tank would be 2,000 gallons and the leach field would be approximately 370 square feet.

Solid and Hazardous Waste

The DEM, Solid Waste Division, operates and maintains all solid waste collection and disposal facilities on the island. The Proposed Action is a new component of the county's solid waste disposal facilities and would require a solid waste management permit issued by the DOH pursuant to HAR 11-85.1.

Fire, Police, EMS

Law enforcement is provided by the County of Hawai'i Police Department and fire protection services are provided by the County of Hawai'i Fire Department. The Kea'au Police Station and a 24-hour fire/EMS facility are located along Old Volcano Road in the Kea'au Town Center, which is approximately 1.8 miles south of the project site.

Emergency service providers include critical care providers such as hospitals and clinics. There are two privately operated medical facilities in the Kea'au Town Center: an urgent care center and a medical clinic. The nearest full service hospital facility is Hilo Medical Center, which is approximately 9.3 miles north of the project site.

Potential Impacts

Construction

No significant impacts to public facilities and services are expected during construction of the Proposed Action.

Operation

The Proposed Action would have no impacts to park and recreational areas since there are none in close proximity to the project site.

The Proposed Action would not have significant impacts to utilities. DEM would coordinate with HELCO and either Hawaiian Telcom or Spectrum to receive electrical power and communications to the site, respectively. DEM would have a professional engineer licensed in the State of Hawai'i prepare estimated maximum daily usage calculations for water needs that would be submitted to DWS for review. Based on the estimated water demand, DWS would determine the following: (1) whether a water commitment can be issued, (2) the water commitment deposit and facilities charges due, (3) water system improvements to be made, and (4) any other conditions necessary for final approval. Assuming a water commitment is made, the Proposed Action would be designed to include the installation of a reduced principle type backflow prevention assembly within five feet of the meter on private property. This assembly would be inspected and approved by DWS prior to the commencement of water service.

The Proposed Action would divert organic waste from the landfills, which currently constitutes approximately 54% of the landfill waste. Besides converting "waste" to an asset, the Proposed Action would extend the life of the landfill. This is especially important since the South Hilo Sanitary Landfill is being closed. The Proposed Action would not handle any hazardous waste, as defined and regulated under HAR 11-260 to 11-280.

No significant impacts are expected to fire, police, and EMS during operation of the Proposed Action. Although it is likely that the Proposed Action would require the occasional police, fire, or medical services, it would not be an increase over the existing conditions and would not represent a significant amount relative to the overall regional demand. DEM would coordinate with the Fire Department to approve the design of the Proposed Action to ensure compliance with the National Fire Protection Association 1,

Hawai'i State Fire Code, as amended by the County of Hawai'i (Hawai'i County Code Chapter 26), and to approve the Proposed Action's fire response plan.

Minimization and Mitigation Measures

No minimization or mitigation measures are proposed or expected to be required.

3.10. Transportation and Traffic

Existing Transportation System

The existing transportation system consists of two primary roadways: Māmalahoa Highway (State Route 11), also known as Volcano Highway and Hawai'i Belt Road, and Kipimana Street. There is also a secondary roadway, Macadamia Nut Road, which intersects with Māmalahoa Highway, as well as a road that runs parallel to Māmalahoa Highway (Wiliama Street) that were both analyzed in the *Traffic Impact Assessment Report* included in **Appendix G**.

Māmalahoa Highway is a north-south State Route arterial that is a divided highway in the study located at the intersections of Kipimana Street and Macadamia Nut Road. The posted speed limit at the study intersections is 55 miles per hour (mph).

Kipimana Street is an undivided, four-lane, commercial collector road, oriented in the east-west direction. This is the main street within the W.H. Shipman Business Park and connects to Māmalahoa Highway. The posted speed limit is 25 mph. The intersection with Māmalahoa Highway is an unsignalized intersection in both the northbound and southbound directions.

Volumes

The Average Daily Traffic (ADT) along Māmalahoa Highway is 32,700 (HDOT, 2015). Traffic from Kipimana Street and Macadamia Nut Road experience delays when entering Māmalahoa Highway. It is expected that these delays will get longer as traffic grows and additional development occurs within W.H. Shipman Business Park.

Intersection turning movement counts were taken in March and April 2018 and are provided in the *Traffic Impact Assessment Report* in **Appendix G**. The level of service (LOS) of the following intersections was modeled for existing and future conditions:

1. Kipimana Street and Wiliama Street
2. Kipimana Street and Māmalahoa Highway southbound
3. Kipimana Street and Māmalahoa Highway northbound
4. Macadamia Nut Road and Māmalahoa Highway southbound
5. Macadamia Nut Road and Māmalahoa Highway southbound

The results show that intersections 2, 3, 4, and 5 currently operate at LOS D, E, or F during both AM and PM peak hours. These intersections would operation at LOS E or F during both AM and PM peak hours with the Proposed Action. It is expected that drivers would experience delays of 10 minutes or more at Kipimana Street and Māmalahoa Highway southbound in the evening. Similar delays are expected for side street drivers at Kipimana Street and Māmalahoa Highway northbound in the morning. This is due to the high volume of traffic on Māmalahoa Highway and the limited availability of gaps to allow traffic entry from the side streets.

Potential Impacts

Construction

During construction, there is the potential for traffic impacts due to the movement of construction workers, equipment, and materials. These impacts would be short-term and temporary.

Operation

The Proposed Action is not expected to be a significant generator of traffic as only five to 24 additional vehicles are expected for during peak hours at the intersections with Māmalahoa Highway. However, some of the intersection operations are already over capacity, as discussed above.

Minimization and Mitigation Measures

The following measures would be implemented to minimize impacts to traffic from the Proposed Action:

- Encourage truck arrivals and departures outside of the peak hours of 6:30 to 7:30 AM and 3:00 to 4:00 PM.

In addition, the following measures are recommended to improve existing traffic operations:

- Provide good visibility at all intersection with Māmalahoa Highway by clearing any vegetation interfering with sightlines and moving signage out of sightlines.
- Add left-turn acceleration lanes at the following intersections:
    - Kipimana Street and Māmalahoa Highway southbound
    - Māmalahoa Highway northbound and Macadamia Nut Road
    - Māmalahoa Highway southbound and Macadamia Nut Road

DEM would coordinate with HDOT regarding suggested intersection improvements to alleviate existing traffic operation problems, as well as measures to minimize impacts associated with the Proposed Action.

3.11. Visual Resources

Existing Scenic and Visual Environment

The project site is generally flat with dense vegetation on and surrounding the site. There are no notable visual resources either on or visible from the project site. The project site is located within the W.H. Shipman Business Park. The visual character of the area is that of commercial and industrial uses.

Potential Impacts

Construction

Construction of the Proposed Action would introduce construction equipment and activity to the area. The project site is located in an industrial area; therefore, construction activities would be consistent with the existing conditions of the area and impacts to the visual environment would not be significant.

Operation

The Proposed Action would be designed and constructed to be compatible with the character of the surrounding area. The composting facility would encompass a small portion of the 40-acre site and would be surrounded by a vegetated buffer that would minimize impacts to the existing visual environment.

Minimization and Mitigation Measures

No minimization or mitigation measures are proposed or expected to be required.

3.12. Secondary and Cumulative Impacts

Secondary impacts are those effects that are caused by an action and are later in time or farther removed in distance, but are reasonably foreseeable. They may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water or other natural systems. The Proposed Action would not involve a change in land use and would not induce growth. Therefore, the Proposed Action would not have secondary impacts.

Cumulative impacts refer to the impact on the environment that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant impacts taking place over time. The Proposed Action would divert organic waste from the landfills, which would extend the life of the landfill. This is especially important since the South Hilo Sanitary Landfill is being closed. Therefore, the Proposed Action would have beneficial cumulative effects.

3.13. Irretrievable and Irreversible Commitment of Resources

Implementation of the Proposed Action would not result in the irretrievable and irreversible commitment of resources other than the financial resources, fuel, land, and other consumable materials required for construction. Development of the Proposed Action would involve the commitment of privately-owned land for use as a composting facility. The Proposed Action would divert organic waste from the landfills, which would extend the life of the landfill. This is especially important since the South Hilo Sanitary Landfill is being closed.

4. Relationship to Land Use Plans and Policies

4.1. State of Hawai‘i Planning Documents

The Hawai‘i State Plan

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

Section 226-7. *Objectives and Policies for the Economy – Agriculture*

(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:
(2) Growth and development of diversified agriculture throughout the State.
(b) To achieve the agricultural objectives, it shall be the policy of this State to:
(2) Encourage agriculture by making best use of natural resources.
(12) Expand Hawai‘i's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.
(13) Promote economically competitive activities that increase Hawai‘i's agricultural self-sufficiency.

Discussion: The Proposed Action would produce agricultural fertilizers, allowing local agriculture to use local fertilizer, promoting self-sufficiency and providing a vital resource for agricultural producers statewide. By suing solid organic waste, the compost process represents a prudent use of natural resources to help achieve the State's goal.

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

(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:
(2) Effective protection of Hawai‘i's unique and fragile environmental resources.
(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:
(1) Exercise an overall conservation ethic in the use of Hawai‘i's natural resources.
(7) Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion.
(8) Pursue compatible relationships among activities, facilities, and natural resources.

Discussion: The Proposed Action would be reducing the amount of waste buried in the landfill, reducing strain on natural resources, and allowing private individuals, organic-waste-producing industry, and agricultural industries to share in a natural resource which otherwise would be turned into pollution. This

reduces the need of the agricultural industry to import fertilizers and/or deplete natural resources unnecessarily, instead promoting a conservational relationship between state agriculture and private individuals/industry.

Section 226-14. *Objective and policies for facility systems – in general.*

(a) Planning for the State's facility systems in general whall be directed towards the achievement of the objective of water, transportation, waste disposal, and energy and telecommunications systems that support statewide social, economic, and physical objectives.

(b) To achieve the general facility systems objective, it shall be the policy of this State to:

(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.

(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.

Discussion: The Proposed Action would assist the County of Hawai'i in its Zero Waste goal as part of its county plan. It would also encourage the prudent use of resources through the composting of organic solid waste from individuals and industries which produce organic waste. As the facility would consume waste and produce a marketable commodity, the facility would be able to maintain its capacity with reasonable cost to the user.

Section 226-15. *Objectives and policies for facility systems – solid and liquid wastes.*

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

(2) Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.

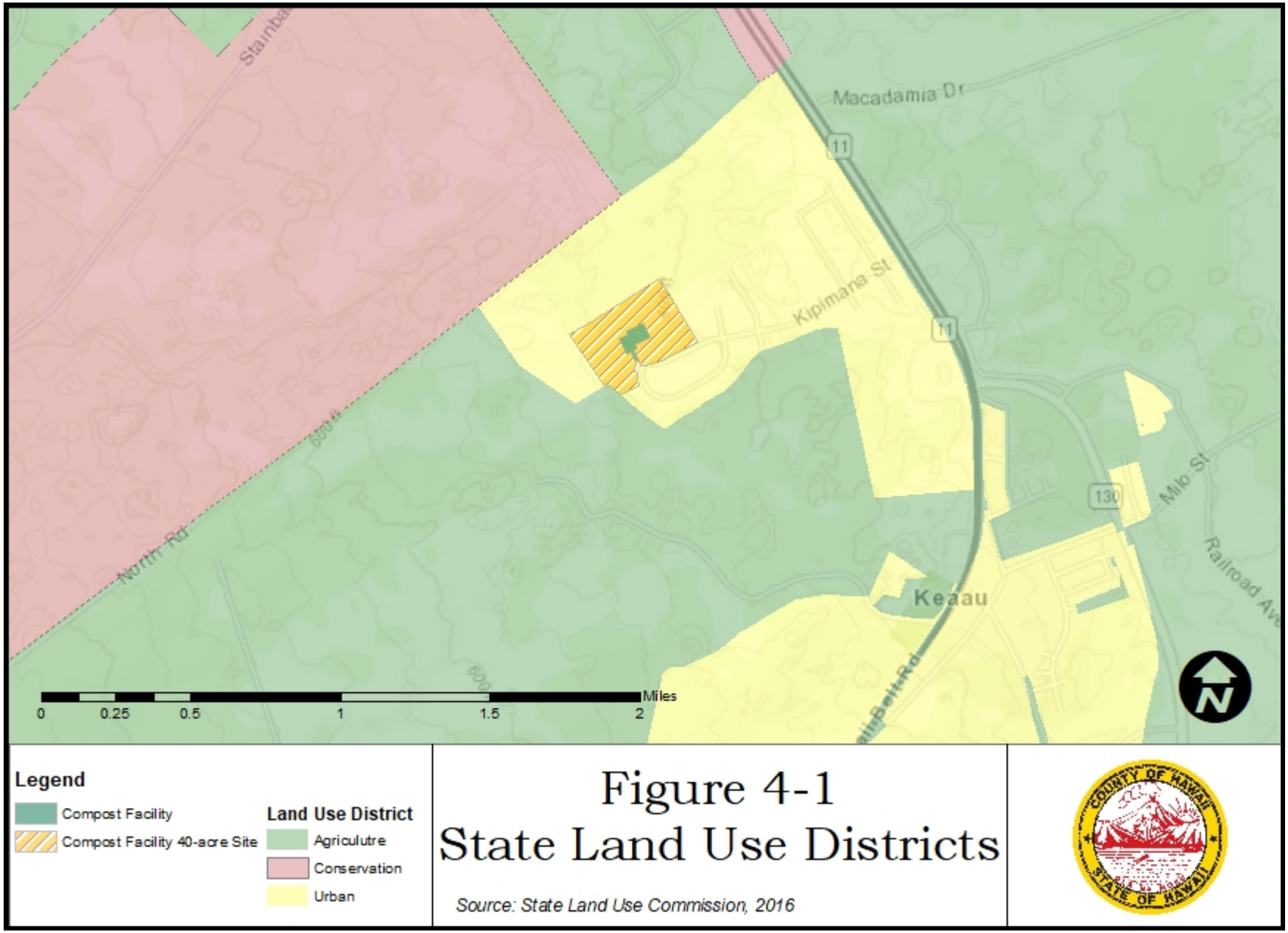
(3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.

Discussion: The Proposed Action would conserve landfill space and treat solid organic waste in a way that produces products beneficial to the economy of Hawai'i.

State Land Use Law

Hawai'i was the first of the fifty States to have a State Land Use Law (originally adopted in 1961) and a State Plan. Today, Hawai'i remains unique among the fifty states with respect to the extent of control that the state exercises in land use regulation. The state has four classifications: Agricultural, Conservation, Rural, and Urban. The State Land Use Law HRS, Chapter 205 initially set the boundaries for the four classifications. Changes to boundaries for areas less than 15 acres can be approved at the County level; larger modifications must be approved by the Land Use Commission by super-majority vote. Counties have full control over the use of urban-designated area. Only the Land Use Commission can take land out of the Conservation District.

Discussion: **Figure 4-1** identifies the project site as located in the Urban state land use district. The Urban District generally includes lands characterized by "city-like" services. Jurisdiction of this district primarily lies with the respective counties.


Macadamia Dr
11
Kipimana St
Mio St
130
Railroad Ave
North Rd
Keaau
0
0.25
0.5
1
1.5
2
Miles
N
Legend
Compost Facility
Compost Facility 40-acre Site
Land Use District
Agriculutre
Conservation
Urban
Figure 4-1
State Land Use Districts
Source: State Land Use Commission, 2016
COUNTY OF HAWAII
STATE OF HAWAII

4.2. County of Hawai‘i Planning Documents

County of Hawai‘i General Plan

The County of Hawai‘i’s General Plan is the policy document for the long-range comprehensive development on the island of Hawai‘i. The General Plan includes the long-range goals, policies, standards, and courses of action for the entire County. Specifically, the purposes of the General Plan are to:

- Guide the pattern of future development in the County based on long-term goals;
- Identify the visions, values, and priorities important to the people of the County;
- Provide the framework for regulatory decisions, capital improvement priorities, acquisition strategies, and other pertinent government programs within the County organization and coordinated with State and Federal programs;
- Improve the physical environment of the County as a setting for human activities to make it more functional, beautiful, healthful, interesting, and efficient;
- Promote and safeguard the public interest and the interest of the County as a whole;
- Facilitate the democratic determination of community policies concerning the utilization of its natural, man-made, and human resources;
- Effect political and technical coordination in community improvement and development; and
- Inject long-range considerations into the determination of short-range actions and implementation.

The Proposed Action is consistent with the following applicable goals and policies of the *County of Hawai‘i General Plan*:

Environmental Quality

Section 4.3: POLICIES

d. Encourage the concept of recycling agricultural, industrial, and municipal waste material.

Discussion: The Proposed Action would divert green waste and designated organic materials from the County’s landfill by establishing Hawai‘i County’s first municipal composting operation. This facility would accept waste from residents and commercial businesses, thus encouraging the concept and practice of recycling various green waste and organic materials. The Proposed Action would help the County achieve its Zero Waste goal.

Flooding and Other Natural Hazards

Section 5.2: GOALS

a. Protect human life.

b. Prevent damage to man-made improvements.

Section 5.3: POLICIES

l. Continue to promote public education programs on tsunami, hurricane, storm surge, and flood hazards.

q. Consider natural hazards in all land use planning and permitting.

Discussion: According to the FIRM, the Project Site is within Zone X, which is an area of minimal hazard that is higher than the elevation of the 0.2-percent-annual-chance flood. There are no floodplains on or near the Project Site.

Historic Sites

Section 6.2: GOALS

c. Protect, restore, and enhance the sites, buildings, and objects of significant historical and cultural importance to Hawai'i.

Section 6.3: POLICIES

a. Agencies and organizations, either public or private, pursuing knowledge about historic sites should keep the public apprised of projects.

c. Require both public and private developers of land to provide historical and archaeological surveys and cultural assessments, where appropriate, prior to the clearing or development of land when there are indications that the land under consideration has historical significance.

o. Recognize the importance of certain natural features in Hawaiian culture by incorporating the concept of "cultural landscapes" in land use planning.

Discussion: Based on the findings during the archaeological literature review and field inspection, construction and operation of the Proposed Action is not expected to affect any historic properties. Any pre-Contact and/or historic era subsurface deposits that may have once been present are likely to have been obliterated by bulldozing and plowing for agricultural plantings in the modern era. Undetected lava tubes may be present and can contain cultural materials and modifications including human burials. However, no lava tube openings were found in the project area and no lava tubes have been documented in the near vicinity of the project site. Should historic remains such as artifacts, burials, concentrations of shell or charcoal be encountered during construction activities, work shall cease immediately in the immediate vicinity of the find and the find shall be protected from further damage. The contractor shall immediately contact the State Historic Preservation Division, which will assess the significance of the find and recommend an appropriate mitigation measure, if necessary.

Natural Beauty

Section 7.2: GOALS

d. Protect scenic vistas and view planes from becoming obstructed.

e. Maximize opportunities for present and future generations to appreciate and enjoy natural and scenic beauty.

Section 7.3: POLICIES

h. Protect the views of areas endowed with natural beauty by carefully considering the effects of proposed construction during all land use reviews.

i. Do not allow incompatible construction in areas of natural beauty.

Discussion: The Proposed Action would be designed and constructed to be compatible with the character of the surrounding area. The composting facility would encompass a small portion of the 40-acre site and would be surrounded by a vegetated buffer that would minimize impacts to the existing visual environment.

Public Facilities

Section 10.1.2: GOALS

a. Encourage the provision of public facilities that effectively service community and visitor needs and seek ways of improving public service through better and more functional facilities in keeping with the environmental and aesthetic concerns of the community.

Section 10.5.2: POLICIES

h. Encourage the full development and implementation of a green waste recycling program.

Discussion: To help the County achieve its diversion and Zero Waste goals, the Proposed Action would divert green waste and designated organic materials from the landfill by establishing Hawai'i County's first municipal composting operation. This composting facility would accept and recycle/process green waste and designated organic materials from residents and commercial businesses, thus improving public service through better and more functional facilities in keeping with the environmental concerns of the community.

Land Use – Agriculture

Section 14.2.2: GOALS

a. Identify, protect, and maintain important agricultural lands on the island of Hawai'i.

Section 14.2.3: POLICIES

l. Assist in the development of agriculture.

Discussion: The Proposed Action would assist in the development of agriculture by providing mulch and compost, which are valued soil amendments to support subsistence and commercial agriculture, and will be sold to the public.

Land Use Pattern Allocation Guide (LUPAG)

The Land Use Pattern Allocation Guide (LUPAG) is a part of the *County of Hawai'i General Plan* that provides a broad, flexible design intended to guide the direction and quality of future developments in a coordinated and rational manner. The LUPAG Map identifies the general location of various land uses in relation to each other.

Discussion: **Figure 4-2** identifies the land use of the project site as Industrial. The Proposed Action is a compatible use within the Industrial district.

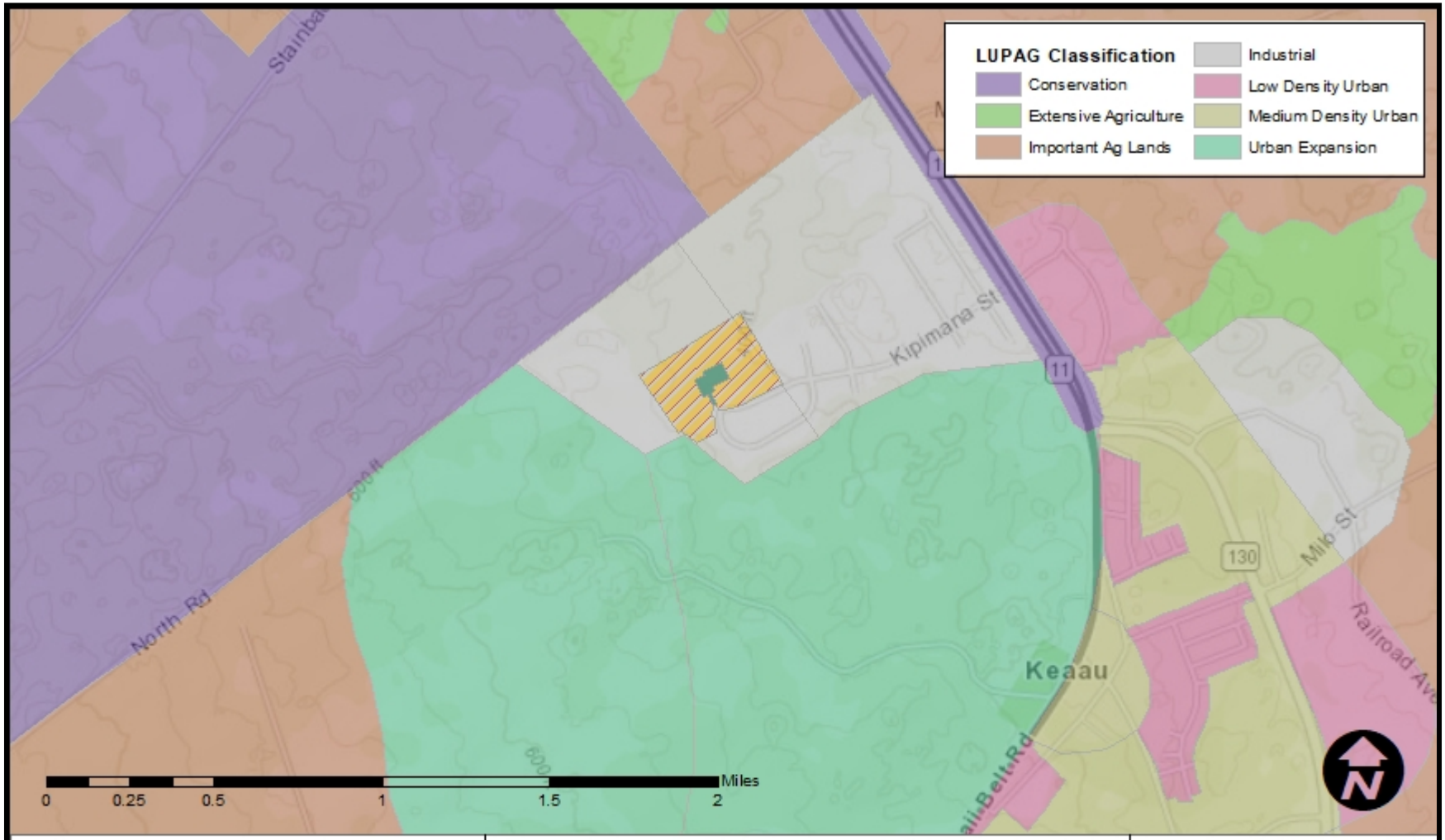


Figure 4-2
Land Use Pattern Allocation Guide

Source: County of Hawaii Planning Department, 2015a

County of Hawai'i Zoning

The Hawai'i County Code Chapter 25, Zoning, establishes zoning districts and regulations for Hawai'i Island. The Zoning Code is applied and administered within the framework of the *County of Hawai'i General Plan.*

Discussion: **Figure 4-3** identifies the project site as being located in zone MG-20, General Industrial District (minimum land area of 20,000 square feet required for each building site). The Proposed Action is a compatible use within the MG-20 zone.

County of Hawai'i Special Management Area

Pursuant to the Hawai'i CZM Program, HRS 205A, the counties have enacted ordinances establishing Special Management Areas (SMA). The County of Hawai'i enacted its SMA ordinance as Planning Commission Rule 9. No "development" within the geographically defined SMA shall be allowed without obtaining a SMA Use Permit as administered by the County of Hawai'i Planning Department.

Discussion: The project site is not located within the SMA.

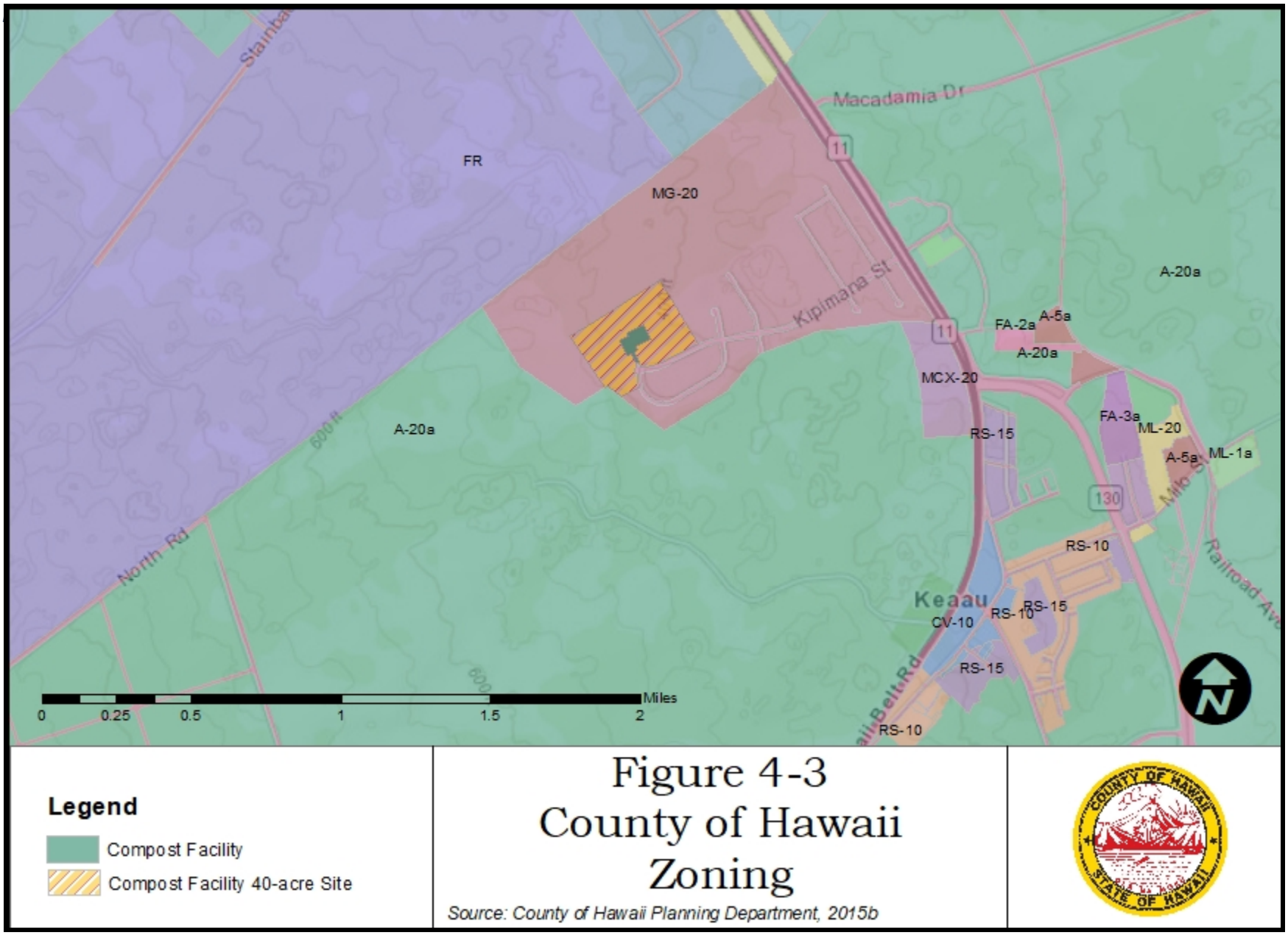


Figure 4-3
County of Hawaii
Zoning

Source: County of Hawaii Planning Department, 2015b

This page intentionally left blank.

5. Findings and Conclusion

5.1. Significance Criteria

HAR 11-200 provides significance criteria for which all projects in Hawai'i are assessed. These significance criteria and their relationship to the Proposed Action are as follows:

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

The Proposed Action is not anticipated to involve any construction activity that may lead to a loss or destruction of any natural or cultural resource. The project site has been the subject of biological, archaeological, and cultural studies conducted in and around the project site. These studies have revealed the absence of any significant natural or cultural resources.

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

The Proposed Action would not curtail the range of beneficial uses of the environment. By diverting solid waste from local landfills, the Proposed Action would promote beneficial uses of the environment.

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

The Proposed Action is not in conflict with the long-term environmental policies, goals, and guidelines of the State of Hawai'i as discussed in **Section 4.1**.

(4) Substantially affects the economic, social welfare, or cultural practices of the community or State.

The Proposed Action would have no adverse economic, social, or cultural impacts. The Proposed Action would provide affordable and quality-controlled compost and mulch, which would have beneficial economic effects to the agricultural sector.

(5) Substantially affects public health.

The Proposed Action would have temporary impacts to noise and air quality during construction; however, these potential impacts would be short-term and temporary and are not expected to substantially affect public health, particularly because of the distance of the project site to the closest residences. All construction activities would comply with applicable regulations and would implement BMPs and the minimization measures provided in this EA. The enclosed tipping building and covered compost heaps would mitigate potential odor and vector concerns.

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

The Proposed Action would not alter the existing land use pattern or induce any increases or shifts in population. In addition, the Proposed Action would not have a significant effect on any other public facilities, as discussed in **Section 3.9**; therefore, there would be no secondary impacts, such as population changes that would have effects of public facilities. The Proposed Action would have a beneficial impact of diverting organic waste from the landfill, thereby increasing the lifespan of the existing facilities.

(7) Involves a substantial degradation of environmental quality.

Construction activities associated with the Proposed Action would result in negligible short-term impacts to noise, air quality, and traffic in the immediate vicinity of the project site. With incorporation of BMPs and the recommended minimization measures during the construction period, the Proposed Action would not result in the degradation of environmental quality. No long-term negative effects are expected from implementation of the Proposed Action. Reducing waste input to landfills would improve environmental quality.

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

The Proposed Action would divert organic waste from the landfills, which would extend the life of the landfill. This is especially important since the South Hilo Sanitary Landfill is being closed. Therefore, the Proposed Action would have beneficial cumulative effects.

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

There are no known threatened or endangered species of flora or fauna located on the project site that could be adversely impacted by the construction and operation of the Proposed Action. As discussed in **Section 3.6**, it is possible that six federal and state-listed species may use or overfly the project site. The recommended minimization measures would be implemented for the Proposed Action.

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

Construction of the Proposed Action would potentially impact noise levels, air quality, and water quality on and near the project site. However, these impacts would be short-term and temporary. All construction activities would comply with applicable regulations and permit requirements and would implement BMPs and the minimization measures provided in this EA, as applicable. After construction, the Proposed Action is not expected to adversely impact ambient noise levels or water and air quality. There would be an increase in impervious surfaces over the project site as compared to the current conditions. Any increase in runoff would be accommodated by the proposed drainage improvements discussed in **Section 2.2** and would not detrimentally impact water quality. Odor would be contained within the enclosed tipping building. Operational noise levels are not expected to exceed ambient noise levels.

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

The Proposed Action would not affect any environmentally sensitive area. The project site is located outside a FIRM-designated floodplain and inland from the coast. The Proposed Action would be designed and constructed in compliance with County of Hawai'i building codes, and the drainage improvements would be designed to minimize any potential for localized flooding.

(12)Substantially affects scenic vistas and viewplanes identified in County or State plans or studies.

The Proposed Action would not alter the existing visual setting of the area, nor would it block any scenic vistas. The area is not listed as a scenic view plane or area of natural beauty by the County of Hawai'i.

(13)Requires substantial energy consumption.

The Proposed Action would involve the commitment of fuel for equipment, vehicles, and machinery during construction and operational phases. However, the energy demand is not considered substantive or excessive within the context of the region’s overall energy consumption.

5.2. Anticipated Finding of No Significant Impact

Based on the significance criteria set forth in HAR 11-200 and discussed in **Section 5.1**, it is anticipated that the Proposed Action would not have a significant effect on the environment and that a Finding of No Significant Impact (FONSI) will be filed with the State of Hawai‘i Office of Environmental Quality Control following the public comment period.

This page intentionally left blank.

6. Agencies and Organizations Consulted

6.1. Pre-Assessment Consultation

The following agencies and organizations were consulted during the preparation of the Draft EA. Those who formally replied are indicated by an asterisk (*). All written comments received during the early consultation period of the Draft EA and responses are included in **Appendix A**.

Federal

U.S. Army Corps of Engineers, Honolulu District *
U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
U.S. Environmental Protection Agency, Region IX, Pacific Islands Office
U.S. Geological Survey, Hawaii Volcano Observatory *
U.S. Geological Survey, Pacific Islands Water Science Center

State of Hawai‘i

Department of Agriculture
Department of Accounting and General Services *
Department of Business, Economic Development & Tourism
Emergency Management Agency *
Department of Hawaiian Home Lands
Department of Health, Hawai‘i District *
Department of Health, Clean Water Branch
Department of Health, Clean Air Branch
Department of Health, Indoor and Radiological Health Branch
Department of Health, Environmental Planning Office *
Department of Health, Office of Environmental Quality Control
Department of Health, Solid and Hazardous Waste Branch*
Department of Health, Safe Drinking Water Branch
Department of Land and Natural Resources, Land Division *
Department of Land and Natural Resources, State Historic Preservation Division
Department of Transportation
Office of Hawaiian Affairs
Office of Planning *
University of Hawaii at Mānoa, Water Resources Research Center
University of Hawaii at Mānoa, College of Tropical Agriculture and Human Resources*
Senator Russell E. Ruderman, Senate District 2
Representative Joy A. San Buenaventura, House District 4

County of Hawai‘i

Council Member Valerie T. Poindexter, Hawai‘i County Council District 1
Council Member Aaron Chung, Hawai‘i County Council District 2
Council Member Sue L. K. Lee Loy, Hawai‘i County Council District 3
Council Member Eileen O’Hara, Hawai‘i County Council District 4
Council Member Jen Ruggles, Hawai‘i County Council District 5

Council Member Maile Medeiros David, Hawai‘i County Council District 6
Council Member Dru Mamo Kanuha, Hawai‘i County Council District 7
Council Member Karen Eoff, Hawai‘i County Council District 8
Council Member Tim Richards III, Hawai‘i County Council District 9
Department of Parks and Recreation
Department of Research and Development *
Department of Water Supply *
Planning Department *
Civil Defense Agency
Department of Public Works *
Mass Transit Agency
Police Department *
Fire Department *
Office of the Mayor

Non-Governmental Organizations

Hawaiian Telcom
Hawai‘i Gas *
Spectrum
Hawai‘i Electric Light Company
Sierra Club of Hawai‘i
Hawai‘i Island Chamber of Commerce
Hawai‘i Audubon Society
Nature Conservancy Hawai‘i
Hawai‘i Invasive Species Council*
Big Island Invasive Species Committee
Little Fire Ant HUI

Adjacent Landowners and Tenants

Green Point Nurseries
Island Princess Macadamia Orchards
H&Y and Associates
Big Island Container Sales & Rentals, LLC
Bob’s Fender Shop, Inc.
Big Island Mexican Foods
Maona Lunch Counter
Natural Pacific Tofu
Hawai‘i Marine Holdings, LLC
Anheuser-Busch Sales of Hawai‘i
Allied Machinery Corporation
HRC Roofing Company
Inter-Island Solar Company
HFN
Island Cold Storage
Jay’s Auto Repair, LLC
Chem-Tainer of Hawai‘i
Akita Enterprises, Inc.
Mattos Towing
HPM Building Supply
A-American Self Storage
Hawai‘i Bookmark
Big Island Poultry
Curves
City of Joy Christian Fellowship
Big Island Federal Credit Union
Puna Rentals, Inc.
Easterseals Hawai‘i
Hawai‘i Island HIV/AIDS Foundation
Pepsi-Cola
Business Services Hawai‘i
Hawaiian Watertank Supply
DBGB Trust
Harberts Family Trust
Pomaikai Holdings, LLC
Velo, LLC
Laser Graphics Hawai‘i
Hilo Fire Extinguishers
Hawai‘i Paper Products
Puna Kamalii Flowers

Rainbow Medical Supply
Tex's Small Engine Repair
Terminix
Shipman Self Storage, LLC*
C&F Trucking
Eight Point Distributors, Inc.
DL Downing General Contractor, Inc.
Big Island Biodiesel
Hawai'i Sun Products, Inc.
Power Generation Services, Inc.
Hawai'i Electric Light Company, Inc.
CAI Loeffler, LLC
Eman, LLC
Aloha M&W Properties, LLC
Isemoto Contracting Inc., Ltd.
GKJK, LLC
Kea'au Service Station, Inc.
Geo Investment Company, Inc.
Maui Varieties Invest, Inc.
Stanley Street Realty Company
Mokihana Ten, LLC
MHC 8, LLC
Melekane, LLC
RNI-NV LTD Partnership
Robert's Tours and Transportation, Inc.
DTT Land Trust
Melekahiwa Watamull, LLC
W.H. Shipman Ltd.
Willocks Construction Corp.
Partners 4, LLC
HMP, Inc.
PC Land, LLC
Kipimana, LLC
DC's Towing Service, LLC
Walter M. Yamada Family Trust
PFI Realty V, LP
IV Elements, LLC
Teminix International Co. Ltd. Partnership
Electro Motor Services, Inc.
Frontline, LLC
JM Sakamoto, LLC
Hawaiian Water Holdings, LLC
A Pacific Island Properties, LLC
Day-Lum Rentals*
Elain Loui Chang Trust
K E Properties, LLC *
Mikahala Holdings, LLC
Kai's Trucking, LLC
Delima's Drilling, Inc.
Carvalho Hawai'i Properties, LLC
Agribusiness Development Corp. *
Imua Energy, LLC
MSJR, LLC
Hilo Christian Broadcasting Corp.
David Jones
Clayton Uyehara
Lawrence Peck
Patrick Abate
Rex Reed
Clayton Watkins
James and Tracy Pa
Mark and Rachel Kitagawa
Wallace and Carolyn Oki*
Benjamin and Clareen Alonzo
Derrick and Ross Moreira
John and Cynthia Bartholomew
Kenneth and Noreen Silva
Raymond Kobayashi, Jr.
Gerald and Wendy Yamada
Lester and Derrick Mende
Russell and Donna Pacheco
Jieyu Zhu-Shepard
Howard and Napua De Lima
Leanna, March, and Tyler Arizumi
Michael Allend and James Nutter
Jeffrey Joseph and Theresa McCrary
Alex Krieg
Richard Cunningham and Michelle Jodoi
Gary and Nancy Capri *
Michael Fleming
Herman and Tracy Ludwig
Donavan and Kimberly Enanoria
John and Diane Kelly
Kenneth Antonio, Sr.
Louis and Joleen Nobriga

This page intentionally left blank.

7. List of Contributors

The following people identified in **Table 7-1** contributed to the preparation of this Draft EA.

Table 7-1. Contributors to the Environmental Assessment

COMPANY/ ORGANIZATION	PERSONNEL	ROLE	DOCUMENT
SSFM International, Inc.	Jennifer M. Scheffel	Primary Author	Environmental Assessment
	Susan LeBrun	Traffic Engineer	Traffic Impact Assessment Report
	Rethwick Gona	Traffic Engineer	
ASM Affiliates	Lokelani Brandt, M.A.	Principal Investigator	Cultural Impact Assessment
	Lauren Tam Sing	Associate Archaeologist	
	Robert B. Rechtman, Ph.D.	Project Director	
Cultural Surveys Hawai'i	Olivier M. Bautista, B.A.	Archaeologist	Archaeological Literature Review and Field Inspection
	McKenzie Wildey, B.A.	Archaeologist	
	Hallett H. Hammatt, Ph.D.	Project Director	
SWCA	Francis Quitazol	Biologist	Biological Resources Survey Report

This page intentionally left blank.

8. References

County of Hawai‘i Department of Environmental Management (DEM). 2009. *County of Hawai‘i Integrated Resources and Solid Waste Management Plan Update, The Path to Zero Waste.* December 2009. Available online at: http://records.co.hawaii.hi.us/weblink/1/doc/61944/Page1.aspx.

County of Hawai‘i Department of Parks and Recreation. 2011. *Pana‘ewa Rainforest Zoo & Gardens Brochure.* Available online at: http://records.co.hawaii.hi.us/WebLink/PDF/r1tqwep0afprl3yplnwszaio/21/Pana%60ewa%20Rainforest%20Zoo%20_%20Gardens%20Brochure.pdf.

County of Hawai‘i Planning Department. 2008. *Puna Community Development Plan.* September 2008. Amended December 2011. Available online at: http://www.hawaiicountycdp.info/puna-cdp/draft-plan-recommendations/1%20%20Puna%20CDP%20amended%20Nov-2011.pdf/view.

_____. 2015a. County of Hawai‘i LUPAG Map as of October 2015. Available online at: http://geoportal.hawaii.gov/datasets/hawaii-county-lupag.

_____. 2015b. Zoning (Hawai‘i County). Available online at: http://geoportal.hawaii.gov/datasets/zoning-hawaii-county.

Department of Health (DOH). 2014. Fugitive Dust Fact Sheet. Prepared by the DOH, Clean Air Branch. Revised October 2014. Available online at: http://health.hawaii.gov/cab/files/2015/09/Hawaii-Fugitive-Dust-Fact-Sheet-Oct-2014-.pdf.

_____. 2015. Federal and State Ambient Air Quality Standards. November 19, 2015. Available online at: http://health.hawaii.gov/cab/files/2013/05/naaqs_nov_2015.pdf.

_____. 2018. Underground Injection Control Program. Island of Hawai‘i Map. Prepared by Safe Drinking Water Branch. Available online at: http://health.hawaii.gov/sdwb/underground-injection-control-program/.

Federal Emergency Management Agency (FEMA). 2017. Digital Flood Insurance Rate Map (DFIRM). FEMA Special Flood Hazard Areas for Hawai‘i County. Available online at: http://geoportal.hawaii.gov/datasets/e3c4e3bfda4149ef8cc21399caf04d78_14?geometry=-160.08%2C18.677%2C-150.791%2C20.488.

Fukunaga & Associates. 2010. *Hawai‘i County Water Use and Development Plan Update.* Prepared for the County of Hawai‘i Department of Water Supply. August 2010. Available online at: http://files.hawaii.gov/dlnr/cwrm/planning/wudpha2012.pdf.

Hawai‘i Department of Transportation. 2015. *Historical Traffic Station Maps.*

National Park Service (NPS). 2009. *Hawai‘i Volcanoes National Park, Geologic Resources Inventory Report.* Natural Resource Report NPS/NRPC/GRD/NRR – 2009/163. Available online at: https://irma.nps.gov/DataStore/DownloadFile/425531.

State Land Use Commission. 2016. State Land Use Districts. Available online at: http://geoportal.hawaii.gov/datasets/state-land-use-districts?geometry=-166.787%2C18.763%2C-157.592%2C22.363.

State of Hawai'i Department of Defense. 2018. State Civil Defense Emergency Siren Locations. Map of Civil Defense Sirens. Provided by State of Hawai'i's Open Data Portal. Available online at: https://data.hawaii.gov/Public-Safety/Map-of-Civil-Defense-Sirens/rr54-pkun/data/.

Travis, T. 2018. Pre-Assessment Consultation for Draft Environmental Assessment. Letter to Jennifer M. Scheffel, April 9, 2018. Received April 16, 2018.

U.S. Census Bureau. 2010. Profile of General Demographic Characteristics: 2010. Census 2010 Summary File 1 (SF 1). 100-Percent Data. Available online at: https://factfinder.census.gov/.

_____. 2016. Selected Economic Characteristics. 2012-2016 American Community Survey 5-Year Estimates (DP 03). Available online at: https://factfinder.census.gov/.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). *Unknown.* Gridded SSURGO (gSSURGO) Database. Available online at: http://geoportal.hawaii.gov/datasets/soils-mu-state-of-hawaii.

U.S. Department of Agriculture, Soil Conservation Service (USDA-SCS). 1973. *Soil Survey of Island of Hawai'i, State of Hawai'i.* Available online at: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/hawaii/HI801/0/hawaii.pdf.

U.S. Environmental Protection Agency (USEPA). 2005. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas.* EPA-841-B-05-004. November 2005. Available online at: https://www.epa.gov/sites/production/files/2015-09/documents/urban_guidance_0.pdf.

U.S. Fish and Wildlife Service (USFWS). *Unknown.* National Wetlands Inventory. Available online at: http://geoportal.hawaii.gov/datasets/wetlands.

_____. 2018a. Information for Planning and Consultation (IPaC). Migratory Birds. Available online at: https://ecos.fws.gov/ipac/location/PGSFJ3BJIBGOFOPZJIRSONZ7T4/resources#migratory-birds.

_____. 2018b. Environmental Conservation Online System (ECOS). Available online at: https://ecos.fws.gov/ecp/.

U.S. Geological Survey (USGS). 1991. Volcano Lava Flow Hazard Zone Map – Hawai'i County. Available online at: http://geoportal.hawaii.gov/datasets/volcano-lava-flow-hazard-zones.

_____. 2007. Geological Units for the State of Hawai'i. Prepared by Hawai'i Statewide GIS Program. Available online at: http://geoportal.hawaii.gov/datasets/geological-units?geometry=-166.78%2C18.766%2C-157.585%2C22.366.

University of Hawai'i – Mānoa (UH-Mānoa). 2011. Rainfall Atlas of Hawai'i, Interactive Map. Available online at: http://rainfall.geography.hawaii.edu/interactivemap.html.

_____. 2014. Climate of Hawai'i, Interactive Map. Available online at: http://climate.geography.hawaii.edu/interactivemap.html.

Western Regional Climate Center (WRCC). 2018. Hilo WSO AP 87, Hawai‘i (511492). Period of Record Monthly Climate Summary, 10/01/1949 to 12/31/2005. Available online at: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?hihilo.

W.H. Shipman. 2012. Kea‘au Village Webpage. Available online at: http://www.whshipman.com/village-services-opportunities/kea%CA%BBau-village/.

This page intentionally left blank.

Appendix A

Pre-Assessment Consultation Letters and Responses

This page intentionally blank.

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Hawaiian Volcano Observatory
Post Office Box 51
Hawaii National Park, Hawai'i 96718-0051

IN REPLY REFER TO:

March 23, 2018

Jennifer M. Scheffel
Sr. Environmental Planner
SSFM International, Inc.
99 Aupuni St. Suite 202
Hilo, HI 96720

SSFM International, Inc.
RECEIVED
3.27.2018

Dear Jennifer:

I have received your letter of 20 March referring to the East Hawai'i Organics Facility EA process. Thank you for reaching out to HVO for comment.

The area in question is in lava hazard zone 3 which is defined as follows: "areas less hazardous than zone 2 because of greater distance from recently active vents and/or because of topography. One – five percent of zone 3 has been covered since 1800 CE, 15-75 percent has been covered in the last 750 years."

More information about lava flow hazards may be found here: https://pubs.usgs.gov/mf/1992/2193/

South Hilo is in a severe earthquake hazard zone, so any final design should account for potential shaking hazards as they would impact the stabilized feature.

Earthquake hazards are addressed in these USGS ground motion hazard maps:
https://earthquake.usgs.gov/hazards/hazmaps/hi/1998/maps.php

I refer you as well to the State of Hawai'i building codes for information about seismic design appropriate for Hawai'i.

I also encourage you to reach out to the USGS Water Science Center in Honolulu, to discuss groundwater issues that may be pertinent.

Stephen S. Anthony | Director
U.S. Geological Survey | Pacific Islands Water Science Center
Inouye Regional Center | 1845 Wasp Blvd., Bldg. 176 | Honolulu, HI 96818
O: 808.690.9602 | C: 808-285-6448 | F: 808-690-9599
santhony@usgs.gov | http://hi.water.usgs.gov

Best wishes for your planning and decision process. If you have additional questions, please don't hesitate to contact me.

Christina Neal
Scientist in Charge
USGS Hawaiian Volcano Observatory
808-967-8853

TAKE PRIDE IN AMERICA

SSFM International

May 14, 2018

SSFM 2017_174

Ms. Christina Neal, Scientist in Charge
U.S. Geological Survey
Hawai'i Volcano Observatory
PO Box 51
Hawai'i National Park, HI 96718-0051

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Ms. Neal,

Thank you for your letter dated March 23, 2018 on the subject project. We offer the following responses to your comments.

The Draft Environmental Assessment (EA) will address natural hazards, including lava zones and earthquakes. The facility will be designed in accordance with the 2006 International Building Code (IBC) as amended by the State of Hawaii Building Code. The 2006 IBC provides minimum design criteria to address the potential for damage due to seismic forces.

A pre-assessment consultation letter was sent to the U.S. Geological Survey Pacific Islands Water Science Center (WSC) on May 11, 2018. Any comments or information received from WSC will be considered during the preparation of the Draft EA and throughout project planning.

Your March 23rd letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

Harry Kim
Mayor

Paul K. Ferreira
Police Chief

Kenneth Bugado Jr.
Deputy Police Chief

County of Hawai`i

POLICE DEPARTMENT

349 Kapiolani Street • Hilo, Hawai`i 96720-3998
(808) 935-3311 • Fax (808) 961-8865

March 23, 2018

SSFM International, Inc.
RECEIVED
3·30·2018

SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, HI 96720

ATTENTION: JENNIFER SCHEFFEL

Subject: East Hawaii Organics Facility
Keaau, Puna District, Island of Hawaii
Tax Map Key: (3) 1-6-003:090 (por.)
Pre-Assessment Consultation for Draft Environmental Assessment

Staff, upon reviewing the provided documents, does not anticipate any significant impact to traffic and/or public safety.

Thank you for allowing us the opportunity to comment.

If you have any questions, please contact Captain Samuel Jelsma, Puna Patrol, at 965-2716.

M. Kanehailua

MITCHELL K. KANEHAILUA
ASSISTANT POLICE CHIEF
AREA I OPERATIONS

SJ/lli
180298

"Hawai`i County is an Equal Opportunity Provider and Employer"

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Mitchell K. Kanehailua
Assistant Police Chief, Area I Operations
County of Hawai'i Police Department
349 Kapiolani Street
Hilo, HI 96720

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Kanehailua,

Thank you for your letter dated March 23, 2018 on the subject project. We note that the County of Hawaii Police Department does not anticipate any significant impact to traffic and/or public safety.

Your March 23rd letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

HAWAI'I GAS
THE CLEAN ENERGY COMPANY

March 28, 2018

SSFM International, Inc.
RECEIVED
4-2-2018

Ms. Jennifer M. Scheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

Subject: East Hawai'i Organics Facility
Kea'au, Puna District, Island of Hawaii
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Pre-Assessment Consultation for Draft Environmental Assessment

In response to your letter dated March 20, 2018, it has been determined that the area is currently clear of utility gas facilities.

Should there be any questions, or if additional information is desired, please call Jeremy Santiago at 594-5552.

Sincerely,

Hawaii Gas

Keith K. Yamamoto
Manager, Engineering

KKY:krs

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Keith K. Yamamoto, Manager, Engineering
Hawai'i Gas
PO Box 3000
Honolulu, HI 96802-3000

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Yamamoto,

Thank you for your letter dated March 20, 2018 on the subject project. We note that Hawaii Gas has determined that the area is currently clear of utility gas facilities.

Your March 20th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

April 3, 2018

SSFM International, Inc.
Attn: Jennifer Scheffel
99 Aupuni Street, Suite 202
Hilo, Hi 96720

SSFM International, Inc.
RECEIVED
4.16.2018

Subject: Letter dated March 20, 2018
East Hawai'i Organics Facility
Kea'au Puna District, Island of Hawai'i
Tax Map Key (TMK)⑧3) 1-6-003:090 (por.)
Pre-Assessment Consultation for Draft Environmental Assessment

Dear Jennifer,

Thank you for the telephone conversation regarding the proposed East Hawai'i Organics Facility.

The proposed facility borders our property located on the corner of Mikahala Place and Kipimana Street. Our concerns are the impact not only to the Shipman Business Park overall but also to the direct impact to our property as an adjacent bordering property.

Therefore we would like further information as follows;

1) Count of all daily vehicles including, size/type/use of vehicle; employee, drop off vehicles and green trip vehicles, etc..
2) Day/hours of operation with expected high usage hours w/number of estimated vehicles with type/size of vehicles.
3) Traffic control at entrance to Shipman Business Park
4) Ingress and egress location(s) on/off of Kipimana Street
5) Description of treatment of water run off and waste water.
6) Description of buffers, size, etc. along adjacent properties
7) Noise control

Mahalo,
Gary & Nancye Capri
TMK: 3/1-6-148-21
73-5619 Kauhola Street
Kailua-Kona, Hi 96740

SSFM International

May 14, 2018

SSFM 2017_174

Gary and Nancye Capri
73-5619 Kauhola Street
Kailua-Kona, HI 96740

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. and Mrs. Capri,

Thank you for your letter dated April 3, 2018 on the subject project. We offer the following responses to your comments.

The Draft Environmental Assessment (EA) will assess impacts to transportation and traffic, water quality, and noise, as well as other environmental resources.

Traffic

A Traffic Impact Assessment Report (TIAR) is currently being prepared for the Proposed Action. The TIAR will estimate the project's daily trip generation, including the vehicle classification and peak hours, and will make recommendations for traffic control at the entrance to Shipman Business Park, if warranted.

Water Quality and Wastewater

The facility will be designed to comply with the latest County of Hawaii *Storm Drainage Standards and Standard Details for Public Works Construction.* To the extent practicable, the facility will be designed to maintain post-development peak runoff rate and average volume levels that are similar to pre-development levels. The facility will utilize several best management practices (BMP), including infiltration practices, vegetated and open channel practices, and filtering practices defined in the Environmental Protection Agency's (EPA) guidance document entitled *National Management Measures to Control Non-point Source Pollution from Urban Areas.* BMPs listed in the State of Hawaii Office of Planning's *Stormwater Impact Assessment* will also be implemented.

Wastewater treatment and disposal at the facility would be by a new, on-site septic tank and leach field. Prior to construction of the septic tank and leach field, an Individual Wastewater System permit would be obtained from the State of Hawaii Department of Health. The new wastewater system will comply with Title 11, Chapter 62, of the Hawaii Administrative Rules.

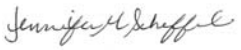
Buffers and Noise Control

The site is heavily vegetated, and the acreage not used for the facility would remain vegetated to provide a buffer around the facility. The conceptual layout of the facility within the 40 acre site will be included in the Draft EA.

Your April 3rd letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.



Jennifer M. Scheffel
Sr. Environmental Planner

From: Tatum, Alton L CTR (US)
To: Jennifer Scheffel
Cc: Gayagas, Susan A CIV (US)
Subject: POH-2018-00065 (Organics Composting Facility, Kea"au Puna District, Big Island, Hawaii TMK: (3) 1-6-003:090 (por.))
Date: Wednesday, April 4, 2018 5:00:30 PM

Aloha Jennifer,

Your project has been assigned Department of the Army File No. POH-2018-00065 and is currently assigned to Ms. Susan Gayagas (PROJECT MANAGER). You may contact her at (808) 835-4599 or via email at Susan.A.Gayagas@usace.army.mil.

If you have not received a response from the above project manager within 30 days, please contact our main office at (808) 835-4303 or via email at CEPOH-RO@usace.army.mil.

Mahalo,

ALTON L. TATUM
Administrative Assistant, Regulatory Office
USACE-Honolulu District Bldg 252
Fort Shafter, HI 96858-5440
Phone: (808)-835-4303
Fax: (808)-835-4126

http://www.poh.usace.army.mil/Missions/Regulatory/

SSFM International

May 14, 2018 SSFM 2017_174

Mr. Alton L. Tatum, Administrative Assistant
Regulatory Office
U.S. Army Corps of Engineers, Honolulu District
Building 252
Fort Shafter, HI 96858-5440

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Tatum,

Thank you for your email on April 4, 2018 on the subject project. We note that the proposed project has been assigned Army File No. POH-2018-00065 and has been assigned to Susan Gayagas, Project Manager. An email was sent to Ms. Gayagas on May 7, 2018 requesting comments on the proposed project.

Your April 4th email, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process and look forward to working with Ms. Gayagas. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

Harry Kim
Mayor

Darren J. Rosario
Fire Chief

Renwick J. Victorino
Deputy Fire Chief

County of Hawai'i
HAWAI'I FIRE DEPARTMENT
25 Aupuni Street ● Suite 2501 ● Hilo, Hawai'i 96720
(808) 932-2900 ● Fax (808) 932-2928

April 13, 2018

Jennifer M. Scheffel
Sr. Environmental Planner
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawai'i 96720

Dear Ms. Scheffel,

SUBJECT: East Hawai'i Organics Facility, Kea'au Puna District, Island of Hawai'i
Pre-Assessment Consultation for Draft Environmental Assessment
TMK: (3) 1-6-003:090 (por)

In regards to the above-referenced Pre-Assessment Consultation for Draft Environmental Assessment application, the following shall be in accordance:

NFPA 1, UNIFORM FIRE CODE, 2006 EDITION
Note: Hawai'i State Fire Code, National Fire Protection Association 2006 version, with County of Hawaii amendments. County amendments are identified with a preceding "C~" of the reference code.

Chapter 18 Fire Department Access and Water Supply

18.1 General. Fire department access and water supplies shall comply with this chapter.

For occupancies of an especially hazardous nature, or where special hazards exist in addition to the normal hazard of the occupancy, or where access for fire apparatus is unduly difficult, or areas where there is an inadequate fire flow, or inadequate fire hydrant spacing, and the AHJ may require additional safeguards including, but not limited to, additional fire appliance units, more than one type of appliance, or special systems suitable for the protection of the hazard involved.

18.1.1 Plans.

18.1.1.1 Fire Apparatus Access. Plans for fire apparatus access roads shall be submitted to the fire department for review and approval prior to construction.

18.1.1.2 Fire Hydrant Systems. Plans and specifications for fire hydrant systems shall be submitted to the fire department for review and approval prior to construction.

C~ 18.1.1.2.1 Fire Hydrant use and Restrictions. No unauthorized person shall use or operate any Fire hydrant unless such person first secures permission or a permit from the owner or representative of the department, or company that owns or governs that water supply or system. Exception: Fire Department personnel conducting firefighting operations, hydrant testing, and/or maintenance, and the flushing and acceptance of hydrants witnessed by Fire Prevention Bureau personnel.

18.2 Fire Department Access.

18.2.1 Fire department access and fire department access roads shall be provided and maintained in accordance with Section 18.2.

18.2.2* Access to Structures or Areas.

18.2.2.1 Access Box(es). The AHJ shall have the authority to require an access box(es) to be installed in an accessible location where access to or within a structure or area is difficult because of security.

18.2.2.2 Access to Gated Subdivisions or Developments. The AHJ shall have the authority to require fire department access be provided to gated subdivisions or developments through the use of an approved device or system.

18.2.2.3 Access Maintenance. The owner or occupant of a structure or area, with required fire department access as specified in 18.2.2.1 or 18.2.2.2, shall notify the AHJ when the access is modified in a manner that could prevent fire department access.

18.2.3 Fire Department Access Roads. (*may be referred as FDAR)

18.2.3.1 Required Access.

18.2.3.1.1 Approved fire department access roads shall be provided for every facility, building, or portion of a building hereafter constructed or relocated.

18.2.3.1.2 Fire Department access roads shall consist of roadways, fire lanes, parking lots lanes, or a combination thereof.

18.2.3.1.3* When not more than two one- and two-family dwellings or private garages, carports, sheds, agricultural buildings, and detached buildings or structures 400ft^2 (37 m^2) or less are present, the requirements of 18.2.3.1 through 18.2.3.2.1 shall be permitted to be modified by the AHJ.

18.2.3.1.4 When fire department access roads cannot be installed due to location on property, topography, waterways, nonnegotiable grades, or other similar conditions, the AHJ shall be authorized to require additional fire protection features.

18.2.3.2 Access to Building.

18.2.3.2.1 A fire department access road shall extend to within in 50 ft (15 m) of at least one exterior door that can be opened from the outside that provides access to the interior of the building. Exception: 1 and 2 single-family dwellings.

18.2.3.2.1.1 When buildings are protected throughout with an approved automatic sprinkler system that is installed in accordance with NFPA 13, NFPA 13D, or NFPA 13R, the distance in 18.2.3.2.1 shall be permitted to be increased to 300 feet.

18.2.3.2.2 Fire department access roads shall be provided such that any portion of the facility or any portion of an exterior wall of the first story of the building is located not more than 150 ft (46 m) from fire department access roads as measured by an approved route around the exterior of the building or facility.

18.2.3.2.2.1 When buildings are protected throughout with an approved automatic sprinkler system that is installed in accordance with NFPA 13, NFPA 13D, or NFPA 13R, the distance in 18.2.3.2.2 shall be permitted to be increased to 450 ft (137 m).

18.2.3.3 Multiple Access Roads. More than one fire department access road shall be provided when it is determined by the AHJ that access by a single road could be impaired by vehicle congestion, condition of terrain, climatic conditions, or other factors that could limit access.

18.2.3.4 Specifications.

18.2.3.4.1 Dimensions.

C~ 18.2.3.4.1.1 FDAR shall have an unobstructed width of not less than 20ft with an approved turn around area if the FDAR exceeds 150 feet. **Exception:** FDAR for one and two family dwellings shall have an unobstructed width of not less than 15 feet, with an area of not less than 20 feet wide within 150 feet of the structure being protected. An approved turn around area shall be provided if the FDAR exceeds 250 feet.

C~ 18.2.3.4.1.2 FDAR shall have an unobstructed vertical clearance of not less then 13ft 6 in.

C~ 18.2.3.4.1.2.1 Vertical clearances may be increased or reduced by the AHJ, provided such increase or reduction does not impair access by the fire apparatus, and approved signs are installed and maintained indicating such approved changes.

18.2.3.4.1.2.2 Vertical clearances shall be increased when vertical clearances or widths are not adequate to accommodate fire apparatus.

C~ 18.2.3.4.2 Surface. Fire department access roads and bridges shall be designed and maintained to support the imposed loads (25 Tons) of the fire apparatus. Such FDAR and shall be comprised of an all-weather driving surface.

18.2.3.4.3 Turning Radius.

C~ 18.2.3.4.3.1 Fire department access roads shall have a minimum inside turning radius of 30 feet, and a minimum outside turning radius of 60 feet.

18.2.3.4.3.2 Turns in fire department access road shall maintain the minimum road width.

18.2.3.4.4 Dead Ends. Dead-end fire department access roads in excess of 150 ft (46 m) in length shall be provided with approved provisions for the fire apparatus to turn around.

18.2.3.4.5 Bridges.

18.2.3.4.5.1 When a bridge is required to be used as part of a fire department access road, it shall be constructed and maintained in accordance with county requirements.

18.2.3.4.5.2 The bridge shall be designed for a live load sufficient to carry the imposed loads of fire apparatus.

18.2.3.4.5.3 Vehicle load limits shall be posted at both entrances to bridges where required by the AHJ.

18.2.3.4.6 Grade.

C~ 18.2.3.4.6.1 The maximum gradient of a Fire department access road shall not exceed 12 percent for unpaved surfaces and 15 percent for paved surfaces. In areas of the FDAR where a Fire apparatus would connect to a Fire hydrant or Fire Department Connection, the maximum gradient of such area(s) shall not exceed 10 percent.

18.2.3.4.6.2* The angle of approach and departure for any means of fire department access road shall not exceed 1 ft drop in 20 ft (0.3 m drop in 6 m) or the design limitations of the fire apparatus of the fire department, and shall be subject to approval by the AHJ.

18.2.3.4.6.3 Fire department access roads connecting to roadways shall be provided with curb cuts extending at least 2 ft (0.61 m) beyond each edge of the fire lane.

18.2.3.4.7 Traffic Calming Devices. The design and use of traffic calming devices shall be approved the AHJ.

18.2.3.5 Marking of Fire Apparatus Access Road.

18.2.3.5.1 Where required by the AHJ, approved signs or other approved notices shall be provided and maintained to identify fire department access roads or to prohibit the obstruction thereof of both.

18.2.3.5.2 A marked fire apparatus access road shall also be known as a fire lane.

18.2.4* Obstruction and Control of Fire Department Access Road.

18.2.4.1 General.

18.2.4.1.1 The required width of a fire department access road shall not be obstructed in any manner, including by the parking of vehicles.

18.2.4.1.2 Minimum required widths and clearances established under 18.2.3.4 shall be maintained at all times.

18.2.4.1.3* Facilities and structures shall be maintained in a manner that does not impair or impede accessibility for fire department operations.

18.2.4.1.4 Entrances to fire departments access roads that have been closed with gates and barriers in accordance with 18.2.4.2.1 shall not be obstructed by parked vehicles.

18.2.4.2 Closure of Accessways.

18.2.4.2.1 The AHJ shall be authorized to require the installation and maintenance of gates or other approved barricades across roads, trails, or other accessways not including public streets, alleys, or highways.

18.2.4.2.2 Where required, gates and barricades shall be secured in an approved manner.

18.2.4.2.3 Roads, trails, and other access ways that have been closed and obstructed in the manner prescribed by 18.2.4.2.1 shall not be trespassed upon or used unless authorized by the owner and the AHJ.

18.2.4.2.4 Public officers acting within their scope of duty shall be permitted to access restricted property identified in 18.2.4.2.1.

18.2.4.2.5 Locks, gates, doors, barricades, chains, enclosures, signs, tags, or seals that have been installed by the fire department or by its order or under its control shall not be removed, unlocked, destroyed, tampered with, or otherwise vandalized in any manner.

18.3 Water Supplies and Fire Hydrants

18.3.1* A water supply approved by the county, capable of supplying the required fire flow for fire protection shall be provided to all premises upon which facilities or buildings, or portions thereof, are hereafter constructed, or moved into or within the county. When any portion of the facility or building is in excess of 150 feet (45 720 mm) from a water supply on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains capable of supplying the required fire flow shall be provided when required by the AHJ. For on-site fire hydrant requirements see section 18.3.3.

EXCEPTIONS:

1. When facilities or buildings, or portions thereof, are completely protected with an approved automatic fire sprinkler system the provisions of section 18.3.1 may be modified by the AHJ.
2. When water supply requirements cannot be installed due to topography or other conditions, the AHJ may require additional fire protection as specified in section 18.3.2 as amended in the code.
3. When there are not more than two dwellings, or two private garage, carports, sheds and agricultural. Occupancies, the requirements of section 18.3.1 may be modified by AHJ.

18.3.2* Where no adequate or reliable water distribution system exists, approved reservoirs, pressure tanks, elevated tanks, fire department tanker shuttles, or other approved systems capable of providing the required fire flow shall be permitted.

18.3.3* The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be provided on a fire apparatus access road on the site of the premises or both, in accordance with the appropriate county water requirements.

18.3.4 Fire Hydrants and connections to other approved water supplies shall be accessible to the fire department.

18.3.5 Private water supply systems shall be tested and maintained in accordance with NFPA 25 or county requirements as determined by the AHJ.

18.3.6 Where required by the AHJ, fire hydrants subject to vehicular damage shall be protected unless located within a public right of way.

18.3.7 The AHJ shall be notified whenever any fire hydrant is placed out of service or returned to service. Owners of private property required to have hydrants shall maintain hydrant records of approval, testing, and maintenance, in accordance with the respective county water requirements. Records shall be made available for review by the AHJ upon request.

C~ 18.3.8 Minimum water supply for buildings that do not meet the minimum County water standards:

Buildings up to 2000 square feet, shall have a minimum of 3,000 gallons of water available for Firefighting.

Buildings 2001- 3000 square feet, shall have a minimum of 6,000 gallons of water available for Firefighting.

Buildings, 3001- 6000 square feet, shall have a minimum of 12,000 gallons of water available for Firefighting.

Buildings, greater than 6000 square feet, shall meet the minimum County water and fire flow requirements.

Multiple story buildings shall multiply the square feet by the amount of stories when determining the minimum water supply.

Commercial buildings requiring a minimum fire flow of 2000gpm per the Department of Water standards shall double the minimum water supply reserved for firefighting.

Fire Department Connections (FDC) to alternative water supplies shall comply with 18.3.8 (1)-(6) of *this code.*

NOTE: In that water catchment systems are being used as a means of water supply for firefighting, such systems shall meet the following requirements:

1) In that a single water tank is used for both domestic and firefighting water, the water for domestic use shall not be capable of being drawn from the water reserved for firefighting;

2) Minimum pipe diameter sizes from the water supply to the Fire Department Connection (FDC) shall be as follows:
   a) 4” for C900 PVC pipe;
   b) 4” for C906 PE pipe;
   c) 3” for ductile Iron;
   d) 3’ for galvanized steel.

3) The Fire Department Connection (FDC) shall:
   a) be made of galvanized steel;
   b) have a gated valve with 2-1/2 inch, National Standard Thread male fitting and cap;
   c) be located between 8 ft and 16 ft from the Fire department access. The location shall be approved by the AHJ;
   d) not be located less than 24 inches, and no higher than 36 inches from finish grade, as measured from the center of the FDC orifice;
   e) be secure and capable of withstanding drafting operations. Engineered stamped plans may be required;
   f) not be located more than 150 feet of the most remote part, but not less than 20 feet, of the structure being protected;
   g) also comply with section 13.1.3 and 18.2.3.4.6.1 of *this code.*

4) Commercial buildings requiring a fire flow of 2000gpm shall be provided with a second FDC. Each FDC shall be independent of each other, with each FDC being capable of flowing 500gpm by engineered design standards. The second FDC shall be located in an area approved by the AHJ with the idea of multiple Fire apparatus’conducting drafting operations at once, in mind.

5) Inspection and maintenance shall be in accordance to NFPA 25.

6) The owner or lessee of the property shall be responsible for maintaining the water level, quality, and appurtenances of the system.

EXCEPTIONS TO SECTION 18.3.8:

1) Agricultural buildings, storage sheds, and shade houses with no combustible or equipment storage.

2) Buildings less than 800 square feet in size that meets the minimum Fire Department Access Road requirements.

3) For one and two family dwellings, agricultural buildings, storage sheds, and detached garages 800 to 2000 square feet in size, and meets the minimum Fire Department Access Road requirements, the distance to the Fire Department Connection may be increased to 1000 feet.

4) For one and two family dwellings, agricultural buildings, and storage sheds greater than 2000square feet, but less than 3000 square feet and meets the minimum Fire Department Access Road requirements, the distance to the Fire Department Connection may be increased to 500 feet.

5) For buildings with an approved automatic sprinkler system, the minimum water supply required may be modified.

If there are any questions regarding these requirements, please contact the Fire Prevention Bureau at (808) 932-2911.

DARREN J. ROSARIO
Fire Chief

RP:ds

SSFM International

May 14, 2018 SSFM 2017_174

Mr. Darren J. Rosario, Fire Chief
County of Hawai‘i Fire Department
25 Aupuni Street, Suite 2501
Hilo, HI 96720

SUBJECT: **East Hawai‘i Organics Facility**
Kea‘au, Puna District, Island of Hawai‘i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Rosario,

Thank you for your letter dated April 13, 2018 on the subject project. We offer the following response to your comments.

The proposed facility will be designed, constructed, and operated in accordance with the Hawai‘i State Fire Code, National Fire Protection Association 2006 version, with County of Hawai‘i amendments.

Your April 13th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

April 12, 2018

SSFM International, Inc.
RECEIVED
4.16.2018

Ms. Jennifer Scheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, HI 96720

Dear Ms. Scheffel:

Subject: Pre-Environmental Assessment for the East Hawai'i Organics Facility
Kea'au, Puna District, Island of Hawai'i
Tax Map Key 1-6-003:090 portion

This is in response to your Pre-Environmental Assessment letter dated March 20, 2018.

Please be informed that there is an existing service lateral on Kipimana Street, installed for the subject parcel capable of accommodating a 1-inch meter, which is limited to an average usage of 800 gallons per day or two (2) equivalent units of water. There is an existing 16-inch waterline along Kipimana Street.

The Department would request estimated maximum daily water usage calculations prepared by a professional engineer licensed in the State of Hawai'i for review. After review of the calculations, the Department will determine if the existing service can accommodate the proposed demand.

Due to the demand and usage within W.H. Shipman Business Park, the Department cannot provide additional water beyond the two (2) units of water for the proposed project at this time. Extensive improvements and additions, including, but not limited to, source, storage, transmission, booster pumps, and distribution facilities, may be required. It should also be noted that a portion of the subject parcel is not within the Department's 524-foot pressure zone.

Please also be informed that any meter(s) serving the proposed project will require the installation of a reduced principle type backflow prevention assembly within five feet of the meter on private property. The Department must inspect and approve the installation prior to commencement of water service.

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Keith K. Okamoto, P.E.
Manager-Chief Engineer

RQ:dfg

. . . Water, Our Most Precious Resource . . . Ka Wai A Kāne . . .

The Department of Water Supply is an Equal Opportunity provider and employer.

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Keith K. Okamoto, P.E., Manager-Chief Engineer
County of Hawai'i Department of Water Supply
345 Kekūanaō'a Street, Suite 20
Hilo, HI 96720

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Okamoto,

Thank you for your letter dated April 12, 2018 on the subject project. We offer the following responses to your comments.

The County of Hawaii Department of Environmental Management (DEM) will provide an estimated maximum daily water usage calculation prepared by a professional engineer licensed in the State of Hawaii to the County of Hawaii Department of Water Supply (DWS) for review and determination if a water commitment can be made. DEM will continue to consult and coordinate with the DWS as the project moves forward.

Your April 12th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

DAVID Y. IGE
GOVERNOR

MAJOR GENERAL ARTHUR J. LOGAN
DIRECTOR OF EMERGENCY MANAGEMENT

THOMAS L. TRAVIS
ADMINISTRATOR OF EMERGENCY MANAGEMENT

PHONE (808) 733-4300
FAX (808) 733-4287

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF EMERGENCY MANAGEMENT / CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

April 9, 2018

SSFM International, Inc.
RECEIVED
4.16.2018

Ms. Jennifer Scheffel
SSFM International
99 Aupuni Street, Suite 202
Hilo, Hawaii 96820

Dear Ms. Scheffel:

East Hawaii Organics Facility
Pre-Assessment Consultation for Draft Environmental Assessment

Thank you for the opportunity to comment on this proposed project.

After reading the documents provided for the project, we have determined that there is insufficient siren coverage for the project area. Therefore, we request that one 121 db(c) omni-directional siren be installed on the property. We will work with the developer to determine the best location for the siren site.

If you have any questions please call Ms. Havinne Okamura, Hazard Mitigation Planner, at (808) 733-4300, extension 556.

Sincerely,

Thomas L. Travis

THOMAS L. TRAVIS
Administrator of Emergency Management

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Thomas L. Travis
Administrator of Emergency Management
State of Hawai'i Department of Defense
Office of the Director of Emergency Management/Civil Defense
3949 Diamond Head Road
Honolulu, HI 96816-4495

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Travis,

Thank you for your letter dated April 9, 2018 on the subject project. We offer the following responses to your comments. The County of Hawaii Department of Environmental Management consult and coordinate with State Civil Defense Agency as the project moves forward.

Your April 9th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 916
HILO, HAWAII 96721-0916

April 6, 2018

SSFM International, Inc.
RECEIVED
RECEIVED
4·16·2018

Jennifer M. Scheffel
Sr. Environmental Planner
SSFM Internationl, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

SUBJECT: East Hawaii Organics Facility Pre Assessment Consultation

Dear Ms. Scheffel,

Thank you for allowing the Department of Health (DOH) the opportunity to provide comments for the proposed project. At this time, based on the limited information provided it seems that environmental impacts such as odor and pests should be addressed by an in-vessel composting operation.

I recommend consulting with the DOH Solid and Hazardous Waste Branch for all composting operations (808-586-4226), DOH Safe Drinking Water Branch for dry wells and injection wells (808-586-4258), and DOH Clean Water Branch for NPDES requirements (808586-4309).

Sincerely,

Eric Honda
Hawaii District Health Office
District Environmental Health Program Chief
808-933-0913
Eric.honda@doh.hawaii.gov

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Eric Honda, Environmental Health Program Chief
State of Hawai'i Department of Health
Hawai'i District Health Office
PO Box 916
Hilo, HI 96721-0916

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Honda,

Thank you for your letter dated April 6, 2018 on the subject project. We offer the following responses to your comments. We offer the following responses to your comments.

Active composting will be performed within an in-vessel (covered) positive aeration system. A GORETM Cover System, which is an EPA-approved in-vessel composting system, will be used. This system utilizes heap composting with forced aeration coupled with a semi-permeable membrane cover. The cover membrane has a pore structure sized to selectively influence the composting process. The system allows carbon dioxide to pass through the membrane, but prevents odor from escaping. The GORETM Cover System is a barrier against dust, bacteria, and odor.

The State of Hawai'i Department of Health (DOH), Clean Water Branch was sent a pre-assessment consultation letter on March 20, 2018. Letters to the Solid and Hazardous Waste Branch and Safe Drinking Water Branch were sent on May 11, 2018. As of the date of this response, no comments have been received from any of the aforementioned agencies.

Your April 6th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

Harry Kim
Mayor

Diane L. Ley
Director

Ron Whitmore
Deputy Director

County of Hawai'i

DEPARTMENT OF RESEARCH AND DEVELOPMENT

25 Aupuni Street, Room 1301 • Hilo, Hawai'i 96720-4252
(808) 961-8366 • Fax (808) 935-1205
E-mail: chresdev@hawaiicounty.gov

April 19, 2018

SSFM International, Inc.
Attn: Jennifer Scheffel
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

We are writing in response to your March 20, 2018 notice of pre-consultation for the Draft Environmental Assessment regarding the East Hawaii Organics Facility. Thank you for the opportunity to comment.

At this time, the proposed East Hawaii Organics Facility's proposed location is not expected to impact any agricultural plans, policies, or future programs in the area.

We would ask that you carefully consider, however, the impacts on two significant agricultural businesses adjacent to the proposed composting site, Green Point Nursery and Island Princess Macadamia Orchards. Green Point Nursery may be concerned about the need for buffers and odor abatement. Both sites would likely be concerned about the possible spread of Little Fire Ants into their sites and the potential impact on their employees.

Please also consider establishing well managed biosecurity systems throughout collection sites, intermediary sites (i.e., West Hawaii landfill), and to final product distribution sites in order to mitigate movement of pests, viruses, weeds, or invasive plants.

In addition, we would recommend consultation with the Hawaii Invasive Species Council (HISC), the Big Island Invasive Species Committee (BIISC), the Little Fire Ant HUI, the State of Hawaii Department of Agriculture, and the University of Hawaii College of Tropical Agriculture and Human Resources (CTAHR).

Again, thank you for the opportunity to comment. Please notify us when the Draft Environmental Assessment is available for review. In the interim, please contact Deputy Director Ron Whitmore if you have any questions.

Sincerely,

Diane L. Ley
Director

JD:nc

Hawai`i County is an Equal Opportunity Provider and Employer

SSFM International

May 14, 2018

SSFM 2017_174

Ms. Diane L. Ley, Director
County of Hawai'i Department of Research and Development
25 Aupuni Street, Room 1301
Hilo, HI 96720-4252

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Ms. Ley,

Thank you for your letter dated April 19, 2018 on the subject project. We offer the following responses to your comments. We offer the following responses to your comments.

We note that the County of Hawaii Department of Research and Development (R&D) does not anticipate impacts to any agricultural plans, policies, or future programs in the area from the proposed project. DEM will consult and coordinate with R&D regarding biosecurity as the project moves forward.

A pre-assessment consultation letter was sent to the State of Hawaii Department of Agriculture on March 20, 2018. Pre-assessment consultation letters were sent to the following on May 11, 2018 to solicit comments on the proposed project:

- Green Point Nursery
- Island Princess Macadamia Orchards
- Hawaii Invasive Species Council
- Big Island Invasive Species Committee
- Little Fire Ant HUI
- University of Hawaii College of Tropical Agriculture and Human Resources

As of the date of this response, no comments from these organizations/agency have been received. Your April 19th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

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

April 20, 2018

SSFM International, Inc.
Attn: Ms. Jennifer M. Scheffel
Sr. Environmental Planner
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

via email: jscheffel@ssfm.com

Dear Ms. Scheffel:

SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed **East Hawaii Organics Facility** located at Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090

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; (b) Division of Forestry & Wildlife; (c) Commission on Water Resource Management; and (d) Land Division – Hawaii District on the subject matter. Should you have any questions, please feel free to call Darlene Nakamura at (808) 587-0417. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosures
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

RECEIVED
2018 APR 17 AM 10:44
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
2018 APR 17 PM 1:08 ENGINEERING
LAND DIVISION

March 27, 2018

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 – Hawaii District
X Historic Preservation

FROM: To
Russell Y. Tsuji, Land Administrator
SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed **East Hawaii Organics Facility**
LOCATION: Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090
APPLICANT: SSFM International on behalf of County of Hawaii, Department of Environmental Management, Solid Waste Division

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 18, 2018.**

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 Darlene Nakamura at 587-0417. Thank you.

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

Signed: _____
Print Name: Carty S. Chang, Chief Engineer
Date: 4/13/18

Attachments
cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed East Hawaii Organics Facility, Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090

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). State projects are required to comply with 44CFR regulations as stipulated in Section 60.12. 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: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 4/13/18

18170

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

March 27, 2018

RECEIVED
LAND DIVISION
2018 APR -6 AM 10:49
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

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 – Hawaii District
X Historic Preservation

FROM: TO:
Russell Y. Tsuji, Land Administrator
SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed **East Hawaii Organics Facility**
LOCATION: Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090
APPLICANT: SSFM International on behalf of County of Hawaii, Department of Environmental Management, Solid Waste Division

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 18, 2018.**

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 Darlene Nakamura at 587-0417. Thank you.

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

Signed: _____

Print Name: **DAVID G. SMITH, Administrator**

Date: 4/5/18

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

ROBERT K. MASUDA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

APR 05 2018

MEMORANDUM

TO: Russel Y. Tsuji, Administrator
Land Division

FROM: David G. Smith, Administrator dgs

SUBJECT: **Comments on Pre-Assessment Consultation for Draft Environmental Assessment for the proposed East Hawaii Organics Facility**

DOFAW appreciates the opportunity to comment on the pre-assessment consultation for the East Hawaii Organics Facility proposed by the County of Hawaii. Because the proposed facility is in an area heavily infested with the pathogens causing Rapid Ohia Death and little fire ant, DOFAW suggests that the following issues be considered in the Environmental Assessment:

- The pathogens causing Rapid Ohia Death are a sanitation concern. Although the composting process should kill the pathogens, care will need to be taken to ensure all processed material reaches temperatures high enough to kill the pathogen so that mulch distributed to the public is not a source for disease spread.
- While the pre-assessment memo states that mulch will be treated for little fire ant prior to being made available to the public, consideration should be given to longer term solutions to fire ant control across the property in question. Namely, periodic testing for the presence of little fire ant and the treatment of the entire property with an ant bait containing a growth regulator (e.g., Tango) would be a valuable addition to treating any outgoing mulch. Care will need to be taken to ensure that treatment of outgoing mulch is sufficient to ensure the absence of little fire ants.
- Due to the presence of both little fire ant and Rapid Ohia Death in the area for the proposed project, DOFAW recommends requiring that any mulch released to the public be used on Hawaii Island only, and not shipped interisland.

Thank you for the opportunity to comment.

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
LAND DIVISION
2018 APR 11 AM 10:38
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII
2018 MAR 27 PM 2:41

March 27, 2018

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 – Hawaii District
X Historic Preservation

FR:

TO:

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed **East Hawaii Organics Facility**
LOCATION: Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090
APPLICANT: SSFM International on behalf of County of Hawaii, Department of Environmental Management, Solid Waste Division

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 18, 2018.**

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 Darlene Nakamura at 587-0417. Thank you.

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

Signed: /s/ W. Roy Hardy

Print Name: Acting Deputy Director

Date: _____

Attachments
cc: Central Files

FILE ID: RFD. 4813.8
DOC ID: 19750J

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
KAMANA BEAMER, PH.D.
MICHAEL G. BUCK
NEIL J. HANNAHS
PAUL J. MEYER
VIRGINIA PRESSLER, M.D.

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR

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

April 9, 2018

REF: RFD.4813.8

TO: Mr. Russell Tsuji, Administrator
Land Division

FROM: W. Roy Hardy, Acting Deputy Director
Commission on Water Resource Management

SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the Proposed East Hawaii Organics Facility

FILE NO.: RFD.4813.8
TMK NO.: (3) 1-6-003: por. 090

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.

- ☐ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.
- ☐ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.
- ☐ 3. 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.
- ☐ 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.
- ☐ 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/
- ☐ 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.

- ☒ OTHER: The DEA should discuss the projected water demands for the project, both potable and non-potable, and provide the calculations used to estimate demands. The DEA should identify the proposed water source(s) to support the project. Water conservation and efficiency measures to be implemented should also be discussed.

If you have any questions, please contact Lenore Ohye of the Commission staff at 587-0216.



Doc Reviews (4) RFD.4813.8, RFD.4814.0, RFD.4816.3, RFD.4818.8

Adobe Sign Document History 04/10/2018

Created:	04/09/2018
By:	Kathy Yoda (kathy.s.yoda@hawaii.gov)
Status:	Signed
Transaction ID:	CBJCHBCAABAAamKwXL9eVNTLUq3u2BY0CskCMTI9GPNs

"Doc Reviews (4) RFD.4813.8, RFD.4814.0, RFD.4816.3, RFD. 4818.8" History

Document created by Kathy Yoda (kathy.s.yoda@hawaii.gov)
04/09/2018 - 1:39:09 PM HST- IP address: 132.160.239.30

Document emailed to Roy Hardy (roy.hardy@hawaii.gov) for signature
04/09/2018 - 1:43:36 PM HST

Document viewed by Roy Hardy (roy.hardy@hawaii.gov)
04/10/2018 - 11:13:58 AM HST- IP address: 132.160.239.30

Document e-signed by Roy Hardy (roy.hardy@hawaii.gov)
Signature Date: 04/10/2018 - 11:15:05 AM HST - Time Source: server- IP address: 132.160.239.30

Signed document emailed to all eligible parties.
04/10/2018 - 11:15:05 AM HST

ETS
STATE OF HAWAI'I

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

2018 MAR 29 P 12:08
RECEIVED
LAND DIVISION
HILO, HAWAII

March 27, 2018

MEMORANDUM

RECEIVED
LAND DIVISION
2018 APR 16 AM 10:52
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

FROM:
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 – Hawaii District
X Historic Preservation

TO:
FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment for the proposed **East Hawaii Organics Facility**
LOCATION: Kea'au, Puna, Island of Hawaii; TMK: (3) 1-6-003: por. 090
APPLICANT: SSFM International on behalf of County of Hawaii, Department of Environmental Management, Solid Waste Division

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 18, 2018.**

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 Darlene Nakamura at 587-0417. Thank you.

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

Signed: [signature]

Print Name: GORDON C. HEIT

Date: 4/12/18

Attachments
cc: Central Files

SSFM International

May 14, 2018 SSFM 2017_174

Mr. Russell Y. Tsuji, Land Administrator
State of Hawai‘i Department of Land and Natural Resources
Land Division
PO Box 621
Honolulu, HI 96809

SUBJECT: **East Hawai‘i Organics Facility**
Kea‘au, Puna District, Island of Hawai‘i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Tsuji,

Thank you for your letter dated April 20, 2018 on the subject project. We appreciate the Department of Land and Natural Resources (DLNR) Land Division distributing the pre-assessment consultation letter to other DLNR Divisions for review and comments. We note that the Land Division – Hawai‘i District has no comments. We provide the following responses to comments from the Engineering Division, Division of Forestry and Wildlife (DOFAW), and Commission on Water Resource Management (CWRM).

Engineering Division
The project site is located in Zone X and is therefore not considered a Special Flood Hazard Area (high risk area).

DOFAW
DEM will consult and coordinate with DOFAW regarding best management practices to minimize the spread of Rapid Ohia Death and little fire ant as the project progresses.

CWRM
The County of Hawai‘i Department of Environmental Management (DEM) will provide an estimated maximum daily water usage calculation prepared by a professional engineer licensed in the State of Hawai‘i to the County of Hawai‘i Department of Water Supply (DWS) for review and determination if a water commitment can be made. DEM will consult and coordinate with the DWS as the project moves forward.

Your April 20th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

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/

DTS 201804161041BE

April 16, 2018

Ms. Jennifer Scheffel
Project Manager
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

Subject: Pre-Assessment Consultation for Draft Environmental Assessment, East Hawaii Organics Facility, Keaau, Puna, Hawaii;
TMK: (3) 1-6-003: 090 (por.)

Thank you for the opportunity to provide pre-consultation comments on the Draft Environmental Assessment (Draft EA) for the East Hawaii Organics Facility in Keaau, Puna Hawaii. The review material was transmitted to our office via letter dated March 22, 2018.

The County of Hawaii Department of Environmental Management Solid Waste Division is proposing an organic composting facility on approximately 40 acres of land near Keaau, Puna. The site is adjacent to the W.H. Shipman Business Park utilizing the existing access off Kipimana Street.

The project proposes to accept green waste including food, paper and compostable plastics from the landfill stream to generate compost and mulch. After sufficient treatment to limit odors, pests and dust, a portion of the mulch will be made available to the public.

The Office of Planning (OP) has reviewed the transmitted material and has the following comments to offer:

1. Agricultural District Uses. As the project site is located on a parcel with both the State Agricultural and Urban Districts, the Draft EA should clarify project extents and proposed uses relative to the district boundaries. Should portions of the project lie within the Agricultural District, the Draft EA should assess the proposed uses in terms of their consistency with the permissible uses in the Agricultural District pursuant to Hawaii Revised Statutes (HRS) § 205-2(d) and § 205-4.5.

2. Hawaii State Planning Act. Pursuant to Hawaii Administrative Rules (HAR) § 11-200-10(4) – general description of the action's technical, economic, social, and environmental characteristics, this project must demonstrate that it is consistent with a number of state environmental, social, economic goals, and policies. Hawaii Revised Statutes (HRS)

Chapter 226, the Hawaii State Planning Act, provides goals, objectives, policies, planning coordination and implementation, and priority guidelines for growth, development, and allocation of resources throughout the State.

The compost operation and diversion of green waste from county landfills is consistent with HRS § 226-108 -- the priority guideline on sustainability. The Draft EA should include a discussion on the project and its compatibility with the principles of sustainability.

The Draft EA should include a discussion on the project's ability to meet all parts of HRS Chapter 226. The analysis should examine consistency with these statutes or clarify where it is in conflict with them. If any of these statutes are not applicable to the project, the analysis should affirmatively state such determination, followed by discussion paragraphs.

3. Hawaii Coastal Zone Management Program, Objectives and Policies. The coastal zone management (CZM) 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" (HRS § 205A-1).

   HRS Chapter 205A-5(b) requires all state and county agencies to enforce the CZM objectives and policies. The Draft EA should include an assessment as to how the proposed action conforms to each of the goals and objectives as listed in HRS § 205A-2. Compliance with HRS § 205A-2 is an important component for satisfying the requirements of HRS Chapter 343.

4. Stormwater Runoff, Erosion Controls, and Water Resources. Pursuant to HAR § 11-200-10(6) – identification and summary of impacts and alternatives considered; in order to ensure that the surface water and marine resources near the Puna area and throughout the Hawaii County remain protected, the negative effects of stormwater inundation, potentially caused by the proposed development activities, should be evaluated in the Draft EA.

   Issues that may be examined include, but are not limited to, project site characteristics in relation to flood and erosion prone areas, open spaces, the potential vulnerability of surface water resources, drainage infrastructure currently in place, soil absorption characteristics of the area, and examining the amount of permeable versus impervious surfaces. These items should be considered when developing mitigation measures for the protection for surface water resources and the coastal ecosystem, pursuant to HAR § 11-200-10(7).

OP has developed a number of resources and recommends consulting these guidance documents and stormwater evaluative tools when developing strategies to address polluted runoff. They offer useful techniques to keep land-based pollutants and sediment in place and prevent nearshore water contamination while considering the best management practices (BMP) suited for the project and the types of contaminants affecting the project area.

Although a portion of the project site is within the agricultural district, landfill operations are consistent with urban uses. According to the review material, the project's drainage plan will incorporate dry wells which are consistent with low impact development (LID). The Draft EA should include an examination on the use of LID design features incorporated for this project. The evaluative tools developed by OP that may assist in the creation of stormwater mitigation strategies include:

- Hawaii Watershed Guidance provides direction on mitigation strategies for urban development activities that will safeguard 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 analyze information on hydrology, sensitivity of coastal 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 BMPs for stormwater control management, onsite infiltration techniques, water reuse methods, and building layout designs that minimize negative environmental impacts. http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid_guide_2006.pdf

If you have any questions regarding this comment letter, please contact Joshua Hekekia at (808) 587-2845 or Tomas J Oberding at (808) 587-6024 of our office.

Sincerely,

Leo R. Asuncion
Director

c: Claire Oshiro, Environmental Planner, The Limtiaco Consulting Group

SSFM International

May 14, 2018 SSFM 2017_174

Mr. Leo R. Asuncion, Director
State of Hawai'i Office of Planning
PO Box 2359
Honolulu, HI 96804

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Asuncion,

Thank you for your letter dated April 16, 2018 (Letter No. DTS 201804161041BE) on the subject project. We offer the following responses to your comments.

1. The project site is located within a 40 acre section of TMK (3) 1-6-003:090 that is located entirely within the Urban District.
2. The Draft Environmental Assessment (EA) will include a chapter on the project's consistency with state and county land use plans, policies, and ordinances. This chapter will include an assessment of the proposed project's ability to meet all parts of Hawaii Revised Statutes (HRS) Chapter 226 (Hawaii State Plan).
3. The Draft EA will include an assessment as to how the proposed project conforms to each of the goals and objectives of HRS Chapter 205A (Coastal Zone Management).
4. The facility will be designed to comply with the latest County of Hawaii *Storm Drainage Standards and Standard Details for Public Works Construction.* To the extent practicable, the facility will be designed to maintain post-development peak runoff rate and average volume levels that are similar to pre-development levels. The facility will utilize several best management practices (BMP), including infiltration practices, vegetated and open channel practices, and filtering practices defined in the Environmental Protection Agency's (EPA) guidance document entitled *National Management Measures to Control Non-point Source Pollution from Urban Areas.* BMPs listed in the State of Hawaii Office of Planning's *Stormwater Impact Assessment* will also be implemented.

   To mitigate storm water impacts, on-site drainage design will incorporate Low Impact Development (LID) practices such as vegetated buffer/filter strips, open vegetated channels, and infiltration. The resources developed by the Office of Planning and provided in your letter will be consulted during the design process.

Your April 16th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

From: Dennis Okazaki
To: Jennifer Scheffel
Cc: Dennis Okazaki
Subject: East Hawai"i Organics Facility
Date: Saturday, April 21, 2018 10:35:45 AM

Jennifer,

KE Properties, LLC is a concern tenant within the W.H. Shipman Business Park Association. Some of our concerns are:

1. Additional traffic on Kipimana Street
2. Odor from proposed facility
3. Maintenance of Kipimana Steet
4. How does this facility affect the valuation

Should you have any questions please feel free to call me at (808)864-3154 or email me at the above address.

This email has been scanned for spam and viruses by Proofpoint Essentials. Click here to report this email as spam.

SSFM International

May 14, 2018 SSFM 2017_174

Mr. Dennis Okazaki
KE Properties, LLC

[VIA EMAIL]

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Okazaki,

Thank you for your email on April 21st regarding the subject project. We offer the following responses to your comments.

The Draft Environmental Assessment (EA) will assess impacts to transportation and traffic, including roadway maintenance, and odors, as well as impacts to the natural and human environment.

Traffic
A Traffic Impact Assessment Report (TIAR) is currently being prepared for the Proposed Action. The TIAR will estimate the project's daily trip generation, including the vehicle classification and peak hours. The TIAR will also address any recommended improvements to existing roadways to accommodate traffic associated with the Proposed Action.

Odors
Active composting will be performed within an in-vessel (covered) positive aeration system. A GORE™ Cover System, which is an EPA-approved in-vessel composting system, will be used. This system utilizes heap composting with forced aeration coupled with a semi-permeable membrane cover. The cover membrane has a pore structure sized to selectively influence the composting process. The system allows carbon dioxide to pass through the membrane, but prevents odor from escaping. The GORE™ Cover System is a barrier against dust, bacteria, and odor.

Property Values
The proposed project is located in an area designated as "Urban" land use and zoned "Industrial". The facility is an allowed use in these designations and is not expected to impact adjacent property values.

Your April 21st email, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

DAVID Y. IGE
Governor

DOUGLAS S. CHIN
Lt. Governor

JAMES J. NAKATANI
Executive Director

STATE OF HAWAII
AGRIBUSINESS DEVELOPMENT CORPORATION
235 S. Beretania Street, Room 205
Honolulu, HI 96813
Phone: (808) 586-0186 Fax: (808) 586-0189

April 20, 2018

SSFM International, Inc.
Attn: Jennifer M. Scheffel
99 Aupuni Street, Suite 202
Hilo, HI 96720

Subject: East Hawaii Organics Facility Keaau, Puna District, Island of Hawaii
Tax map Key (TMK): (3) 1-6-003:090 (por.) Pre-Assessment
Consultation for Draft Environmental Assessment

Dear Ms. Scheffel:

The Agribusiness Development Corporation (ADC), upon reviewing the provided documents, does not anticipate any significant impact to its proposed project in the W.H. Shipman Business Park.

Thank you for allowing us the opportunity to comment.

If you have any questions, please contact Ken Nakamoto at 586-0087.

Sincerely,

James J. Nakatani
Executive Director

SSFM International

May 14, 2018

SSFM 2017_174

Mr. James J. Nakatani, Executive Director
Agribusiness Development Corporation
235 S. Beretania Street, Room 205
Honolulu, HI 96813

SUBJECT: **East Hawai‘i Organics Facility**
Kea‘au, Puna District, Island of Hawai‘i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Nakatani,

Thank you for your letter dated April 20th regarding the subject project. We note that the Agribusiness Development Corporation does not anticipate any significant impact to its proposed project in the W.H. Shipman Business Park.

Your April 20th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

DAVID Y. IGE
GOVERNOR

RODERICK K. BECKER
Comptroller

AUDREY HIDANO
Deputy Comptroller

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

(P)1107.8

APR 20 2018

Ms. Jennifer Scheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

Subject: Draft Environmental Assessment, Pre-Assessment Consultation
East Hawaii Organics Facility
Keaau, Puna District, Island of Hawaii
TMK: (3) 1-6-003:090 (por.)

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

We are anticipating a future project to be initiated by the Hawaii State Public Library System (HSPLS) to begin planning efforts, which includes a site selection study, for a new public library in Keaau. As DAGS assists HSPLS with their capital projects, we request to be kept informed of the progress of your efforts.

If you have any questions, your staff may call Mr. David DePonte of the Public Works Division at 586-0492.

Sincerely,

RODERICK K. BECKER
Comptroller

c: Mr. Cory Kaizuka, DAGS Hawaii

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Roderick K. Becker, Comptroller
State of Hawai'i
Department of Accounting and General Services
PO Box 119
Honolulu, HI 96810-0119

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Becker,

Thank you for your letter dated April 20th regarding the subject project. We note that the proposed project does not impact any of the Department of Accounting and General Services' (DAGS) current projects or existing facilities, and therefore DAGS has no comments at this time.

We also note that the Hawaii State Public Library System (HSPLS) is expected to initiate a site selection study for a new library in Keaau. As requested, the County of Hawaii Department of Environmental Management will keep DAGS informed of the progress made regarding the proposed project and will provide a copy of the Draft EA to DAGS for review and comment.

Your April 20th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

For future correspondence, please send it to our P.O. Box address at:

Environmental Planning Office
P.O. Box 3378
Honolulu, HI 96801-3378

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

In reply, please refer to:
File:
EPO 18-100

April 11, 2018

Ms. Jennifer Sheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

SUBJECT: Pre-Assessment Consultation (PAC) for East Hawaii Organics Facility, Keaau, Hawaii
TMK: (3) 1-6-003:090 (por)

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your PAC to our office on March 27, 2018.

We understand from the PAC that *"The Proposed Action includes the construction and operation of an organics composting facility in Keaau in the Puna District on the north side of the W.H. Shipman Business Park.*

This project is intended to divert green waste and designated organic materials from the South Hilo Sanitary Landfill and the West Hawai'i Sanitary Landfill by establishing Hawai'i County's first municipal composting operation.

The facility would feature an in-vessel (covered) compost operation that would allow for acceptance of organic materials such as food, paper, and compostable plastics. In-vessel composting will minimize the environmental impacts regarding odor, pests, and dust, and it will decrease the time required to make compost. Green waste and untreated wood pallets would be ground and chipped into mulch before mixing with other organics. A portion of the mulch would be treated for invasive species (e.g., little red fire ant) and would be made available to the public."

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.

If you haven't already, EPO recommends that you review the new Healthy Communities Policy Guide: https://planning-org-uploaded-media.s3.amazonaws.com/document/Healthy-Communities-Policy-Guide.pdf, Plan4health website: http://plan4health.us and the free, on-demand, six part Plan4Health webinar series available on the American Planning Association website.

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.

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.

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.

The property may harbor vectors which may 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 vectors be determined, the applicant shall eradicate the vectors prior to clearing the site.

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 HAR 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: DOH: DHO Hawaii, SHWB, CWB, CAB, IRHB {via email only}

Attachment: U.S. EPA EJSCREEN Report for Project Area

Attachment: U.S. EPA EJSCREEN Report for Project Area

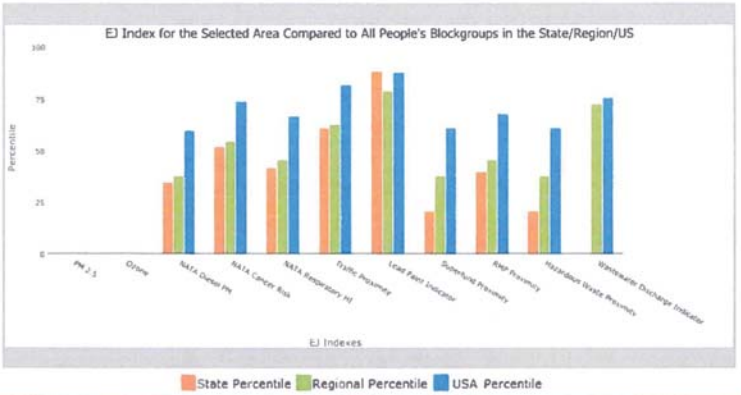
EPA United States Environmental Protection Agency

EJSCREEN Report (Version 2017)

1 mile Ring Centered at 19.635507,-155.055251, HAWAII, EPA Region 9

Approximate Population: 28
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	35	38	60
EJ Index for NATA* Air Toxics Cancer Risk	52	55	74
EJ Index for NATA* Respiratory Hazard Index	42	46	67
EJ Index for Traffic Proximity and Volume	61	63	82
EJ Index for Lead Paint Indicator	89	79	88
EJ Index for Superfund Proximity	21	38	61
EJ Index for RMP Proximity	40	46	68
EJ Index for Hazardous Waste Proximity	21	38	61
EJ Index for Wastewater Discharge Indicator	N/A	73	76



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.

EPA United States Environmental Protection Agency

EJSCREEN Report (Version 2017)

1 mile Ring Centered at 19.635507,-155.055251, HAWAII, EPA Region 9

Approximate Population: 28

Input Area (sq. miles): 3.14



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 19.635507,-155.055251, HAWAII, EPA Region 9

Approximate Population: 28

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 µg/m³)	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 (µg/m³)	0.0258	0.149	17	0.978	<50th	0.938	<50th
NATA* Cancer Risk (lifetime risk per million)	25	34	13	43	<50th	40	<50th
NATA* Respiratory Hazard Index	0.53	1	11	2	<50th	1.8	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	210	1000	52	1100	45	590	63
Lead Paint Indicator (% Pre-1960 Housing)	0.4	0.16	85	0.24	72	0.29	69
Superfund Proximity (site count/km distance)	0.0027	0.1	2	0.15	0	0.13	0
RMP Proximity (facility count/km distance)	0.088	0.39	21	0.98	8	0.73	13
Hazardous Waste Proximity (facility count/km distance)	0.0028	0.1	2	0.12	0	0.093	0
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0	0.04	N/A	13	59	30	40
Demographic Indicators							
Demographic Index	69%	51%	92	47%	78	36%	88
Minority Population	93%	77%	78	59%	86	38%	92
Low Income Population	45%	26%	87	36%	65	34%	70
Linguistically Isolated Population	38%	6%	98	9%	97	5%	98
Population With Less Than High School Education	26%	9%	95	17%	72	13%	84
Population Under 5 years of age	3%	6%	18	7%	20	6%	22
Population over 64 years of age	27%	16%	90	13%	93	14%	92

* 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

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. 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. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

May 14, 2018 SSFM 2017_174

Ms. Laura Leialoha Phillips McIntyre, AICP
State of Hawai'i Department of Health
Environmental Planning Office
PO Box 3378
Honolulu, HI 96801-3378

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Ms. McIntyre,

Thank you for your letter dated April 11th (Letter No. EPO 18-100) regarding the subject project. We offer the following responses to your comments.

The Draft Environmental Assessment (EA) will include a review of the standard comments provided via the Department of Health, Environmental Planning Office website, as well as the new Healthy Communities Policy Guide provided by the American Planning Association. Furthermore, we appreciate your information regarding available online resources, including the Hawaii Environmental Health Portal, National Pollutant Elimination System permit, and EJSCREEN, and we will utilize these resources during the preparation of the Draft EA.

Fugitive dust would be managed during construction in compliance with the requirements of Hawaii Administrative Rules (HAR), Chapter 11-60.1, Air Pollution Control. This would include the development of a dust control plan to be approved by the DOH. The plan would include some or all of the following measures:

- Watering of active work areas
- Screening piles of materials from wind, if appropriate
- Cleaning nearby paved roads affected by construction
- Covering open trucks carrying construction materials
- Limiting areas to be disturbed at any given time
- Mulching or chemically stabilizing inactive areas that have been disturbed

Construction waste would be disposed of at the West Hawaii Sanitary Landfill.

Noise from construction activities will comply with HAR Chapter 11-46, Community Noise Control. If construction noise is expected to exceed the DOH's allowable limits, a permit will be obtained from the DOH and all permit conditions will be complied with.

DEM will comply with all permit conditions regarding site preparation, including any pertaining to the control of vectors.

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

DEM will coordinate with the Hawaii Disability and Communication Access Board and provide all construction documents to the board for review to ensure compliance with applicable accessibility requirements. DCAB clearance will be acquired as part of the Building permitting process.

Your April 11th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

Harry Kim
Mayor

Wil Okabe
Managing Director

Allan G. Simeon, P.E.
Director

Merrick H. Nishimoto
Deputy Director

County of Hawai'i
DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 · Hilo, Hawai'i 96720-4224
(808) 961-8321 · Fax (808) 961-8630
public_works@hawaiicounty.gov

APRIL 27, 2018

SSFM INTERNATIONAL, INC.
ATTN: JENNIFER SCHEFFEL
99 AUPUNI STREET, SUITE 202
HILO, HAWAII 96720
(via email to jscheffel@ssfm.com)

SUBJECT: PRE-ASSESSMENT CONSULATION FOR DRAFT ENVIRONMENTAL ASSESSMENT
KEA`AU, PUNA DISTRICT, HAWAI`I
TMK: (3) 1-6-003:090 (POR.)

We received the subject dated March 20, 2018 and have the following comments:

The subject parcel is in an area designated as Zone X on the Flood Insurance Rate Map (FIRM) by the Federal Emergency Management Agency (FEMA). Zone X is an area determined to be outside the 500-year floodplain.

All activities shall comply with the requirements of Hawaii County Code (HCC), Chapter 10, Erosion and Sedimentary Control.

Construction within the County right-of-way shall comply with HCC, Chapter 22, County Streets.

Should there be any questions concerning this matter, please contact Ms. Robyn Matsumoto in our Engineering Division at (808) 961-8924.

BEN ISHII, Division Chief
Engineering Division

RM

County of Hawai'i is an Equal Opportunity Provider and Employer.

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Ben Ishii, Division Chief
County of Hawai'i Department of Public Works
Engineering Division
101 Pauahi Street, Suite 7
Hilo, HI 96720

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Ishii,

Thank you for your letter dated April 27th regarding the subject project. We offer the following responses to your comments.

We concur that the project site is in an area designated as Zone X on the Flood Insurance Rate Map by the Federal Emergency Management Agency. A Flood Hazard Area map will be included as part of the Draft EA.

Grading, grubbing, and stockpiling permits will be obtained prior to construction in compliance with Hawaii County Code (HCC), Chapter 10, Erosion and Sedimentary Control. Standard permit conditions listed in HCC Chapter 10 will be included as minimization measures in the Draft EA.

Construction within the County right-of-way, if required, will comply with HCC, Chapter 22, County Streets. This includes acquiring any necessary permits prior to construction and complying with permit conditions.

Your April 27th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

Harry Kim
Mayor

Michael Yee
Director

Daryn Arai
Deputy Director

West Hawai'i Office
74-5044 Ane Keohokalole Hwy
Kailua-Kona, Hawai'i 96740
Phone (808) 323-4770
Fax (808) 327-3563

County of Hawai'i
PLANNING DEPARTMENT

East Hawai'i Office
101 Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

April 20, 2018

SSFM International, Inc.
RECEIVED
5. 1. 2018

Ms. Jennifer Scheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawai'i 96720

Dear Ms. Scheffel,

SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment
Project: East Hawai'i Organics Facility
TMK: (3) 1-6-003:090 (por.), Kea'au, Puna District, Island of Hawai'i

Thank you for your letter dated March 20, 2018, requesting comments from this office regarding the preparation of a Draft Environmental Assessment (DEA) for the subject property.

The County of Hawai'i, Department of Environmental Management (DEM) is proposing to construct and operate a composting facility for organics on approximately 40 acres in the W.H. Shipman Business Park area.

The subject parcel consists of 424.303 acres and is zoned General Industrial (MG-20) and Agricultural (A-20a) by the County. It is located in the State Land Use Urban (U) and Agricultural (A) districts. In addition, the parcel is designated Industrial (IND) and Urban Expansion (UE) by the Hawai'i County General Plan Land Use Pattern Allocation Guide (LUPAG) Map. The subject parcel is designated as Prime Forest.

The DEA should describe how the proposed project is consistent with the policies, standards, and courses of action of the County of Hawai'i General Plan 2005 (as amended), including but not limited to:

- Public Facilities chapter: *It is necessary to carefully coordinate the provision of public facilities in order to use them most effectively and to maximize the effect of the public dollar. It is equally necessary to realize the type, quality, capacity and location of*

facilities and services have a significant impact on the community, the people and the total environment.
  - *Goal 10.1.2(a) Encourage the provision of public facilities that effectively service community and visitor needs and seek ways of improving public service through better and more functional facilities in keeping with the environmental and aesthetic concerns of the community.*
  - *Policy 10.5.2(h) Encourage the full development and implementation of a green waste recycling program.*

Given that the site for the proposed project is located near the Waiākea forest reserve, appropriate attention should be given to identify potential impacts (ROD, little fire ants, etc.) the facility may have on surrounding areas.

We have no further comments to offer at this time. Please keep us informed and provide our department with a copy of the DEA for our review and comment. If you have any questions, please feel free to contact Keiko Mercado of this office at Keiko.Mercado@hawaiicounty.gov or (808) 961-8134.

Sincerely,

MICHAEL YEE
Planning Director

KM:ja
\\COH33\planning\public\wpwin60\Keiko\EA-EIS Review\preconsultationEA-East.Hawaii.Organics.Facility.doc

SSFM International

May 14, 2018

SSFM 2017_174

Mr. Michael Yee, Planning Director
County of Hawai'i Planning Department
101 Pauahi Street, Suite 3
Hilo, HI 96720

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Yee,

Thank you for your letter dated April 20th regarding the subject project. We offer the following responses to your comments.

The Draft EA will include an assessment as to how the proposed project is consistent with the policies, standards, and courses of action of the County of Hawaii General Plan 2005 (as amended), including, but not limited to, the Public Facilities chapter.

The Draft EA will include an assessment of potential impacts and measures to minimize/mitigate such impacts associated with Rapid Ohia Death and little fire ants.

Your April 20th letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

SSFM International
99 Aupuni Street
Suite 202
Hilo, Hawaii 96720

SSFM International, Inc.
RECEIVED
5-18-2018

Re: East Hawaii Organics Facility
Keaau, Puna District
TMK: (3) 1-6-003:090
Neighbor Property Comments to Environmental Assessment

Dear Ms. Scheffel:

Shipman Self Storage LLC, under third party management by StorQuest Self Storage, is a neighbor to the proposed development. I represent Shipman Self Storage LLC as one of the owners.

Stor Quest self storage is a mini storage business that is more retail than industrial. There are about 480 self storage units and we are planning to add another 30,000 of net rentable square feet on the vacant land within our site. In addition there are 4 leased office spaces, a 2 bed 2 bath dwelling unit, and 10 commercial units that are rented by businesses. About half of these commercial units of 20x40 feet are occupied on a daily basis. In short this is a successful vibrant retail operation. With such an operation there are 20-40 persons in and out every day.

There will certainly be a negative impact of the proposed green waste facility to our operation. We list the potential impacts as follows:

1. ODOR: This will be smelled by our customers. Rotten green waste smells bad. In addition to being smelled by the customers, the smell may permeate into the stored goods within the self storage units. We have mostly climate controlled areas where this is not as much of a risk. However there are units which are not air tight. If the goods in the units end up smelling like a dump, this causes financial damage.
2. PARTICULATES: The green waste turns into compost. In that process the piles must be turned and moved. The air borne dust will be considerable. This air borne material will land everywhere the wind blows. This means the dust will be all over our buildings, doorways, sidewalks, 110kw photovoltaic system panels, and what people touch. Should the particles be fine enough to be blown into the storage units, such will be a large deterrent to customers selecting to store.
3. WIND PATTERN: Based upon your pre-assessment report, the prevailing wind is north east during the day and south west at night. The north east wind carries the odor and particulates towards our facility. Even in a no wind situation the smell will broadcast out.
4. RODENTS AND INSECTS: There will be a tremendous increase in the number of rodents and insects. Since the source of the rodents and insects will be on the green waste site, this is uncontrollable from our point of view. Currently we have a satisfactory rodent and insect control program fine tuned to the problems we experience. When you add hundreds of thousands of insects and thousands of rodents, they will go everywhere. How can a self storage business prevent them from coming over?

The factors identified are from a layman's perspective. Perhaps I should visit a green waste facility and experience what nearby effects it has. A white glove and smell test would be obvious experiential guides.

Financially the self storage business will suffer. As of April 2018, our occupancy is about 87% which is now consistently high. Our rental rates have and continue being increased due to customers finding out Shipman Self Storage is a desirable and maybe the top place to store in East Hawaii. This is why we are seeking construction estimates to add 30,000 net rentable square feet.

Imagine you are a potential customer seeking a self storage facility. Would you rent a unit next to a green waste garbage dump? What if you go on site and smell the odor? Would that make you want to rent from an otherwise presentable and secure facility? If the competitor self storage business clerk suggests that you would not want to rent in Shipman, due to the green waste facility would you consider that point?

Imagine you are already storing with Stor Quest Self Storage. If you start noticing dust being everywhere and especially on non-rainy days, would that be a negative? If you smell the green waste odor when visiting, would you like it? If you took a box of clothes home and when opening it you smelled the same smell as the green waste odor, would that affect your decision to continue to store?

Now we add the rodent and insects issue. Most people do not want to see rodents or insects on a business premises. Can the green waste operator warrant that their operation will not increase the rodent and insect customer exposure at Stor Quest Self Storage? I think Shipman Self Storage LLC would warrant that there will be a large increase in rodents and insects due to the green waste next door.

Who pays to clean up the particulates landing everywhere the wind blows? Who pays for the added pest and insect control that may be near hopeless in reality? Is there any counter measure for odor permeating into customers' stored goods? Will the green waste operator pay for odor prevention at Stor Quest Self Storage such as building air lock buffer zones and adding independent air conditioner units for these zones?

Should Shipman Self Storage occupancy be reduced or rental rate increases slow, this will cause direct financial damage. I use the word perception as even if the green waste operator is meticulous, customers still may not accept the reality of a great operator. This is not a few thousand of dollars a month discussion. Should the green waste facility project continue its development on this site, we would have to present a financial loss projection.

We invite you to visit our facility. When visiting, you can see the outside exposed units, climate controlled units, commercial bays, offices, management office and apartment. The roll up doors should be examined to determine if odors and fine particulates can enter. The daily activity can be explained and you can determine what effects the proposed green waste facility may bring. I welcome your thoughts and especially how skillful design and practices could minimize the threats. I also welcome your explanation as to how the practices can be maintained and enforced.

We also recognize that the land upon which the green waste facility will be placed is large. Your report does not indicate where the piles will be stored, where the access roads are, and the buffer zones depths relative to Mikahala Place.

Thank you for the opportunity to review your pre-assessment report and provide these comments.

5/10/2018

Wendell Choy, Member
Shipman Self Storage LLC

SSFM International

July 19, 2018

SSFM 2017_174

Mr. Wendell Choy
Shipman Self Storage, LLC
16-180 Mikahala Place
Keaau, HI 96749-8023

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Choy,

Thank you for your letter received May 18, 2018 on the subject project. We offer the following responses to your comments.

The compost operation would be an in-vessel (i.e., covered) operation. In-vessel composting minimizes the environmental impacts such as odor, pests, and dust and decreases the time needed to make compost. An operations plan would also be implemented to minimize any impacts associated with odor, pests, and dust. This operation plan will be provided in the Draft Environmental Assessment (EA).

The proposed project is located in an area designated as "Urban" land use and zoned "Industrial". The facility is an allowed use in these designations and is not expected to impact adjacent property values or financial success of adjacent businesses. In addition, the proposed facility would only encompass approximately 3 acres of a 40-acre site and would have a vegetated buffer on all sides.

Your letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

From: Atwood, Joshua P
To: Jennifer Scheffel
Subject: Re: East Hawaii Organics Facility - Request for Comment
Date: Monday, May 21, 2018 9:02:20 AM

Aloha Jen,

The HISC is administratively housed at the Department of Land and Natural Resources, Division of Forestry and Wildlife. I was able to provide input on your pre-assessment already as part of the DLNR DOFAW response. I don't think there is a need for a separate consultation from HISC at this time. Thanks,

Josh

Joshua Atwood, Ph.D., Invasive Species Coordinator
Hawaii Invasive Species Council / Division of Forestry and Wildlife
Department of Land and Natural Resources
http://hisc.hawaii.gov

> On May 11, 2018, at 11:30 AM, Jennifer Scheffel <jscheffel@ssfm.com> wrote:
>
> <180511 East Hawaii Organics_Pre-assessment Consultation Letter_HISC.PDF>

This email has been scanned for spam and viruses by Proofpoint Essentials. Click here to report this email as spam.

SSFM International

July 19, 2018 SSFM 2017_174

Joshua Atwood, Ph.D., Invasive Species Coordinator
Hawaii Invasive Species Council
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, HI 96813

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

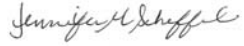
Dear Dr. Atwood,

Thank you for your letter on May 21, 2018 on the subject project. We note that the Hawaii Invasive Species Council provided comments as part of the Department of Land and Natural Resources, Division of Forestry and Wildlife comments and have no further comment at this time.

Your letter, along with this response letter, will be included in the forthcoming Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.



Jennifer M. Scheffel
Sr. Environmental Planner

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

May 31, 2018

SUBJECT: Pre-Assessment Comments for Draft Environmental Assessment, East Hawaii Organics Facility, Kea'uau, Puna District, Island of Hawaii, Hawaii, DA File No. POH-2018-00065

Ms. Jennifer M. Scheffel
Senior Environmental Planner
SSFM International
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

The Honolulu District, U.S. Army Corps of Engineers (Corps), Regulatory Office is responding to your request for pre-assessment comments for a draft environmental assessment (EA) that is under preparation pursuant to Chapter 343 of the Hawaii Revised Statutes for the proposed East Hawaii Organics Facility located in Kea'au Puna District on the Island of Hawaii, Hawaii (TMK: (3) 1-6-003:090 (por.)). I have assigned your project Department of the Army (DA) File No. POH-2018-00065. Please refer to this number in all future correspondence related to this project.

Based on your letter, dated March 20, 2018, we understand the project would involve the construction of an organics composting facility in Kea'au for the purpose of diverting organics from disposal in County landfills in order to extend the life of the landfills and create compost/mulch to support agricultural.

We suggest the draft EA include site-specific information pertaining to the occurrence of water resources within the project area, including perennial, intermittent and ephemeral streams and wetlands. For any non-tidal tributaries/waterways occurring within the project area, the ordinary high water mark should be determined as described at 33 CFR 328.3(e). In addition, the boundaries of any wetlands that may exist on-site or adjacent to the project site should be delineated based on the procedures set forth in the Corps' 1987 *Wetlands Delineation Manual* and the *Hawaii and Pacific Islands Regional Supplement (*dated February 2012, version 2.0).

In general, DA authorization is required for activities that result in the discharge (placement) of dredged and/or fill material into jurisdictional waters of the United States, including wetlands. Examples of such activities include, but are not limited to: 1) creating fills for residential or commercial development, placing bank protection, temporary or permanent stockpiling of excavated material, building road crossings and driveways, backfilling for utility line crossings and constructing outfall structures, dams, levees, groins, weirs, or other structures; 2) mechanized land clearing, grading which

involves filling low areas or land leveling, ditching, channelizing and other excavation activities that would have the effect of destroying or degrading waters of the U.S.; 3) allowing runoff or overflow from a contained land or water disposal area to re-enter a water of the U.S.; and 4) placing pilings when such placement has or would have the effect of a discharge of fill material. For additional permit information, please visit our website at http://www.poh.usace.army.mil/Missions/Regulatory/.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this correspondence, please contact me at (808) 835-4599 or via e-mail at susan.a.meyer@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

Susan A. M. Gayagas
Senior Project Manager

SSFM International

July 19, 2018

SSFM 2017_174

Ms. Susan A. M. Gayagas, Sr. Project Manager
Department of the Army
Honolulu District, U.S. Army Corps of Engineers
Fort Shafter, Hawaii 96858-5440

SUBJECT: **East Hawai‘i Organics Facility**
Kea‘au, Puna District, Island of Hawai‘i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Ms. Gayagas,

Thank you for your letter dated May 31, 2018 on the subject project. We offer the following response to your comment.

A Site Selection Study was completed for the proposed project. This Site Selection Study determined that the project site does not include water resources, including perennial, intermittent, and ephemeral streams and wetlands. Additionally, there are no water resources adjacent to the project site. Therefore, there would be no discharge of dredged and/or fill materials into jurisdictional waters of the US, including wetlands, and a permit from the U.S. Army Corps of Engineers would not be required.

Your letter, along with this response letter, will be included in the forthcoming Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

Day-Lum Rentals & Management, Inc.
DAY-LUM RENTALS
2 Kamehameha Avenue

Phone (808) 935-4152
Fax (808) 961-2459
Email address: luanar@daylum.com

May 25, 2018

SSFM International
99 Aupuni Street
Hilo, Hawaii 96720

SSFM International, Inc.
RECEIVED
6.4.2018

RE: East Hawaii Organics Facility
Keaau, Puna District
Shipman Business Park
TMK: (3) 1-6-003:090
Neighbor Property Comments to Environmental Assessment

Dear Mr. Scheffel,

As the President of the Shipman Business Park Association representing all of the owners/businesses in the Shipman Business Park there are a few concerns regarding the above project.

I would like to refer to Wendell Choy's letter dated February 10, 2018 and the concerns that he has brought to your attention. It is not only the odor, particulates, wind pattern, rodents and insects that are of concern but as you may not be aware there are about 90 organizations doing business currently in the park. All of them have company vehicles and/or trucks and staff vehicles that go in and out of the park daily.

The one major concern is the egress and ingress to the park. We are currently experiencing situations with vehicles trying to get out of the park and it is causing major traffic problems. Accidents have occurred with cars trying to cross the intersection and large trucks are caught half way on the main road due to the bottleneck of cars trying to get into the park from Puna.

There were plans to have streetlights installed on Highway 11 but that has come to a halt as the bill did not get passed by the 2018 State Legislature. We were informed that funding is still available but the bill needs to be re-introduced by Senator Lorraine Inouye in order to begin the process again. Your proposed facility will bring increased traffic to this intersection. Unless streetlights are installed the traffic will only increase and more accidents on the highway are sure to happen.

Thank you for the opportunity to review your pre-assessment report and allow businesses to voice their concerns.

Sincerely,

Frank Lawrence

Frank Lawrence, President
Shipman Business Park Association

SSFM International

July 19, 2018

SSFM 2017_174

Mr. Frank Lawrence, President
Day-Lum Rentals & Management, Inc.
2 Kamehameha Avenue
Hilo, Hawaii 96720-2830

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Lawrence,

Thank you for your letter dated May 25, 2018 on the subject project. We offer the following response to your comment.

The Draft Environmental Assessment (EA) will include an analysis of existing and future traffic conditions and provide recommendations to alleviate potential impacts to traffic associated with the proposed project.

Your letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File:

May 23, 2018 S0520LI

SSFM International, Inc.
RECEIVED
6.4.2018

Ms. Jennifer Scheffel
SSFM International, Inc.
99 Aupuni Street, Suite 202
Hilo, Hawaii 96720

Dear Ms. Scheffel:

SUBJECT: Pre-Assessment Consultation for Draft Environmental Assessment
East Hawaii Organics Facility
Keaau, Hawaii, TMK: (3) 1-6-003:090 Portion

The Department of Health, Solid and Hazardous Waste Branch received your letter dated May 11, 2018. Your letter requested comments, concerns, or regulatory requirements that we may have regarding this project. State solid waste regulations, Hawaii Administrative Rules (HAR), Chapter 11-58.1 require solid waste management facilities, such as the proposed composting facility, to obtain a solid waste management permit for its construction and operation. The siting, design, operational, closure, and reporting requirements may be found in HAR Section 11-58.1-41. The permit application and requirements may be found at: http://health.hawaii.gov/shwb/sw-permits/.

For the type of waste that will be received (such as food waste), one of the concerns is odors. We recommend that sufficient design and operational measures, as well as distances between the proposed facility and neighbors (buffer distance) be provided to address this concern. Odors will likely be encountered during waste acceptance, feedstock mixing, feedstock placement prior to covering, leachate and condensate management, and possibility during movement from active composting to curing. Other concerns include dust, vector, leachate and condensate management, surface water control, impact to groundwater, pathogen reduction and associated testing, and potential for fires. We will also be asking the County and their selected contractor to address our regulatory requirements and our concerns during the solid waste permitting process.

If you have any questions regarding this letter, please contact me at (808) 586-4226.

Sincerely,

LENE ICHINOTSUBO, P.E., ACTING CHIEF
Solid and Hazardous Waste Branch

SSFM International

July 19, 2018 SSFM 2017_174

Mr. Lene Ichinotsubo, P.E., Acting Chief
State of Hawaii Department of Health
Solid and Hazardous Waste Branch
P.O. Box 3378
Honolulu, HI 96801-3378

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Ichinotsubo,

Thank you for your letter dated May 23, 2018 (Letter No. S0520LI) on the subject project. We offer the following response to your comments.

The compost operation would be an in-vessel (i.e., covered) operation. In-vessel composting minimizes the environmental impacts such as odor, pests, and dust and decreases the time needed to make compost. Best management practices would be implemented to minimize impacts to groundwater and soils. In addition, measures would be implemented to minimize impacts associated with pathogens and fire potential.

The County of Hawaii Department of Environmental Management (DEM) will obtain a Solid Waste Management Permit in compliance with HAR Section 11-58.1-41. DEM will coordinate with the Department of Health, Solid and Hazardous Waste Branch through the permitting process and will implement any permit requirements and conditions.

Your letter, along with this response letter, will be included in the forthcoming Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

From: wtopeinc@hilonet.com
To: Jennifer Scheffel
Subject: East Hawaii Organics Facility//Shipman Business Park///Draft EA
Date: Monday, June 11, 2018 9:13:32 AM

Hello Jennifer,
Just a "for what it's worth" very belated comment.
Much has been discussed and will continue to be discussed about the need for easier and safer ingress/egress for Shipman Business Park.
The State really "missed the boat" in not considering an overpass from Volcano Highway onto the Keaau Bypass. The topography at that location is ideal for a 2 lane overpass and still allowed the other movements to be signalized.
Hopefully the State will not repeat that oversight when considering improvements at the Shipman Business Park intersection, mostly due to the additional truck volumes. A combination underpass for exiting/entering Shipman Business Park and overpass for both lanes on Volcano Highway should be given due consideration. There appears to be sufficient land area to provide for the needed turning lanes.
Please call us at 961-9666 for any questions.
Thank you.
Wally Oki

This email has been scanned for spam and viruses by Proofpoint Essentials. Click here to report this email as spam.

SSFM International

July 19, 2018 SSFM 2017_174

Mr. Wally Oki

VIA EMAIL

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Mr. Oki,

Thank you for your email on June 11, 2018 regarding the subject project. We offer the following response to your comment.

The Draft Environmental Assessment (EA) will include an analysis of existing and future traffic conditions and provide recommendations to alleviate potential impacts to traffic associated with the proposed project.

Your letter, along with this response letter, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

College of Tropical Agriculture and Human Resources
Founding College of the University of Hawai'i
Office of the Dean and Director for Research and Cooperative Extension

UNIVERSITY of HAWAI'I MĀNOA

June 5, 2018

SSFM International, Inc.
Attn: Jennifer Scheffel
99 Aupuni Street, Suite 202
Hilo, Hawai'i 96720

SSFM International, Inc.
RECEIVED
6-22-2018

Dear Jennifer Scheffel,

As per your request, we do not see the facility to have any deleterious physical impacts on our facilities or current and future projects, based on the locations mentioned.

Sincerely,

NB Comerford

Nicholas B. Comerford, PhD
Dean and Director for Research and Cooperative Extension

3050 Maile Way, Gilmore Hall 202 Honolulu, Hawai'i 96822-2271
Telephone: (808) 956-8234, Fax: (808) 956-9105
E-mail: dean@ctahr.hawaii.edu

An Equal Opportunity/Affirmative Action Institution

SSFM International

July 19, 2018 SSFM 2017_174

Nicholas B. Comerford, Ph.D.
Dean and Director for Research and Cooperative Education
University of Hawaii-Manoa, College of Tropical Agriculture and Human Resources
3050 Maile Way, Gilmore Hall 202
Honolulu, Hawaii 96822-2271

SUBJECT: **East Hawai'i Organics Facility**
Kea'au, Puna District, Island of Hawai'i
Tax Map Key (TMK): (3) 1-6-003:090 (por.)
Response to Pre-Assessment Consultation Comments

Dear Dr. Comerford,

Thank you for your letter dated June 5, 2018 regarding the subject project. We note that the University of Hawaii-Manoa, College of Tropical Agriculture and Human Resources does not believe that the proposed project would have any deleterious physical impacts on existing facilities or current and future projects.

Your letter, along with this response letter, will be included in the forthcoming Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process. Should you have additional comments or questions regarding this project, please contact me at (808) 356-1273 or via email at jscheffel@ssfm.com

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

99 Aupuni Street | Suite 202 | Hilo, Hawaii 96720 | Tel 808.933.2727 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

This page intentionally left blank

Appendix B

New Compost Facility Siting Study Report

This page intentionally blank.

AECOM

NEW COMPOST FACILITY SITING STUDY

County of Hawai'i
Department of Environmental Management
Solid Waste Division
345 Kekuanaoa Street, Suite 41
Hilo, HI 96720

March 2018

This page is intentionally left blank.

NEW COMPOST FACILITY SITING STUDY

Prepared for:

County of Hawai‘i
Department of Environmental Management
Solid Waste Division
345 Kekuanaoa Street, Suite 41
Hilo, HI 96720

Prepared by:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, HI 96813-3698

March 2018

This page is intentionally left blank.

EXECUTIVE SUMMARY

This New Compost Facility Siting Study evaluates three potential sites identified by the County. The three potential sites are located within the following tax map key (TMK) numbers:

- Site 1 – TMK 1-6-001-015 adjacent to the County's existing Kea'au Transfer Station
- Site 2 – TMK 1-6-003:090 adjacent to (north of) Shipman Business Park
- Site 3 – TMK 1-6-003:007 adjacent to (south of) Shipman Business Park

Twenty-six project-specific siting criteria were identified in this study based on regulations, needs of the local community, and other factors for waste handling facilities in the State of Hawaii. Each site was then evaluated with respect to the criteria and given a recommended scaled score (1 to 5) based on acceptability. Each of the criteria was also assigned a recommended weight (importance). The total score for each site is the sum of the weighted criteria scores for that site.

Based on the total weighted criterion scores, Site 2 ranks as the most desirable site. The difference between the three sites, however, is minimal.

Site 2 and Site 3 score high for Environmental criteria, particularly the lack of potential archaeological features, and for Development cost, though there is a lack of available water because no additional water permits are available in the area. Site 1 scored highest for Land Use and Community Impact (i.e., most compatible), but it is farthest from the East Hawai'i Regional Sort Station and has the highest theoretical site cost due to a long driveway and the potential need to upgrade the public road turn lanes.

All three sites are technically and legally feasible sites for the County's new Compost Facility. Any identified real or perceived deficiency in a particular site could potentially be mitigated.

The top-ranked site will receive additional design and evaluation in the environmental assessment phase of this project.

This page is intentionally left blank.

CONTENTS

EXECUTIVE SUMMARY III

ACRONYMS AND ABBREVIATIONS VII

1.0 INTRODUCTION 1-1

1.1 Background, Purpose, and Need 1-1
1.2 Conceptual Compost Facility Layout 1-1
1.2.1 Design Mitigation Measures 1-2
1.2.2 Construction Mitigation Measures 1-3
1.3 Potential Sites for Evaluation 1-3

2.0 COMPOST FACILITY SITE SCREENING CRITERIA AND METHODOLOGY 2-1

2.1 Criteria Selection 2-1
2.2 Criteria Summary 2-4
2.3 Site Evaluation Methodology 2-4
2.3.1 Site Scoring 2-4
2.3.2 Information Used in Evaluation 2-5

3.0 COMPOST FACILITY SITE EVALUATIONS 3-1

3.1 Exclusionary Criteria Evaluation Results 3-1
3.1.1 Wetland Areas 3-1
3.1.2 Critical Habitat 3-1
3.1.3 Federal Government Lands 3-1
3.1.4 Conservation Land 3-1
3.1.5 Tsunami Inundation Areas 3-1
3.1.6 Areas Within 1 Percent Annual Chance Floodplain 3-1
3.1.7 Fault Areas 3-1
3.1.8 Seismic Impact Zones 3-1
3.1.9 Steep Terrain Areas 3-1
3.1.10 Availability of Forty Acres or More for Use 3-2
3.2 Land Use Criteria Evaluation Results 3-2
3.2.1 Areas within 10,000 Feet of Airport Runways 3-2
3.2.2 Agricultural Land Use Designation 3-2
3.2.3 High Value Agricultural Lands 3-2
3.2.4 Special Management Area 3-2
3.3 Environmental Criteria Evaluation Results 3-3
3.3.1 Archaeological or Cultural Resources 3-3
3.3.2 Protected Species and Biological Resources 3-3
3.3.3 Proximity to Perennial Streams and Other Surface Water 3-4
3.3.4 Proximity to Water Wells 3-4
3.3.5 Unstable Terrain 3-4
3.4 Community Impact Criteria Evaluation Results 3-5
3.4.1 Proximity to Urban Lands 3-5
3.4.2 Distance to Neighbors 3-5
3.4.3 Impact of Nuisance Factors (Aesthetics, Noise, Odor) 3-6
3.5 Development Cost Criteria Evaluation Results 3-6
3.5.1 Ease of Access from Highway 3-6
3.5.2 Proximity to Water and Electric Utilities 3-7
3.5.3 Proximity to Existing Sort Station 3-7
3.5.4 Site Cost 3-8

4.0 SITE COMPARISONS AND CONCLUSIONS 4-1

4.1 Site Scoring Summary and Comparisons 4-1
4.2 Conclusions 4-1

5.0 REFERENCES 5-1

APPENDIXES

A Site Reconnaissance Log

B Archaeological Literature Review

C Transportation Evaluation

FIGURES

1-1 Three Potential Compost Facility Sites 1-4

1-2 Conceptual Compost Facility Layout 1-5

1-3 Site 1 Conceptual Layout 1-6

1-4 Site 2 Conceptual Layout 1-7

1-5 Site 3 Conceptual Layout 1-8

TABLES

2-1 Summary of Compost Facility Siting Criteria 2-2

2-2 Categorization of Compost Facility Siting Criteria 2-4

2-3 Recommended Criteria Weightings 2-5

3-1 Site Cost Estimates 3-8

4-1 Summary of Siting Criteria Scores 4-2

ACRONYMS AND ABBREVIATIONS

%	percent
ALISH	Agricultural Lands of Importance to the State of Hawaii
County	County of Hawai‘i
DEM	Department of Environmental Management
DOH	Department of Health, State of Hawaii
DWS	Department of Water Supply, County of Hawai‘i
EA	environmental assessment
EPA	Environmental Protection Agency, United States
ESA	Endangered Species Act
FEW	freshwater emergent wetland
GIS	geographic information system
HAR	Hawaii Administrative Rules
HER	Hawaiian Earth Recycling
HRS	Hawai‘i Revised Statutes
IAL	important agricultural land
no.	number
TMK	tax map key
tpy	ton per year
U.S.	United States
USFWS	United States Fish and Wildlife Service

This page is intentionally left blank.

1.0 INTRODUCTION

This report summarizes the site selection activities, and comparatively evaluates the suitability and desirability of three sites (Figure 1-1) for development as the new Compost Facility for the County of Hawai‘i (County).

1.1 BACKGROUND, PURPOSE, AND NEED

The proposed action is the construction of an organics composting facility. The purpose and need for the project is to divert organics (e.g., green waste, food, paper, and compostable plastics) from disposal in the County landfills in order to extend the life of the landfills and to generate compost and mulch to support local subsistence and commercial agriculture.

The County had originally proposed an East Hawai‘i Organics Facility situated on tax map key (TMK) parcels (3) 2-1-013: 142, 160, 161, and 163 on the island of Hawai‘i. On April 4, 2017, the County’s Department of Environmental Management, Solid Waste Division, withdrew the Draft Environmental Assessment (EA) (dated September 8, 2016) due to concerns that the location of the proposed facility could have additional impacts on the local communities, many of whom claim a disproportionate share of undesirable land uses.

This New Compost Facility Siting Study evaluates three new potential sites identified by the County. This report presents technical, environmental, cultural, and social comparisons of the sites and is based in part on the conceptual Compost Facility design previously provided to the County by Hawaiian Earth Recycling (HER) (undated drawings for East Hawai‘i Organic Facility). Following review of this Study, the County will then choose a potential location for the new Compost Facility. Upon selection of a proposed compost site, site-specific engineering analyses and design will be performed. Additionally, a detailed Hawai‘i Revised Statute (HRS) Chapter 343-5 EA will be conducted for the proposed site.

Once the public-review process for the EA is complete and the assessment is approved, the site will need to be acquired or land use rights secured, and multiple permits and approvals will need to be obtained before construction and operations can begin.

1.2 CONCEPTUAL COMPOST FACILITY LAYOUT

Figure 1-2 provides a conceptual layout of the proposed Compost Facility. The facility will be designed, constructed, and operated by a private contractor, HER, under contract to the County. The facility will include a covered organic receiving building that will allow for acceptance of organic materials such as food, paper, and green waste. Composting will occur within a United States (U.S.) Environmental Protection Agency (EPA)-approved GORE Cover System which utilizes forced aeration of the compostable material under a semi-permeable membrane cover. This in-vessel composting method will minimize the environmental impacts of odor, pests, and dust and will decrease the composting time required.

According to the contract between the County and HER, the facility will be capable of processing up to 35,000 tons per year (tpy) of organic material, including up to 17,500 tpy of food waste once the facility is fully operational.

The facility would include the following primary features:

- Approximately 40 acres of the selected TMK, including setbacks and room for future expansion.
- Approximately 3 acres of graded, paved, or graveled surface encompassing the primary site operations.
- A multi-bay enclosed receiving building (approximately 50 by 100 feet) for use as a tipping floor and for waste handling.

- A biofilter for treatment of air exhaust from the enclosed receiving building.
- A concrete surface (approximately 160 by 230 feet) for placement of compost windrows under a series of membrane covers.
- A stockpile area for finished compost.
- An access road, which may include pavement, curbs, and drainage.
- Utilities such as water and electricity.
- An on-site septic system for the office building.
- Leachate collection systems for containerization of runoff from waste handling areas.
- An area for grinding green waste and untreated wood pallets
- A truck scale for weighing.
- An office building and onsite parking.

The process for handling incoming green waste would be as follows:

- All incoming food waste, food-soiled paper fiber, and other compostable materials will be received indoors in the receiving (tipping) building.
- Green waste and untreated wood pallets will be ground and chipped into mulch before mixing with the other organics.
- Leachate generated from the tipping building and active composting area will be collected in a storage tank and recycled for feedstock moisture adjustment.
- Mulch to be made available to the public will be treated for invasive species, including fire ants, by maintaining a minimum compost temperature.

The County's existing green waste facility would continue to operate while the new compost facility is under construction.

Potential adverse impacts of the new Compost Facility would be mitigated as follows (PBR Hawaii 2016).

1.2.1 Design Mitigation Measures

- To mitigate operational noise affecting existing or future residences, the receiving building will be enclosed and any openings in the building will be directed away from residences.
- To mitigate storm water impacts, onsite drainage design will incorporate low-impact development practices such as vegetated buffer or filter strips, open, vegetated channels, and infiltration.
- To mitigate potential impact to seabirds, the design will specify shielded outdoor lights in conformance with Hawai'i County Code outdoor lighting requirements (Chapter 14, Article 9).
- To protect low-flying, foraging bats, barbed wire will not be used for fencing.
- The facility will not include any reflective surfaces, such as photovoltaic panels, which could impair pilots' vision, unless such inclusion has been coordinated with the Airports Division.
- An Individual Wastewater System permit approved by the State of Hawaii Department of Health (DOH) will ensure the office building's septic tank and leach field system have adequate capacity.

1.2.2 Construction Mitigation Measures

- To mitigate construction noise and dust, the construction contract will include standard measures such as ensuring mufflers are in proper operating condition, limiting construction hours, and wetting down exposed surfaces.
- To mitigate erosion and sedimentation impacts during construction, the grading plans will specify some or all of the following best management practices: early construction of drainage control features; construction of temporary sediment basins to trap silt; use of temporary berms and cut-off ditches where needed; and use of temporary silt fences or straw bale barriers to trap silt.
- To mitigate potential impact to the native hawk, if grubbing trees in March through September, the construction contract will include a requirement to retain a biologist to check for nests.
- If construction will occur during the Hawaiian hoary bat breeding season (June 1 to September 15), construction documents will specify that woody plants greater than 15 feet tall should not be removed or trimmed.
- The construction documents will include a provision that should historic sites such as walls, platforms, pavements, and mounds, or remains such as artifacts, burials, concentrations of shell or charcoal, and artifacts be inadvertently encountered during construction activities, work in the vicinity will cease immediately and the find will be protected. The contractor will immediately contact State Historic Preservation Division, which will assess the significance of the find and recommend appropriate mitigation measures, if necessary.

1.3 POTENTIAL SITES FOR EVALUATION

The three potential sites identified by the County for evaluation (Figure 1-1) are located within the following TMK numbers:

- Site 1 – TMK 1-6-001-015 adjacent to the County's existing Kea'au Transfer Station
- Site 2 – TMK 1-6-003:090 adjacent to (north of) Shipman Business Park
- Site 3 – TMK 1-6-003:007 adjacent to (south of) Shipman Business Park

All three parcels are owned by W. H. Shipman, Limited. The owner has granted legal right-of-entry access to all parcels for investigation and evaluation purposes to complete this study.

Conceptual site-specific facility layouts are provided in Figure 1-3, Figure 1-4, and Figure 1-5, each identifying a conceptual 40-acre area within the TMK.

The site selected for additional study will receive a more detailed design and evaluation in the EA phase of the project.



FIGURE 1-1: THREE POTENTIAL COMPOST FACILITY SITES
County of Hawai'i Compost Facility Siting Study

AECOM
March 2018

Figure 1-1: Three Potential Compost Facility Sites

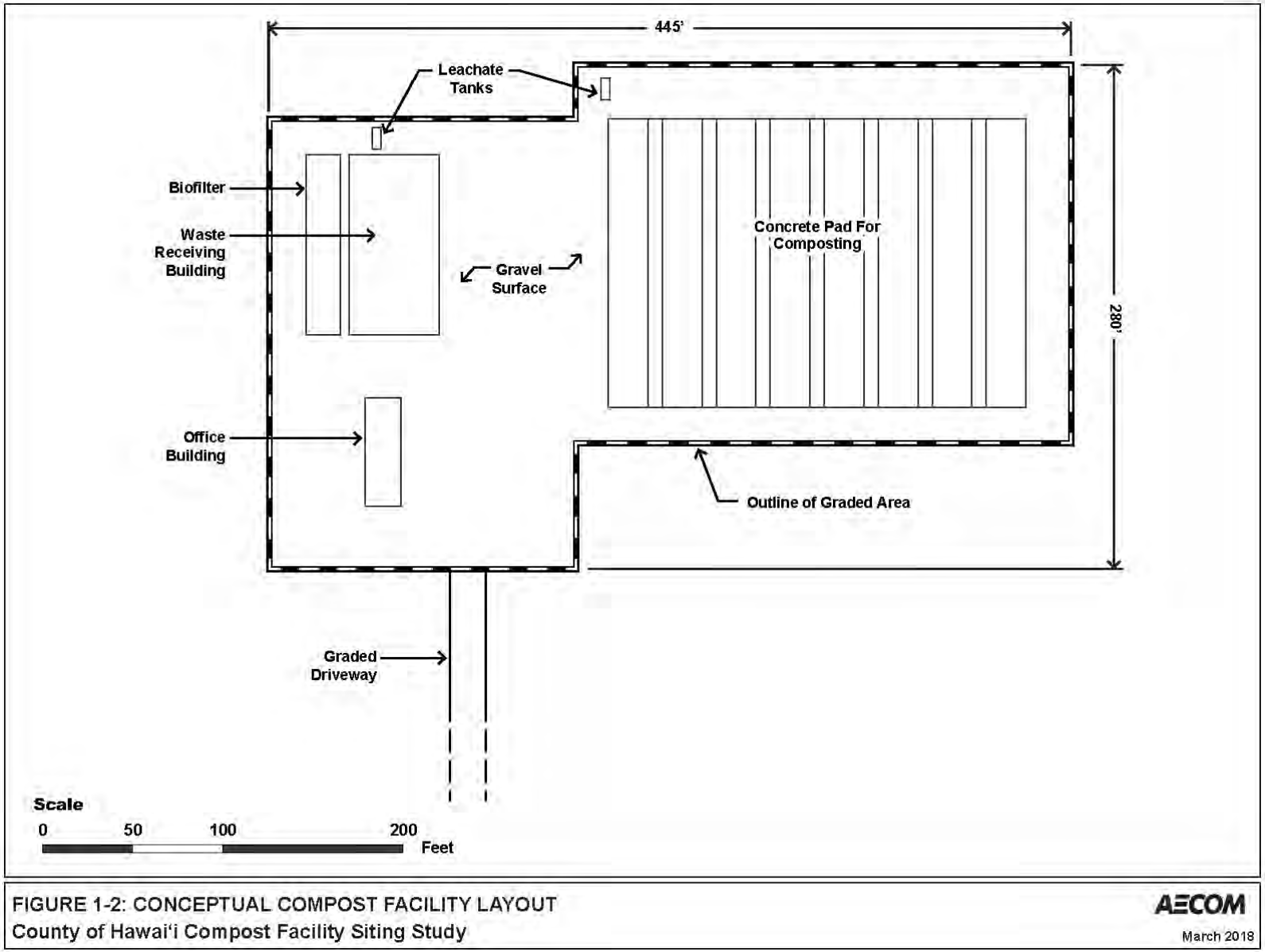


Figure 1-2: Conceptual Compost Facility Layout



FIGURE 1-3: SITE 1 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study
AECOM
March 2018

Figure 1-3: Site 1 Conceptual Layout

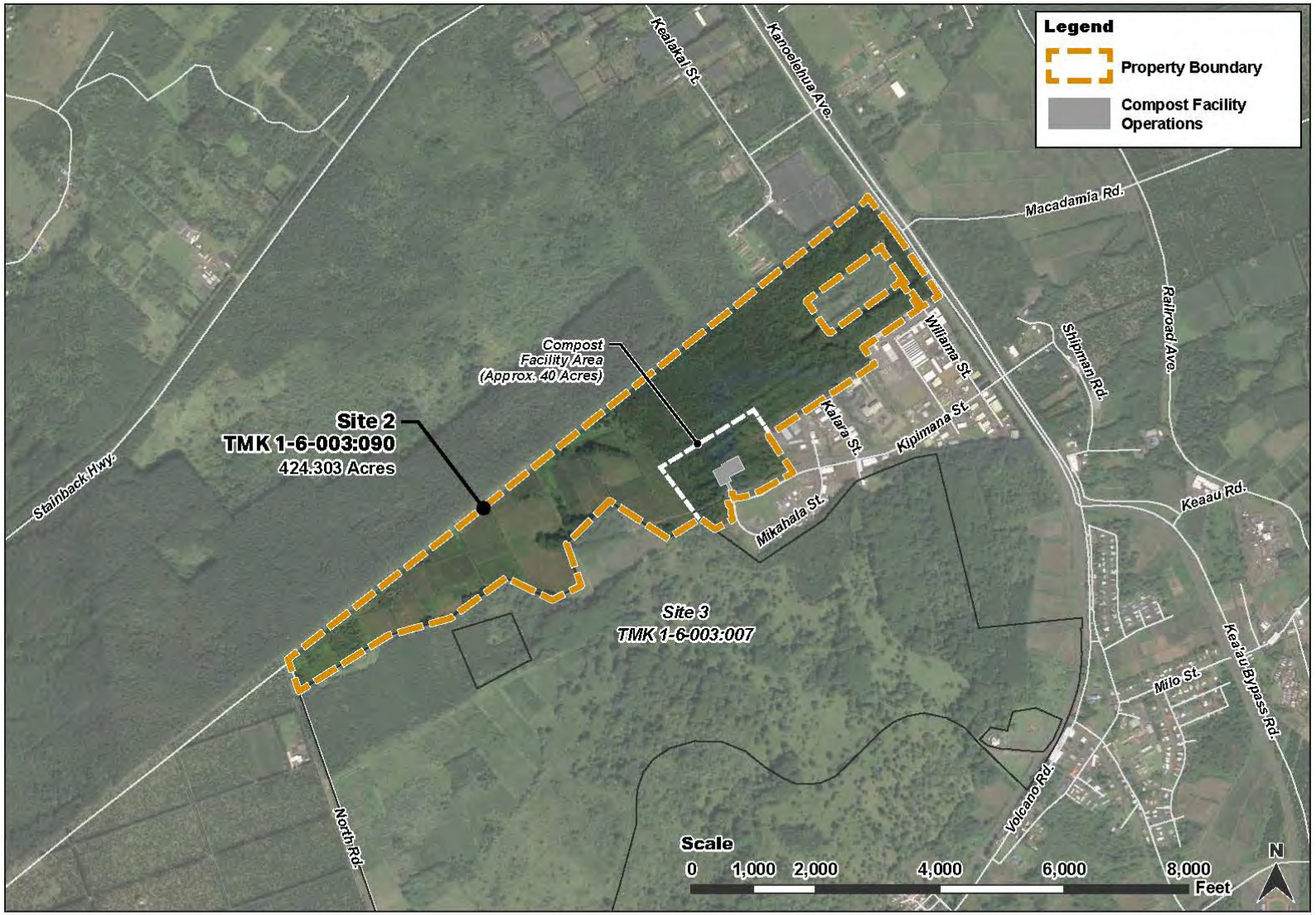


FIGURE 1-4: SITE 2 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study

AECOM
March 2018

Figure 1-4: Site 2 Conceptual Layout



Figure 1-5: Site 3 Conceptual Layout

2.0 COMPOST FACILITY SITE SCREENING CRITERIA AND METHODOLOGY

To accommodate organic waste generated by residents and visitors to the County, the County intends to develop a Compost Facility that will divert organics (food waste and green waste) from disposal in the County landfills. Selecting the appropriate compost site, however, must balance the potential environmental, technical, economic, and social impacts. This section describes the criteria by which the three proposed sites will be evaluated.

2.1 CRITERIA SELECTION

Regulations for bioconversion programs, including composting, are covered by HRS Chapter 342H with associated administrative rules contained in the Hawaii Administrative Rules (HAR) 11-62 and 11-58.1.

HRS 342H (Solid Waste Pollution) pertains to composting as a means of solid waste reclamation, but does not define the siting criteria for a Compost Facility.

HAR 11-62 (Wastewater Systems) pertains to composting and land application of wastewater sludge, which is not relevant to this project as no wastewater sludge will be handled.

As defined under HAR 11-58.1 (Solid Waste Management Control), composting means "*a process in which organic solid wastes, such as biosolids (sewage sludge), green or yard waste materials, manures, and non-treated wood chips and shavings, are biologically decomposed and stabilized under controlled conditions to produce a stable humus-like mulch or soil amendment. This term includes the processing of organic and non-treated wood waste materials for the generation of wood chips or other materials that can be used as soil amendment, planting mixes, mulches for horticultural and agricultural applications, landfill cover, and land reclamation. The process of composting under methods approved by the department is a recycling activity*."

HAR 11-58.1-41 (Solid Waste Reclamation Facilities – Composting Facilities) regulates the construction and operation of composting facilities for sewage sludge, green waste, and other solid wastes. It states that the finished compost shall be nonpathogenic, free of offensive odors, biologically and chemically stable, free of injurious components or particles, and able to sustain plant growth. HAR 11-58.1-41 does not, however, identify specific facility siting criteria.

Though not entirely applicable to the proposed Compost Facility, HAR 11-58.1-13 (Solid Waste Disposal Facilities – Site Analysis) provides criteria for the siting of municipal solid waste landfills; several of the criteria may be relevant to the concerns of the surrounding community and the success of the Compost Facility. The landfill siting criteria (regulatory criteria) identified for this compost siting study are listed in Table 2-1.

Based on the needs of the local community and input from the previous Draft EA (PBR Hawaii 2016), community-specific criteria are also included in this siting study and listed in Table 2-1.

Additional criteria that are factors for waste handling facilities in the State of Hawaii were also considered and are included in Table 2-1.

Table 2-1: Summary of Compost Facility Siting Criteria

No.	Criteria	Relevance
Regulatory Criteria		
1	Not within 10,000 feet of airport	Wildlife strikes are potentially hazardous for air transportation, and wildlife attractants on and near airports can jeopardize future airport expansion. The Federal Aviation Authority's (FAA) Advisory Circular 150/5200-33 helps to comply with Title 14, Code of Federal Regulations, Part 139, Certification of Airports, and provides airport operators with guidance to address potentially hazardous wildlife attractants. Attractants (such as operational landfills) and their distances from specific types of aviation operations are detailed in Advisory Circular 150/5200-33 to evaluate risks and for FAA to determine any necessary course of mitigation, such as an Airport Wildlife Hazard Management Plan. The guidance indicates that wildlife attractants should be located at least 10,000 feet from turbojet airport runways, or 5,000 feet for piston-only type aircraft.
2	Not in 1% annual chance floodplain	Placement of a facility within the 100-year floodplain (area with 1% annual chance of floodwaters) could impede the flow or reduce the storage capacity of the floodplain, or allow for the washout of solid waste. Siting in a 1% annual chance of flood would require additional design and construction activities and costs to accommodate for this risk.
3	Not in wetlands	Wetlands are federally regulated and would require permitting with the U.S. Army Corps of Engineers and federal coordination with other resource agencies. Further, wetlands are habitat for many protected species and are likely to support species that would require additional surveys, consultation/habitat conservation plans, and mitigation. A facility siting would require additional costs and uncertain time for completion with the many agencies likely to be involved.
4	Not in critical habitat	The United States Fish and Wildlife Service (USFWS) proposes critical habitat designations based on the best available scientific and commercial information on what an animal or plant species needs to survive, reproduce, and recover. Proposed actions in critical habitat are likely to require additional surveys, coordination with resource agencies, and possibly a habitat conservation plan. Siting a facility would require additional costs and uncertain time for completion with the agencies likely to be involved.
5	Not in fault area	Pursuant to HAR 11-58.1-13(d), new Municipal Solid Waste Landfill (MSWLF) units and lateral expansions shall not be located within two hundred feet (sixty meters) of a fault that has had displacement in Holocene time unless the owner or operator demonstrates to the director that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the MSWLF unit and will be protective of human health and the environment. Considering that the compost facility will handle food and other waste materials, and protection of health and the environment are concerns, fault zones should be avoided.
6	Not in seismic impact zone	Pursuant to HAR 11-58.1-13(e), new MSWLF units and lateral expansions shall not be located in seismic impact zones, unless the owner or operator demonstrates to the director that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. Though the proposed compost facility is not a MSWLF, construction in a seismic impact zone would require additional design and construction activities and costs to accommodate for this risk.
7	Not in otherwise unstable terrain	Otherwise unstable terrain includes that from debris flows following heavy rains, sinkholes, rockfalls, lava tubes, or the liquefaction of soil. Construction of the proposed compost facility in unstable areas would require additional design and construction activities and costs to accommodate for this risk.
8	Not in tsunami evacuation zone	Pursuant to HAR 11-58.1-13(g), new MSWLFs and lateral expansions shall not be located in areas susceptible to tsunami impact and are, therefore, mandatory evacuation zones for human occupants. Though the proposed Compost Facility is not a MSWLF, construction in a tsunami evacuation zone would be considered an unnecessary risk and will be avoided.
Community-Specific Criteria		
9	40+ acres available	The proposed Compost Facility design calls for a minimum area of 40 acres. This acreage allows for all composting-related operations and site access, and for sufficient setbacks from the property line to reduce potential impacts on the surrounding community.
10	Agricultural land use designation	Pursuant to HRS Chapter 205, the State Land Use Commission (LUC) designates all lands in the state into one of four zoning districts: urban, rural, agricultural, or conservation. Further, County zoning ordinance (HCC §25-5-72(a)(18)) allows "Public uses and structures which are necessary for agricultural practices" within an agricultural district. Placement of the compost facility within an Agriculturally designated district is highly preferable.
11	Proximity to the existing sort station	The shortest route between the East Hawai'i Regional Sort Station or the County's Solid Waste Baseyard to the compost facility would result in the least cost (e.g., fuel, time, maintenance) associated with transportation of waste and personnel.

No.	Criteria	Relevance
12	Proximity to water and electric utilities	Any site with nearby water and electric tie-ins avoids additional time and cost for utility development. Power supply lines, water supply lines, and other utility development all add to the time and cost of site development.
13	Distance to neighbors	The distance to neighbors, including populations that could be considered sensitive, e.g., school or day care for children or elderly, should be maximized to the extent practical. In general, elimination of the potential for nuisance factors is more cost-effective than controlling them. To evaluate the potential for future land use conflicts, distance to potential future neighbors will be based on current land use.
14	Ease of access from highway	The safest and shortest distance to and from the main highway will generally provide the most efficient movement of product to and from the compost facility. Any necessary road development or offsite improvements needed to accommodate vehicular traffic to and from the site, such as changes in existing signalization and additional turn lanes, would add substantially to the site cost.
15	Low likelihood of cultural/archaeological resources	The presence of historic properties as defined under HRS Chapter 6E Historic Preservation will require site surveys and possibly mitigation measures that would involve cost and time. Any potential burials should be avoided and treated as required under HRS Chapter 6E.
16	Low likelihood of protected species	The presence of federally (e.g., Endangered Species Act) or state-protected biological species would require surveys and likely avoidance or mitigation measures to minimize the effects of a compost facility. Should protected species be present, this process would involve consultation (cost and time) with multiple federal and state resource agencies.
Additional Criteria		
17	Impact by nuisance factors (noise, odor)	Regardless of the facility location, neighbors will be present. Nuisance factors are those factors that may meet regulatory standards but are perceived by the individual/population affected to be an issue. For example, noise from a compost facility may meet the permissible noise levels established by the DOH, but may be perceived by the individual/population affected to be an issue. These subjective issues will be considered.
18	Site cost	Site cost includes land acquisition and facility construction, including utilities and roads. Costs must be minimized for the facility to be economically viable and benefit the community.
19	Not in proximity of streams or surface water	Facility construction within 300 feet of perennial streams, and within 1,000 feet of other surface water, should be avoided if practicable in order to minimize attraction of wildlife and impacts to the local environment.
20	Not within 1,000 feet of water wells	Pursuant to the Safe Drinking Water of Act of 1974, 40 Code of Federal Regulations Parts 35, 124, 141, 142, 144, 145, 146, and 148, and HRS Chapters 340E and 340F, landfills should not be constructed within 1,000 feet of drinking water wells. For the purpose of this siting study, this guidance will also be considered for the Compost Facility.
21	Not within 0.5 mile of urban land	The intent of this criterion is to keep a compost facility within agricultural areas, where the site use would be appropriate, and to avoid potential conflicts of mixed types of permitted uses within the urban district.
22	Not on steep terrain	Construction in areas with undesirable topography, such as slopes in excess of 33 degrees, is generally avoided and would require additional design and construction activities and costs to accommodate for site conditions.
23	Not in high value agricultural lands	Agricultural Lands of Importance to the State of Hawaii can be identified on existing maps and should be avoided if possible. Furthermore, existing crop land with high value investments, such as taro or coffee, should not be disturbed, if possible.
24	Not in Special Management Area	Development within the Special Management Area is subject to the permitting and approval requirements that involve cost, time, and, depending on the proposed development, discretionary approval.
25	Not on State conservation land	A compost facility can be sited in the State Conservation district, but would require a Conservation District Use Permit. Because of this lengthy process (approximately one year), the Conservation district will be avoided. Compost facilities are not permitted in the rural district, which will therefore also be avoided.
26	Not on Federal land	The use of federal land would not be considered as the time for negotiations would be lengthy and it is unlikely that the federal government would consider a lease for a County compost facility.

2.2 CRITERIA SUMMARY

For this siting study, the criteria are summarized and categorized in Table 2-2.

Table 2-2: Categorization of Compost Facility Siting Criteria

Category	Criteria	Criteria No. (from Table 2-1)
Exclusionary	Not in wetland	3
	Not in critical habitat	4
	Not on Federal land	26
	Not on State conservation land	25
	Not in tsunami evacuation zone	8
	Not in 1% annual chance floodplain	2
	Not in fault area	5
	Not in seismic impact zone	6
	Not on steep terrain	22
	40+ acres available	9
Land Use	Not within 10,000 feet of an airport	1
	Agricultural land use designation	10
	Not in high value agricultural lands	23
	Not in a Special Management Area	24
Environmental	Low likelihood of cultural/archaeological resources	15
	Low likelihood of protected species	16
	Not in proximity of streams or surface water	19
	Not within 1,000 feet of water wells	20
	Not in otherwise unstable terrain	7
Community Impact	Not within 0.5 mile of urban lands	21
	Distance to neighbors	13
	Impact by nuisance factors (noise, odors)	17
Development Cost	Ease of access from highway	14
	Proximity to water and electric utilities	12
	Proximity to existing sort station	11
	Site cost	18

2.3 SITE EVALUATION METHODOLOGY

This section describes the methodologies by which the three potential sites were evaluated.

2.3.1 Site Scoring

The three sites were scored based on compliance with the established criteria. A recommended scaled score ranging from 1 to 5 was then applied to each criterion for each site as follows:

1. Not acceptable
2. Acceptable, with extensive mitigation
3. Acceptable, with minor caveats
4. Acceptable
5. Acceptable, with unique benefits

Each of the criteria was also assigned a recommended weight (importance) as follows:

Table 2-3: Recommended Criteria Weightings

Category	Criteria	Recommended Category Weight	Recommended Criteria Weight
Exclusionary	Not in wetland	Yes/No	Yes/No
	Not in critical habitat		Yes/No
	Not on Federal land		Yes/No
	Not on State conservation land		Yes/No
	Not in tsunami evacuation zone		Yes/No
	Not in 1% annual chance floodplain		Yes/No
	Not in fault area		Yes/No
	Not in seismic impact zone		Yes/No
	Not on steep terrain		Yes/No
	40+ acres available		Yes/No
Land Use	Not within 10,000 feet of an airport	20%	5%
	Agricultural land use designation		5%
	Not in high value agricultural lands		5%
	Not in a Special Management Area		5%
Environmental	Low likelihood of cultural/archaeological resources	30%	10%
	Low likelihood of protected species		5%
	Not in proximity of streams or surface water		5%
	Not within 1,000 feet of water wells		5%
	Not in otherwise unstable terrain		5%
Community Impact	Not within 0.5 mile of urban lands	20%	5%
	Distance to neighbors		5%
	Minimal impact by nuisance factors (noise, odors)		10%
Development Cost	Ease of access from highway	30%	5%
	Proximity to water and electric utilities		5%
	Proximity to existing sort station		10%
	Site cost		10%

For each criterion applied to each site, the weighted score is the scaled score multiplied by the recommended criteria weight. The total score for each site is the sum of the weighted criteria scores for that site.

Under the Exclusionary category, a site with a “No” rating will be excluded from further evaluation.

2.3.2 Information Used in Evaluation

The information used to evaluate the sites and apply the scaled scores was collected using:

- Desktop analyses, e.g., publicly available websites, geographic information system (GIS), and other reference documents as cited.
- Site reconnaissance conducted on January 5, 2018 and February 7, 2018 (Appendix A).
- Archaeological literature review conducted by Cultural Surveys Hawaii, Inc. (Appendix B).
- Transportation evaluation (Appendix C).
- Other methods, as described or cited.

The desktop analysis was primarily supported by four software platforms that were accessed with GIS:

- Esri software (Esri 2018);
- Flood Hazard Assessment Tool created and maintained by the State of Hawaii Department of Land and Natural Resources;
- County of Hawai‘i Real Property Tax Office website; and
- USFWS National Wetlands Inventory.

3.0 COMPOST FACILITY SITE EVALUATIONS

This section evaluates the suitability of the placement of a Compost Facility, with respect to the selected siting criteria, at each of the three sites.

3.1 EXCLUSIONARY CRITERIA EVALUATION RESULTS

Exclusionary criteria are criteria that must be met before the site will be further considered. All three sites met all of the exclusionary criteria so no site was eliminated from further consideration.

3.1.1 Wetland Areas

None of the three sites include a wetland (USFWS 2018). The nearest wetland to any site is a freshwater emergent wetland (FEW) over 1,000 feet from Site 3, across Volcano Road, a State route. Volcano Road presents a sizable physical barrier between the FEW and Site 3, in addition to other existing development fronting the FEW.

3.1.2 Critical Habitat

None of the three site parcels contain designated critical habitat (OP 2018). The nearest critical habitat to any one of the sites is over 28,000 feet from Site 2 for the Hawaiian picture-wing fly (*Drosophila mulli*).

3.1.3 Federal Government Lands

None of the three sites are federally owned or managed lands (OP 2018).

3.1.4 Conservation Land

None of the three sites is in a State Conservation District (OP 2018).

3.1.5 Tsunami Inundation Areas

None of the three sites are situated within the tsunami evacuation zone for Hawaii County (OP 2018).

3.1.6 Areas Within 1 Percent Annual Chance Floodplain

All three sites are outside the 1 percent annual chance floodplain. Furthermore, all three sites are within “Zone X”, which is “determined to be outside the 0.2 percent annual chance floodplain” (OP 2018).

3.1.7 Fault Areas

There is some faulting on Hawai‘i (Cannon et al. 2007); however, none of the three sites is located within 200 feet (60 meters) of any faults. Also, none of these faults have evidence of movement during the current (Holocene) epoch.

3.1.8 Seismic Impact Zones

The entire island of Hawai‘i is categorized as seismic zone 4 (OP 2018) with equal risk at all three sites. Any construction should be designed per code to endure stress from seismic impacts and should not exclude the siting of a compost facility.

3.1.9 Steep Terrain Areas

GIS investigation (OP 2018) revealed that all three parcels are on gradually sloping land. This was confirmed with field reconnaissance.

3.1.10 Availability of Forty Acres or More for Use

All three sites have at least 40 usable acres. See Figure 1-3, Figure 1-4, and Figure 1-5 for conceptual 40-acre areas and facility footprints.

3.2 LAND USE CRITERIA EVALUATION RESULTS

3.2.1 Areas within 10,000 Feet of Airport Runways

None of the three sites are within 10,000 feet of an airport.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.2.2 Agricultural Land Use Designation

The State of Hawaii designates four land use zoning districts: urban, rural, agricultural, and conservation. Sites 1 and 3 are entirely in a State agricultural district. The Site 2 conceptual site layout (40-acre area) is within a State urban district, though most of the TMK is zoned agricultural.

The County also designates zoning districts. Sites 1 and 2 are also zoned agricultural. The Site 2 conceptual site layout is within a County industrial district, though half of the TMK is zoned agricultural.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 3 of 5
- Site 3 scaled score = 4 of 5

3.2.3 High Value Agricultural Lands

Agricultural Lands of Importance to the State of Hawaii (ALISH) include three classes of agricultural lands: prime agricultural land, unique agricultural land, and other important agricultural land (IAL). Development within ALISH, particularly prime or unique, should be avoided.

Site 1 is not identified as ALISH land, except for a small section that is designated as prime and located far from the proposed facility footprint. Sites 2 and 3 are both primarily within the other IAL classification. Sites 2 and 3 were also confirmed as having active papaya cultivation, though the footprint of the proposed facility can be placed outside of the papaya fields.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 3 of 5
- Site 3 scaled score = 3 of 5

3.2.4 Special Management Area

None of the three sites is in the Special Management Area (OP 2018).

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.3 ENVIRONMENTAL CRITERIA EVALUATION RESULTS

3.3.1 Archaeological or Cultural Resources

An Archaeological Literature Review, performed by Cultural Surveys Hawaii as a part of this study (Appendix B), indicated that to date, no archaeological or historic features have been documented at any of the three proposed compost facility areas.

Site 1 has only been partially investigated, and scattered historic agricultural features have been documented in the vicinity. There is a higher likelihood of encountering intact archaeological features at Site 1 as the historic land use (grazing) would have been less destructive to archaeological features. Additionally, lava tubes, which may contain archaeological features, may be more common in the area of Site 1 (see evaluation of Unstable Terrain, Section 3.3.5).

Site 2 was investigated as part of two prior archaeological reconnaissance surveys, both of which noted extensive prior disturbance of this site, and did not recommend any further archaeological investigation.

Site 3 was investigated as part of one prior archaeological reconnaissance survey. Fewer disturbances were documented at Site 3 compared to those at Site 2, and it is possible that Historic-era features associated with sugar plantation may be present, but the survey did not recommend any further archaeological investigation of Site 3.

The Compost Facility construction documents will include a provision that should historic or archaeological sites be encountered during construction, then work in the vicinity will cease and the State Historic Preservation Division will be immediately notified.

- Site 1 scaled score = 3 of 5
- Site 2 scaled score = 5 of 5
- Site 3 scaled score = 4 of 5

3.3.2 Protected Species and Biological Resources

All three sites are disturbed and dominated by non-native and/or invasive vegetation. The Site Reconnaissance Log (Appendix A) provides a list of plant species observed at each site. It is unlikely that any federally protected Endangered Species Act (ESA) threatened or endangered plant species would be present.

There are no cliffs or sand dunes at these sites that would provide nesting habitat for native Hawaiian seabirds. To mitigate potential impact to seabirds, however, the Compost Facility design will specify shielded outdoor lights. To mitigate potential impact to the native hawk, the construction contract will include a requirement to retain a biologist to check for nests in March through September. To protect low-flying, foraging bats, barbed wire will not be used for fencing and, if construction will occur during the Hawaiian hoary bat breeding season (June 1 to September 15), then construction documents will specify that woody plants greater than 15 feet tall should not be removed or trimmed.

The endemic and State protected Hawaiian short-eared owl is regularly observed in various habitats on the Island of Hawaii. As such, this species may be present at all three sites.

For this study, no ESA-listed threatened or endangered species of state-protected species are suspected that cannot be reasonably managed.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.3.3 Proximity to Perennial Streams and Other Surface Water

None of the three sites are within 300 feet of a perennial stream. The nearest stream to any site is the intermittent Keaau Stream, approximately 5,400 feet from Site 1. No stream, perennial or intermittent, is within 1,000 feet of the three sites (OP 2018), and none of the three sites are within 1,000 feet of other surface water bodies.

The compost facility will include an Individual Wastewater System permit approved by the DOH which will ensure that the septic tank and leach field system have adequate capacity. To mitigate storm water impacts, onsite drainage design will incorporate low-impact development practices such as vegetated buffer or filter strips, vegetated open channels, and infiltration.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.3.4 Proximity to Water Wells

None of the sites are within 1,000 feet of existing drinking water wells (OP 2018).

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.3.5 Unstable Terrain

The soil conditions at Site 1 are classified as Keaukaha series with very shallow, organic soil and an average slope of 2–10 percent (UHM 2014). It has a moderate physical structure, but shallow pahoehoe bedrock which, according to the U.S. Department of Agriculture Soil Survey Geographic database (2016), overlies lava flows. Lava tubes may therefore be present at this site, which could limit engineering activities and also potentially contain cultural features.

The soil conditions at Site 2 are classified as Papai series with very-stony, organic soil and an average slope of 2–10 percent (UHM 2014). The physical structure of this soil type is considered moderate for engineering purposes.

The soil conditions at Site 3 are classified as Ola‘a series with stony, shallow, volcanic-ash soil and an average slope of 2–10 percent (UHM 2014). The Ola‘a series is defined as having a moderate physical structure for engineering purposes.

- Site 1 scaled score = 3 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.4 COMMUNITY IMPACT CRITERIA EVALUATION RESULTS

3.4.1 Proximity to Urban Lands

A preferred buffer distance of 0.5 mile (2,640 feet) from all urban/residential developed lands was used as a siting criterion to avoid potential conflicts with residential communities.

The Site 1 proposed development area is located approximately 6,000 feet from the nearest urban/residential built area to the south. The Site 2 proposed development area is located approximately 5,000 feet from the nearest urban/residential built area to the northeast. The Site 3 proposed development area is located approximately 5,000 feet from the nearest urban/residential built area located to the east.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.4.2 Distance to Neighbors

Site 1 is in an agricultural community. The lands adjacent to the north are crop fields, and the lands to the south, west, and east are predominantly unmaintained pasture or forest. The nearest existing individual residential structure appears to be approximately 1,900 feet to the northwest. The nearest individual commercial facility is approximately 1,800 feet to the west. The nearest school or day care (adult or child) is Keaau High School, approximately 3,750 feet to the northwest.

The Site 2 parcel is dominated by agricultural fields, as is the land to the south. The parcel immediately north is the Waiākea Forest Reserve, and the land to the east is a collection of light industrial facilities in the Shipman Business Park. The nearest existing residential structure appears to be approximately 4,500 feet to the east. The nearest commercial facility is approximately 750 feet to the east. The nearest school or day care (adult or child) is Kea‘au Middle School, approximately 7,600 feet to the south.

Site 3 is on a parcel adjacent to Site 2 and borders the same business park. The Site 3 parcel, and the neighboring areas to the south and west, are dominated by open pasture and forest patches. The nearest residential structure is approximately 5,400 feet to the northeast. The nearest commercial facility is approximately 420 feet to the east. The nearest school or day care (adult or child) is Kea‘au Middle School, approximately 6,900 feet to the south.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 3 of 5
- Site 3 scaled score = 3 of 5

3.4.3 Impact of Nuisance Factors (Aesthetics, Noise, Odor)

Visual aesthetics, noise, and odors are potential concerns from large-scale composting activities. Mitigative technologies and techniques to manage these nuisance factors include:

- The composting will occur within an EPA-approved GORE Cover System which utilizes forced aeration of the compostable material under a semi-permeable membrane cover. This in-vessel composting method will minimize the environmental impacts of odor, pests, and dust and will decrease the composting time required.
- The multi-bay, enclosed, receiving building (for use as a tipping floor and for waste handling) will incorporate a biofilter for treatment of the air exhaust from the building. To mitigate operational noise, openings in the building will be directed away from existing or future residences.
- The 40-acre minimum required facility area assures that site operations will be set back from the property line.

Site 1 is just off of Kea'au-Pahoa Road (Route 130). Existing dense vegetation at the site may shield views of the facility from the main road. Landscaping could also be designed and incorporated to mitigate any adverse visual impacts. Sites 2 and 3 are adjacent to the existing Shipman Business Park, located off of Hawaii Belt Road (Route 11) and would be expected to have similar or comparable visual impacts as the surrounding facilities.

The trade winds drive the predominant wind direction from the southeast at an average wind speed of 6.7 miles per hour, as measured at the Hilo Airport (*2016 The State of Hawaii Data Book*, November 2017 update). Site 1 is approximately 1,900 feet from the nearest downwind structures. Site 2 is approximately 750 feet from the nearest downwind commercial structures and 4,500 feet from the nearest residential structures. Site 3 is approximately 420 feet east of the nearest occupational populations and 5,400 feet from the nearest downwind residential structures.

Line of sight and aesthetic considerations are acceptable for all the sites, though noise and odors may be a greater concern at Sites 2 and 3 due to proximity to other facilities in the Business Park.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 3 of 5
- Site 3 scaled score = 3 of 5

3.5 DEVELOPMENT COST CRITERIA EVALUATION RESULTS

3.5.1 Ease of Access from Highway

As discussed in the Transportation Evaluation (Appendix C), access to Site 1 is proposed to be through the existing Kea'au Transfer Station to Kea'au-Pahoa Road. As proposed, this would be the longest driveway of the three site alternatives. An advantage of Site 1 is that it utilizes the existing Kea'au Transfer Station Driveway for access. DOT encourages consolidation of accesses when feasible. Another advantage is that this access has a median left-turn lane and a median refuge lane. The median left-turn lane may, however, need to be lengthened (with significant cost and effort) to accommodate the increased left-turning demand estimated for the Compost Facility.

Access to Site 2 would be located at the Kipimana Street/Mikahala Street intersection within the Shipman Business Park. Kipimana Street is a four-lane commercial roadway under the jurisdiction of the County of Hawai'i and the Kipimana Street/Mikahala Street intersection is fully constructed with stub outs for the west Kipimana Street and north Mikahala Street legs. The Site 2 driveway is proposed to connect to the Mikahala Street stub. Site 2 has the shortest driveway of the three alternative sites. This intersection likely has low competing demand for traffic and is likely to have the

capacity to handle the traffic generated by the proposed Compost Facility. Additional improvements may be relatively minor in nature.

Access to Site 3 would also be located at the Kipimana Street/Mikahala Street intersection within the Shipman Business Park. Site 3 is proposed to tie its driveway into the Kipimana Street stub. Site 3 has a medium length driveway.

For both Sites 2 and 3, the primary arterial roadway in this region is the Hawaii Belt Road (Route 11), under the jurisdiction of DOT. Kipimana Street intersects Hawaii Belt Road at a major, divided highway, intersection. Deceleration and acceleration lanes are, however, provided for traffic turning off of and on to Hawaii Belt Road. The intersection was designed for a fully built out Shipman Business Park and should be able to accommodate the traffic generated by the proposed Compost Facility.

For any selected site, it would be prudent to conduct intersection operational analyses that take into consideration the traffic volumes that would be added by the Compost Facility during commuter peak periods to understand more fully the costs that would be associated with access improvements.

- Site 1 scaled score = 3 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.5.2 Proximity to Water and Electric Utilities

All three sites are adjacent to overhead power lines and power poles at the proposed access/entrance points. It is assumed that power would be readily available for all three sites.

Consultation with the County of Hawai‘i Department of Water Supply (DWS), Water Resources and Planning Section on January 25, 2018, indicated that no record of any previous water requests exists for Site 1. Therefore, all water units allocated for the parcel are available for use. Water would be readily available from a 12-inch main along Kea‘au-Pahoa Road.

DWS indicated that the Site 2 and 3 parcels at Shipman Business Park, however, have no available water units. According to DWS, although there are 8-inch mains with fire hydrants located at the intersection of Kipimana Street and Mikahala Street, the Business Park has used up all available water units due to prior subdivisions. In order to get potable water at Site 2 or 3, DWS would require the applicant to pay for source development, as the water system for this area is already operating at maximum capacity, or to provide their own water source by wells or catchment. Well development to support either Site 2 or Site 3, as assumed in this study, would require time and cost.

- Site 1 scaled score = 4 of 5
- Site 2 scaled score = 3 of 5
- Site 3 scaled score = 3 of 5

3.5.3 Proximity to Existing Sort Station

Site 1, and both Site 2 and Site 3, are approximately 9.0 miles and 6.8 miles, respectively, from the East Hawai‘i Regional Sort Station. Proximity to the Sort Station and the County’s Solid Waste Baseyard could save substantial time and money in logistics and labor.

- Site 1 scaled score = 3 of 5
- Site 2 scaled score = 4 of 5
- Site 3 scaled score = 4 of 5

3.5.4 Site Cost

Site cost comparisons for this study are based on the following: market value of the property, utilities to the site, and access roads.

Assessed values of the TMKs were obtained from the County's Real Property Tax Office (hawaiipropertytax.com). The market value of the three sites were then roughly estimated based on the assessed value of their respective parcels, normalized by acre, and then multiplied by 40 acres.

As noted in Section 3.5.2, Sites 2 and 3 do not have access to a metered municipal water supply. This evaluation assumes that new wells would be installed on these sites. Also, per Section 3.5.1, access road costs vary depending on the length of the driveway from the adjacent public road.

The estimated costs are summarized in Table 3-1.

Table 3-1: Site Cost Estimates

Parameter	Site 1	Site 2	Site 3
TMK Size (acres)	989.5	424.3	1,235.8
Property Market * Value ($)	$1,831,300	$848,700	$1,236,200
Assessed Value per acre ($/acre)	$1,851	$2,000	$1,000
Assessed Value for 40 acres	$74,040	$80,000	$40,000
Allowance for Water Supply ($) [a]	N/A	$55,000	$55,000
Allowance for Access Road ($) [b]	$224,000	$43,200	$182,400
Total ($)	$298,040	$178,200	$237,400

Notes: N/A not applicable
[a] $100 per linear foot × 500 feet, + $5000 pump.
[b] $160 per linear foot for gravel drive.

The Design/Build cost of the facility, as reported by the County, and based on the conceptual layout (Figure 1-2), is expected to be approximately $10,300,000. For this study, the Design/Build cost is assumed to be equal for each site and is not included in Table 3-1.

- Site 1 scaled score = 3 of 5
- Site 2 scaled score = 5 of 5
- Site 3 scaled score = 4 of 5

4.0 SITE COMPARISONS AND CONCLUSIONS

This section summarizes the scaled scores recommended in Section 3.0, calculates a weighted total score for each site, and provides the Study's conclusions for siting the new Compost Facility.

4.1 SITE SCORING SUMMARY AND COMPARISONS

All three proposed facility sites meet the exclusionary criteria. All three sites were, therefore, further evaluated and scored.

Each site was assigned its total site score using the following steps:

- Each criterion at each site was evaluated and given a recommended scaled score of 1 to 5 (Section 3.0).
- The weighted criterion score for each site was then calculated as the product of its scaled score and the recommended associated weight.
- The weighted criterion scores for each site were then summed to get the total site score.

Table 4-1 summarizes the weighted criterion scores for each of the three sites.

4.2 CONCLUSIONS

All three potential Compost Facility sites are located outside of any identified exclusion zones. All three sites are technically and legally feasible sites for the County's new Compost Facility. The County could rationally decide which site to pursue based on several different criteria, or combinations of considerations. It should also be noted that any identified real or perceived deficiency in a particular site can potentially be mitigated.

Based on the weighted criterion scores, Site 2 ranks as the most desirable site. The difference between the three sites, however, is minimal.

Site 2 and Site 3 score high for Environmental criteria, particularly lack of potential archaeological features, and for Development cost, though lack of available public water is an issue.

Site 1 scored highest for Land Use and Community Impact, but it is farthest from the East Hawai‘i Regional Sort Station and has the highest theoretical site cost due to a long driveway and the potential need to upgrade the public road turn lanes.

The top-ranked site will receive additional design and evaluation in the EA phase of this project.

Table 4-1: Summary of Siting Criteria Scores

Category	Criteria	Recommended Scaled Scored			Recommended Criteria Weight	Weighted Scores		
		Site 1 1-6-001:015	Site 2 1-6-003:090	Site 3 1-6-003:007		Site 1 1-6-001:015	Site 2 1-6-003:090	Site 3 1-6-003:007
Exclusionary	Not in wetland	Y	Y	Y	Yes/No	Y	Y	Y
	Not in critical habitat	Y	Y	Y	Yes/No	Y	Y	Y
	Not on Federal land	Y	Y	Y	Yes/No	Y	Y	Y
	Not on State conservation land	Y	Y	Y	Yes/No	Y	Y	Y
	Not in tsunami evacuation zone	Y	Y	Y	Yes/No	Y	Y	Y
	Not in 1% annual chance floodplain	Y	Y	Y	Yes/No	Y	Y	Y
	Not in fault area	Y	Y	Y	Yes/No	Y	Y	Y
	Not in seismic impact zone	Y	Y	Y	Yes/No	Y	Y	Y
	Not on steep terrain	Y	Y	Y	Yes/No	Y	Y	Y
	40+ acres available	Y	Y	Y	Yes/No	Y	Y	Y
Land Use	Not within 10,000 feet of an airport	4	4	4	5%	0.20	0.20	0.20
	Agricultural land use designation	4	3	4	5%	0.20	0.15	0.20
	Not in high value agricultural lands	4	3	3	5%	0.20	0.15	0.15
	Not in a Special Management Area	4	4	4	10%	0.40	0.40	0.40
Environmental	Low likelihood of cultural/archaeological resources	3	5	4	10%	0.30	0.50	0.40
	Low likelihood of protected species	4	4	4	5%	0.20	0.20	0.20
	Not in proximity of streams or surface water	4	4	4	5%	0.20	0.20	0.20
	Not within 1,000 feet of water wells	4	4	4	5%	0.20	0.20	0.20
	Not in otherwise unstable terrain	3	4	4	5%	0.15	0.20	0.20
Community Impact	Not within 0.5 mile of urban lands	4	4	4	5%	0.20	0.20	0.20
	Distance to neighbors	4	3	3	5%	0.20	0.15	0.15
	Minimal impact by nuisance factors (noise, odors)	4	3	3	10%	0.40	0.30	0.30
Development Cost	Ease of access from highway	3	4	4	5%	0.15	0.20	0.20
	Proximity to water and electric utilities	4	3	3	5%	0.20	0.15	0.15
	Proximity to existing sort station	3	4	4	5%	0.15	0.20	0.20
	Site cost	3	5	4	10%	0.30	0.50	0.40
					Total Site Scores:	**3.65**	**3.90**	**3.75**

5.0 REFERENCES

Cannon, Eric C., Roland Burgmann, Anthony J. Crone, Michael N. Machette, and Richard L. Dart. 2007. “Map and Data for Quaternary Faults and Fault Systems on the Island of Hawai‘i.” Report 2007–1284. Open-File Report. USGS Publications Warehouse. http://pubs.er.usgs.gov/publication/ofr20071284.

Esri. 2018. *ArcGIS Explorer*. Redlands, CA: Environmental Systems Research Institute.

Office of Planning, State of Hawaii (OP). 2018. “Hawaii Statewide GIS Program.” 2018. http://planning.hawaii.gov/gis/.

PBR Hawaii & Associates, Inc. (PBR Hawaii). 2016. *County of Hawaii, East Hawaii Organics Facility, Draft Environmental Assessment – Anticipated Finding of No Significant Impacts*. August.

United States Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2016. “Web Soil Survey.” 2016. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

United States Fish and Wildlife Service (USFWS). 2018. “National Wetlands Inventory.” 2018. http://www.fws.gov/wetlands/.

University of Hawaii at Manoa (UHM). 2014. *Hawaii Soil Atlas*. Honolulu, HI: College of Tropical Agriculture and Human Resources (CTAHR).

This page is intentionally left blank.

Appendix A:
Site Reconnaissance Log

This page is intentionally left blank.

SITE RECONNAISSANCE

The County of Hawai‘i is evaluating three potential sites in east Hawai‘i for its Compost Facility. All three sites are located in the Kea‘au area.

AECOM Technical Services, Inc. (AECOM) conducted a windshield inspection and a site reconnaissance at each of the three potential sites to visually inspect for issues that could preclude or greatly affect the construction of a compost facility. The windshield inspection was conducted on January 5, 2018. The site reconnaissance was conducted on February 7, 2018. The land owner W. H. Shipman, Limited, granted Right of Entry to the County of Hawai‘i and its agents for the site reconnaissance. Results from both the windshield inspection and site reconnaissance are presented below.

1.0 SITE 1 – TMK 1-6-001:015 - KEA‘AU-PAHOA ROAD

Figure 3-1 illustrates the location of the proposed Site 1 of the Compost Facility.



FIGURE 1-3: SITE 1 CONCEPTUAL LAYOUT
County of Hawai‘i Compost Facility Siting Study
AECOM
March 2018

Site 1 (TMK 1-6-001:015) is located on Kea‘au-Pahoa Road (Route 130), adjacent to the existing Kea‘au Transfer Station. The site was accessed from the parking area near the entrance to the Kea‘au Transfer Station. Due to limited safe access points from the highway and dense vegetation, the field reconnaissance was limited to a small area of the proposed compost facility area located directly adjacent to the transfer station. The length of Kea‘au-Pahoa Road (Route 11) that abuts the parcel was also toured. Land use, topography, and vegetation throughout the length of the parcel appeared fairly consistent. No issues that would preclude construction of a compost facility were identified.

1.1 SITE ACCESS

The site would be accessed from the Kea‘au-Pahoa Road (Route 130). Entrance to the site from Kea‘au-Pahoa Road would be the same as currently used for the transfer station. There is an existing left-turn lane that would be used by vehicles access the site from the southbound direction on Kea‘au-Pahoa Road (Photo 1). The driveway to the compost facility would be located prior to the gate for the transfer station (Photo 2).

1.2 LAND USE

No existing land uses were identified on the parcel.

1.3 UTILITIES

Existing power lines are present at the proposed entry point to this site. AECOM consulted with the County of Hawai‘i Department of Water Supply (DWS), Water Resources and Planning Section on January 25, 2018. According to the DWS, Site 1 does not have record of any previous water requests. Therefore, all water units allocated for the parcel are available for use. Water would be readily available from a 12-inch main along Kea‘au-Pahoa Road.

1.4 TOPOGRAPHY

The parcel appeared relatively flat throughout.

1.5 SURFACE WATERS AND DRAINAGE FEATURES

There is an intermittent stream on the parcel (Photo 3) located over 5,000 feet from the proposed composting facility area. No other surface water or drainage features have been identified at the site.

1.6 VEGETATION

The site is overgrown with dense vegetation. All vegetation observed at the site was non-native. Dominate tree species included albizia (*Falcataria moluccana*), kukui nut (*Aleurites moluccana*), gunpowder tree (*Trema orientalis*), African tulip tree (*Spathodea campanulata*), banyan tree (*Ficus microcarpa*) and Manila tamarind (*Pithecellobium dulce*). The understory vegetation included pothos vine (*Epipremnum pinnatum*), Guinea grass (*Megathyrsus maximus*), red ginger (*Alpinia purpurata*), bingabing (*Macaranga mappa*), melochia (*Melochia umbellate*), and dumb cane (*Dieffenbachia seguine*). Photo 4 shows some of the vegetation at the site.

1.7 WILDLIFE

The site does not appear to provide any suitable habitat for most native wildlife. No wildlife was observed during the field reconnaissance. The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), threatened Hawaiian hawk (*Buteo solitarius*) and endemic and State-protected Hawaiian short-eared owl (*Asio flammeus sandwichensis*) are known to occur in a broad range of habitats throughout the island of Hawai‘i and may be present at this site. Tall trees suitable for bat roosting are present at this site.

1.8 VISUAL AND NOISE

The only nearby land use is the existing Kea‘au Transfer Station; therefore, it is unlikely visual and noise impacts will be a significant concern. The site of the proposed compost facility area is densely vegetated. A portion of this vegetation could be retained to mitigate potential noise impacts and block views of the compost facility from Kea‘au-Pahoa Road.



Photo 1: Site 1. Existing left-turn lane for Kea‘au Transfer Station from the southbound Kea‘au-Pahoa Road.



Photo 2: Site 1. Proposed location of driveway to compost facility.



Photo 3: Site 1. Intermittent stream on the parcel; located over 5,000 feet from the proposed composting facility area.



Photo 4: Site 1. Kukui nut tree, gunpowder trees, and pothos vines.

2.0 SITE 2 – TMK 1-6-003:090 – W. H. SHIPMAN BUSINESS PARK #1

Figure 3-2 illustrates the location of the proposed Site 2 of the Compost Facility.



FIGURE 3-2: SITE 2 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study

AECOM
January 2018

Site 2 (TMK 1-6-003:090) is located within W. H. Shipman Business Park at the intersection of Kipimana Street and Mikahala Street. These two roads currently have dead ends a few feet past their point of intersection (Photo 5). A portion of the densely vegetated area of the site, just north of the intersection of Kipimana Street and Mikahala Street, was investigated on foot. The remainder of the site reconnaissance was performed by vehicle utilizing the existing agricultural roads at the site. No issues that would preclude construction of a compost facility were identified.

2.1 SITE ACCESS

The site would be accessed from Kipimana Street in W. H. Shipman Business Park. Vehicles would turn right off of Kipimana Street to enter the facility (Photo 5). The entrance to W. H. Shipman Business Park is located on Hawai'i Belt Road (Route 11). Vehicles would exit Hawai'i Belt Road on to Kipimana Street in order to access to the site.

2.2 LAND USE

Approximately half of the parcel is under papaya cultivation (Photo 6). The remainder of the parcel is densely vegetated and not in use. The proposed site of the compost facility area is densely vegetated and not in use, but would directly abut the papaya fields.

2.3 UTILITIES

There are four drainage inlets near the intersection of Mikahala Street and Kipimana Street (Photo 7). There is a fire hydrant near the intersection of Mikahala Street and Kipimana Street (Photo 8). There are existing power and telephone lines running along the west side of Mikahala Street (Photo 9) and south side of Kipimana Street.

AECOM consulted with the DWS, Water Resources and Planning Section on January 25, 2018. DWS has indicated that W. H. Shipman Business Park has no available water units for the parcels. According to DWS, although there are 8-inch mains with fire hydrants located at the intersection of Kipimana Street and Mikahala Street, W. H. Shipman Business Park has occupied all available water units due to prior subdivisions. In order to get potable water at this site, DWS would require the applicant to pay for source development, as the water system for this area is already operating at maximum capacity.

2.4 TOPOGRAPHY

The parcel appeared relatively flat throughout. There are some small vegetated berms, approximately three feet high, running east-west through the proposed compost facility area.

2.5 SURFACE WATERS AND DRAINAGE FEATURES

No surface water features were observed at the site. There was evidence of some minor drainage gullies and minor erosion through low areas between the berms within the proposed compost facility area.

2.6 VEGETATION

Areas of the site that have not been cleared for papaya cultivation or access roads are overgrown with dense vegetation. All vegetation observed at the site was non-native. The dominate tree species at the site are albizia and gunpowder tree (Photo 10). The understory vegetation included Guinea grass, Koster's curse (*Clidemia hirta*), purple plague (*Miconia calvescens*), bingabing, melochia, cenchrus grass (*Cenchrus sp.*), and wedelia (*Wedelia trilobata*). Both Koster's curse and purple plague miconia are highly invasive (Photo 11 and Photo 12). It is important that miconia at the site be removed by trained professionals with the Department of Land and Natural Resources or the Hawaii Invasive Species Council in order to prevent the spreading of seeds or re-sprouting.

2.7 WILDLIFE

The site does not appear to provide any suitable habitat for most native wildlife. Wildlife observed during the field reconnaissance included mongoose and spotted dove. A trap for wild pigs and evidence of pig rooting were also observed. The endangered Hawaiian hoary bat, threatened Hawaiian hawk, and endemic and State-protected Hawaiian short-eared owl are known to occur in a broad range of habitats throughout the island of Hawai'i and may be present at this site. Tall trees suitable for bat roosting are present at this site.

2.8 VISUAL AND NOISE

Surrounding land uses are light business and agricultural; therefore, it is unlikely that visual and noise impacts will be a significant concern. The site of the proposed compost facility area is densely vegetated. A portion of this vegetation could be retained to mitigate potential visual and noise impacts.

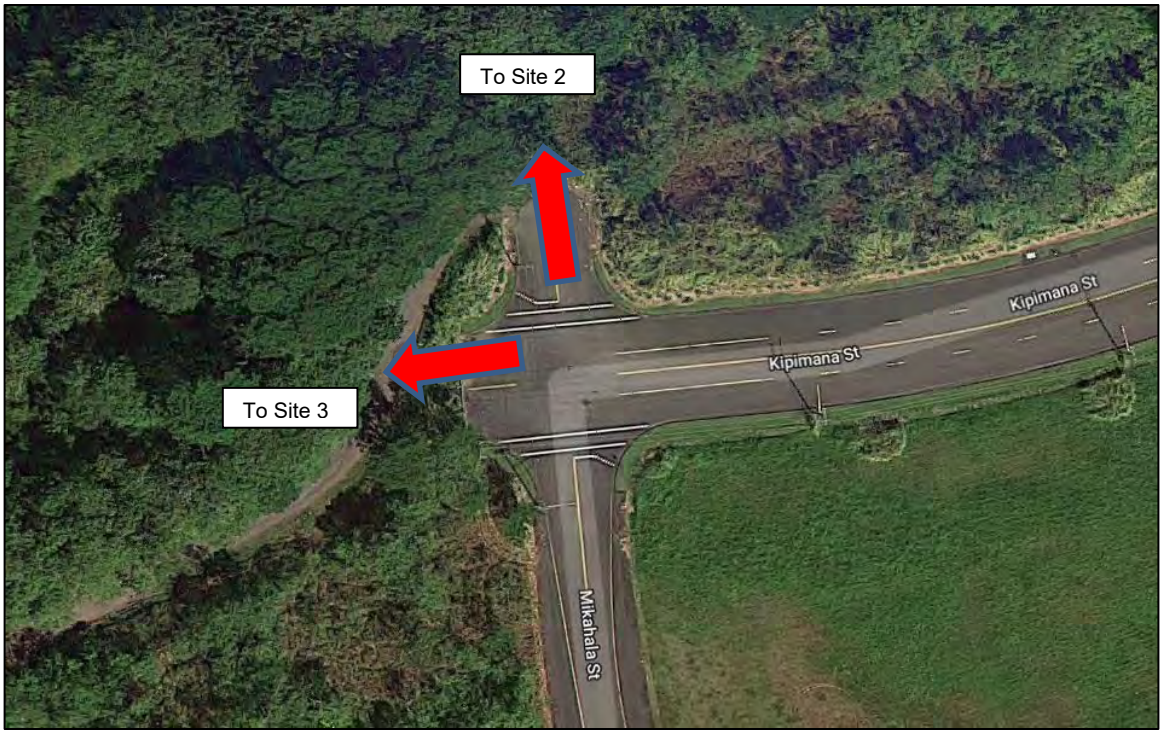


Photo 5: Sites 2 and 3. Location of proposed facility entrance for Sites 2 and 3.



Photo 6: Site 2. Papaya fields.



Photo 7: Sites 2 and 3. Drainage inlet near site entrance on Mikahala Street.



Photo 8: Sites 2 and 3. Fire hydrant and drainage inlet on Mikahala Street near the intersection with Kipimana Street.



Photo 9: Site 2. Existing power and telephone lines running along the west side of Mikahala Street with Kipimana Street.



Photo 10: Site 2. Albizia trees.



Photo 11: Site 2. Koster's curse.



Photo 12: Site 2. Purple plague miconia.

3.0 SITE 3 – TMK 1-6-003:007 – W. H. SHIPMAN BUSINESS PARK #2

Figure 3-3 illustrates the location of the proposed Site 3 of the Compost Facility.



FIGURE 3-3: SITE 3 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study

AECOM
January 2018

Site 3 (TMK 1-6-003:007) is also located within W. H. Shipman Business Park at the intersection of Kipimana Street and Mikahala Street. As described for Site 2, these two roads currently dead end a few feet past their point of intersection. A portion of the densely vegetated area of site, just west of the intersection of Kipimana Street and Mikahala Street was investigated on foot. Approximately 0.6 mile of the northern boundary of site was driven utilizing an existing agricultural road. This is a large parcel, the majority of which was not accessed as part of the site reconnaissance. Site reconnaissance focused on the proposed site of the compost facility area and the northern boundary of the parcel which was more easily accessible due to the presence of an existing agricultural road. No issues that would preclude construction of a compost facility were identified.

3.1 SITE ACCESS

The site would be accessed from Kipimana Street in W. H. Shipman Business Park (Photo 5). The entrance to W. H. Shipman Business Park is located on Hawai'i Belt Road (Route 11). Vehicles would exit Hawai'i Belt Road on to Kipimana Street in order to access to the site.

3.2 LAND USE

A portion of the northern side of this parcel is under papaya cultivation. The remainder of the parcel appears to be densely vegetated and does not appear to be in use. The proposed site of the compost facility area is densely vegetated and not in use, but would directly abut the papaya fields.

3.3 UTILITIES

Utilities at this site are the same as described for Site 2.

3.4 TOPOGRAPHY

The parcel appeared relatively flat throughout.

3.5 SURFACE WATERS AND DRAINAGE FEATURES

No surface water features or drainage features were observed at the site.

3.6 VEGETATION

Areas of the site that have not been cleared for papaya cultivation or access roads are overgrown with dense vegetation. All vegetation observed at the site was non-native. Vegetation observed at this site was the same as observed and described for Site 2. No purple plague miconia was observed at this site, but the lack of direct observation does not mean this highly invasive species is not present in areas not directly observed. The site should be more thoroughly surveyed for purple plague miconia so appropriate notification and removal procedures, described for Site 2, can be undertaken.

3.7 WILDLIFE

The site does not appear to provide any suitable habitat for most native wildlife. Wildlife observed during the field reconnaissance included mongoose and spotted dove. It is likely wild pigs are present at this site. The endangered Hawaiian hoary bat, threatened Hawaiian hawk and endemic and State-protected Hawaiian short-eared owl are known to occur in a broad range of habitats throughout the island of Hawai‘i and may be present at this site. Tall trees suitable for bat roosting are present at this site.

3.8 VISUAL AND NOISE

As discussed from Site 2, surrounding land uses are light industrial and agricultural; therefore, it is unlikely visual and noise impacts will be a significant concern. The site of the proposed compost facility area is densely vegetated. A portion of this vegetation could be retained to mitigate potential visual and noise impacts.

Appendix B:
Archaeological Literature Review

This page is intentionally left blank.

CULTURAL SURVEYS HAWAI'I
ARCHAEOLOGICAL , CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES — SINCE 1982

9 February 2018

Lesley A. Matsumoto, LEED AP
Senior Project Manager
AECOM
1001 Bishop Street, Suite 1600
Honolulu, Hi 96813

CSH Job Code—KEAAU 14

Subject: Archaeological Literature Review for the Compost Facility Siting Study Project, Kea'au Ahupua'a, Puna District, Hawai'i Island, TMKs: [3] 1-6-001:015 and 1-6-003:007 and 090 por.

Aloha Ms. Matsumoto,

At the request of AECOM, Cultural Surveys Hawai'i, Inc. (CSH) has completed an archaeological literature review for the Compost Facility Siting Study project, Kea'au Ahupua'a, Puna District, Hawai'i Island, TMKs: [3]1-6-001:015 and 1-6-003:007 and 090 por. The purpose of this literature review is to support project planning by facilitating selection of a new County of Hawai'i (COH) compost facility site. The Compost Facility Siting Study project area comprises three discrete, privately owned parcels located in Kea'au. A new COH compost facility will be developed on a minimum 40-acre portion of one of the three candidate sites. The three alternative Compost Facility sites (Site 1, Site 2, and Site 3) are depicted on portions of the 1995 Hilo and 1994 Mountain View U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1), tax map plats (Figure 2 and Figure 3), and 2013 aerial photographs (Figure 4 through Figure 6).

This archaeological literature review does not satisfy the Hawai'i state requirements for archaeological inventory surveys for government projects (Hawai'i Administrative Rules [HAR] §13-276 and §13-275). It is intended to support project planning by evaluating past land use patterns and previous archaeological coverage and findings within the proposed Compost Facility sites.

O'ahu Island
P.O. Box 1114
Kailua, HI 96734
Ph: (808) 262-9972
Fax: (808) 262-4950

Maui Island
1860 Main Street
Wailuku, HI 96793
Ph: (808) 242-9882
Fax: (808) 244-1994

Hawai'i Island
399 Hualani St.
Suite 124
Hilo, HI 96720
Ph. (866) 956-6478

Kaua'i Island
2970 Kele St.
Suite 114
Līhu'e, HI 96766
Ph. (808) 245-9374

Date: 9 February 2018

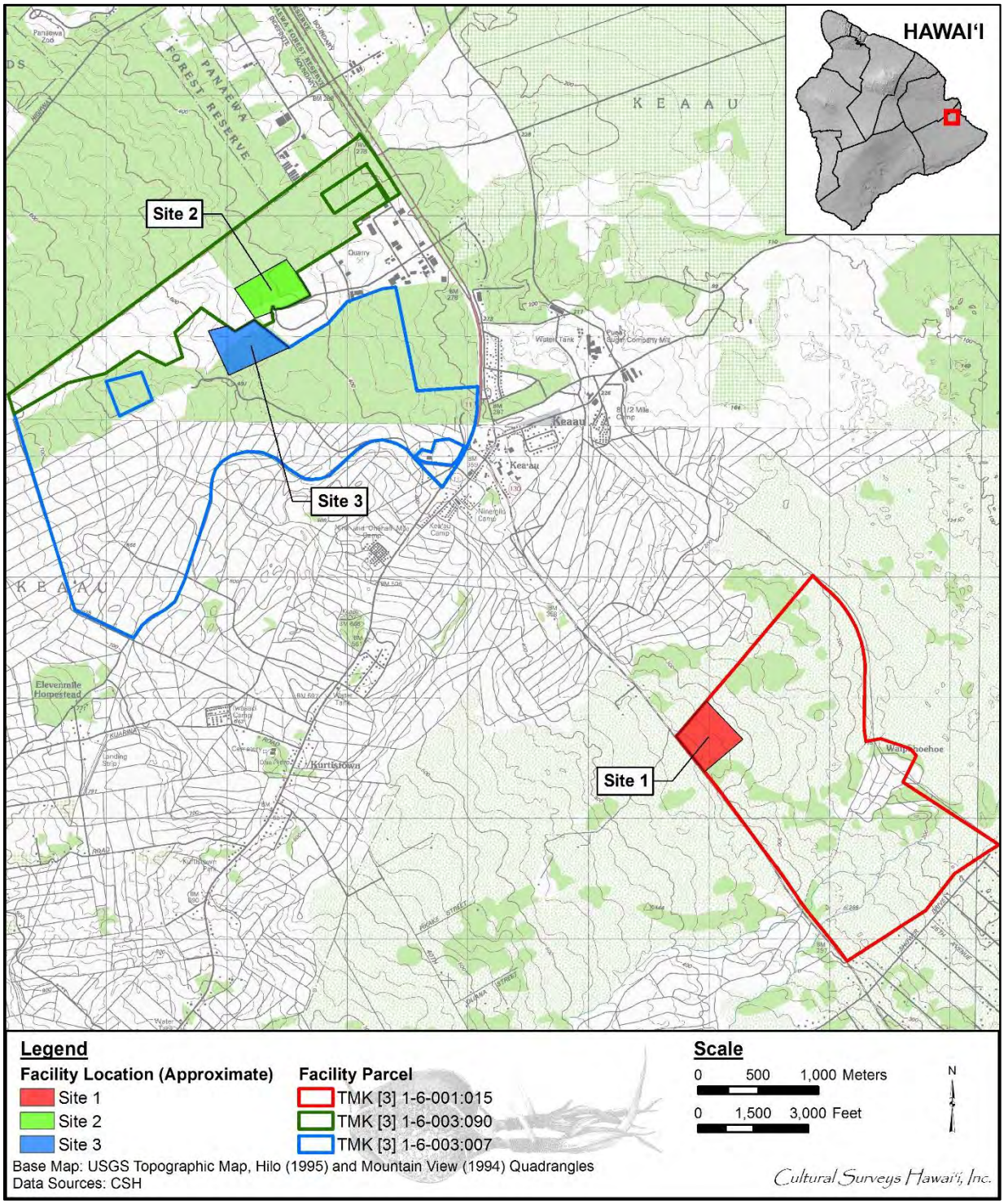


Figure 1. Portions of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangles showing the proposed alternative Compost Facility locations (Sites 1, 2, and 3) within their respective parcels

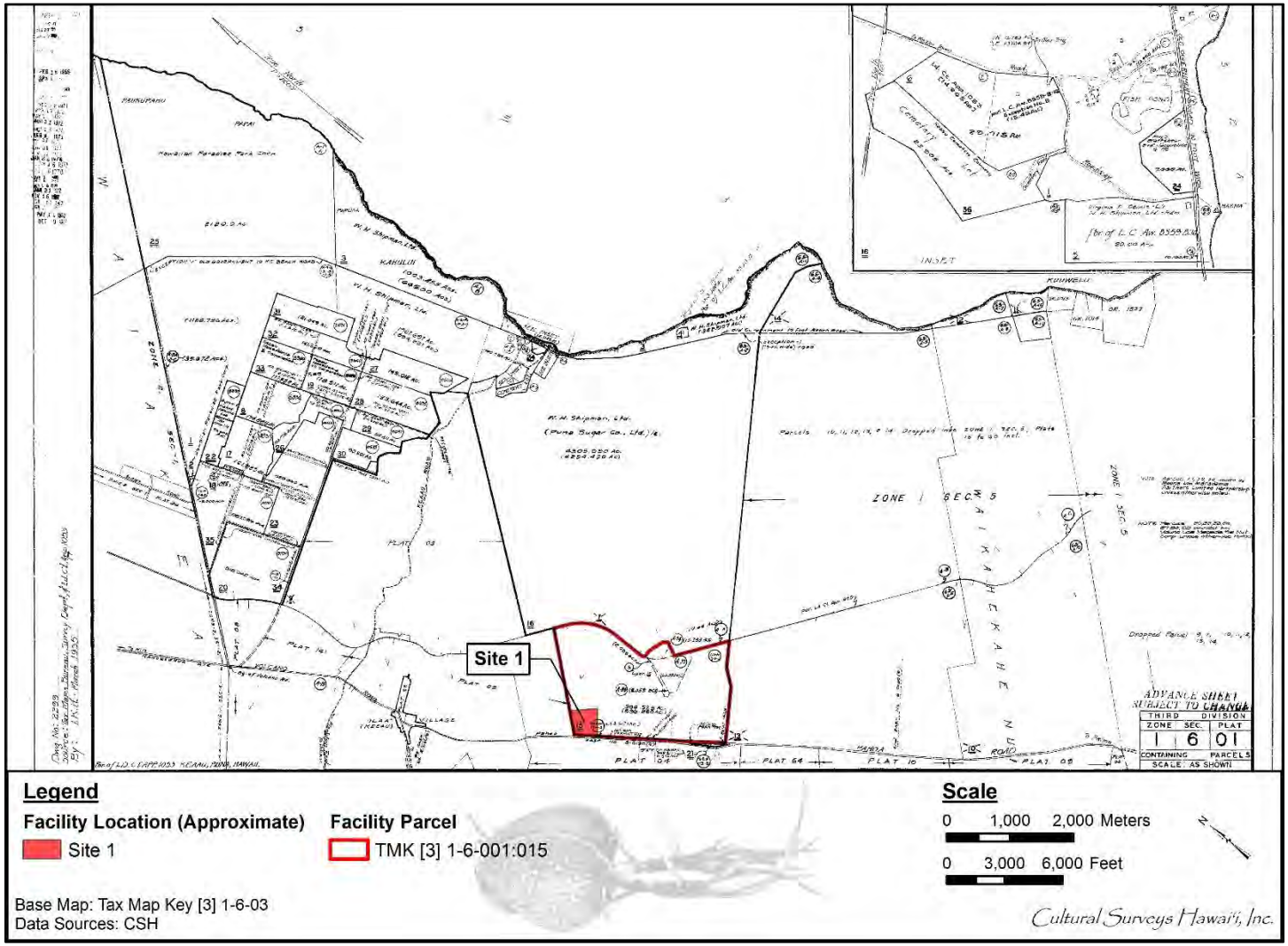


Figure 2. Tax Map Key (TMK) [3] 1-6-001 showing the approximate location of Compost Facility Site 1 (Hawai‘i TMK Service 2014)

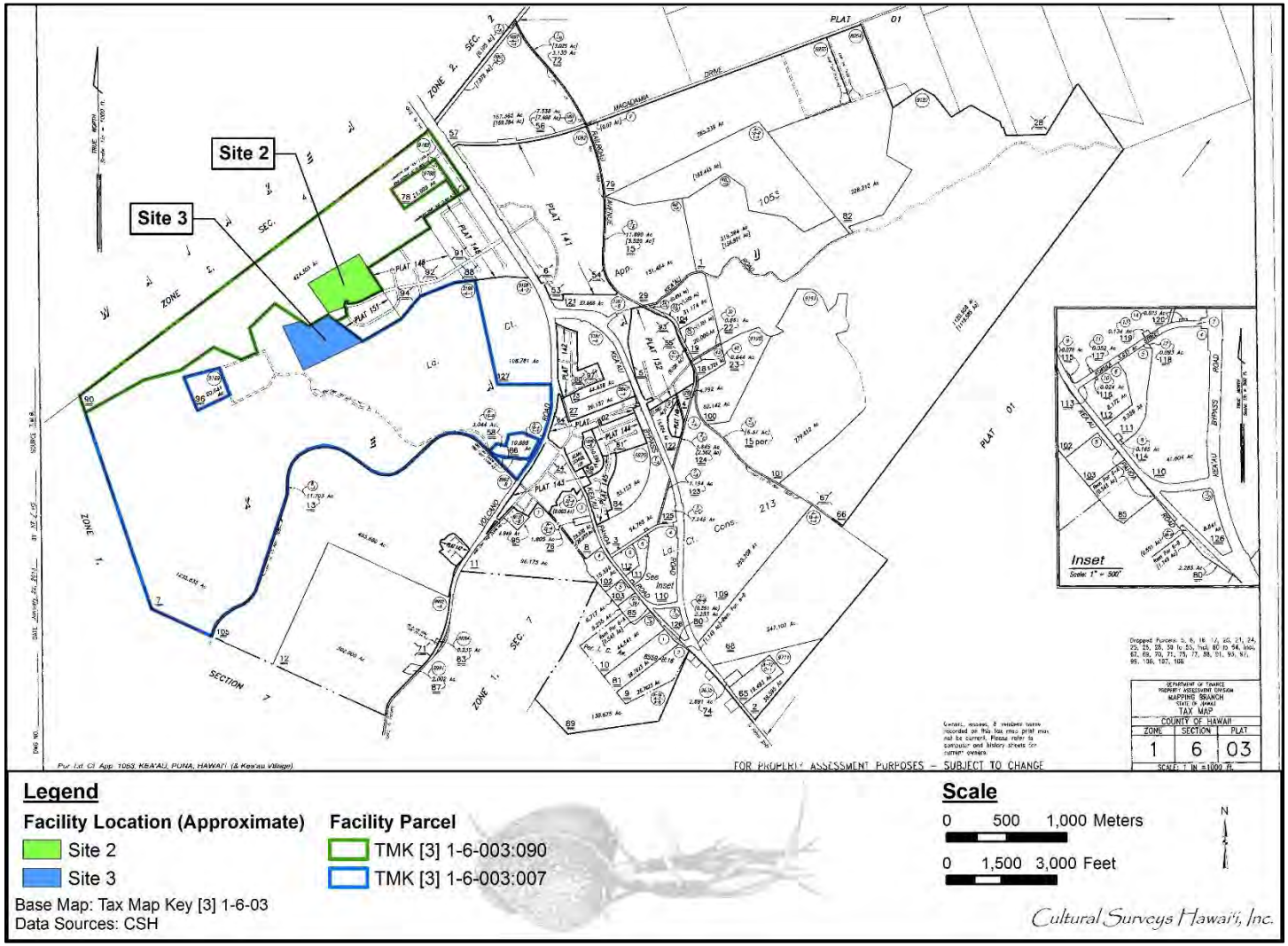


Figure 3. TMK: [3] 1-6-003 showing the approximate locations of Compost Facility Sites 2 and 3 (Hawai'i TMK Service 2014)

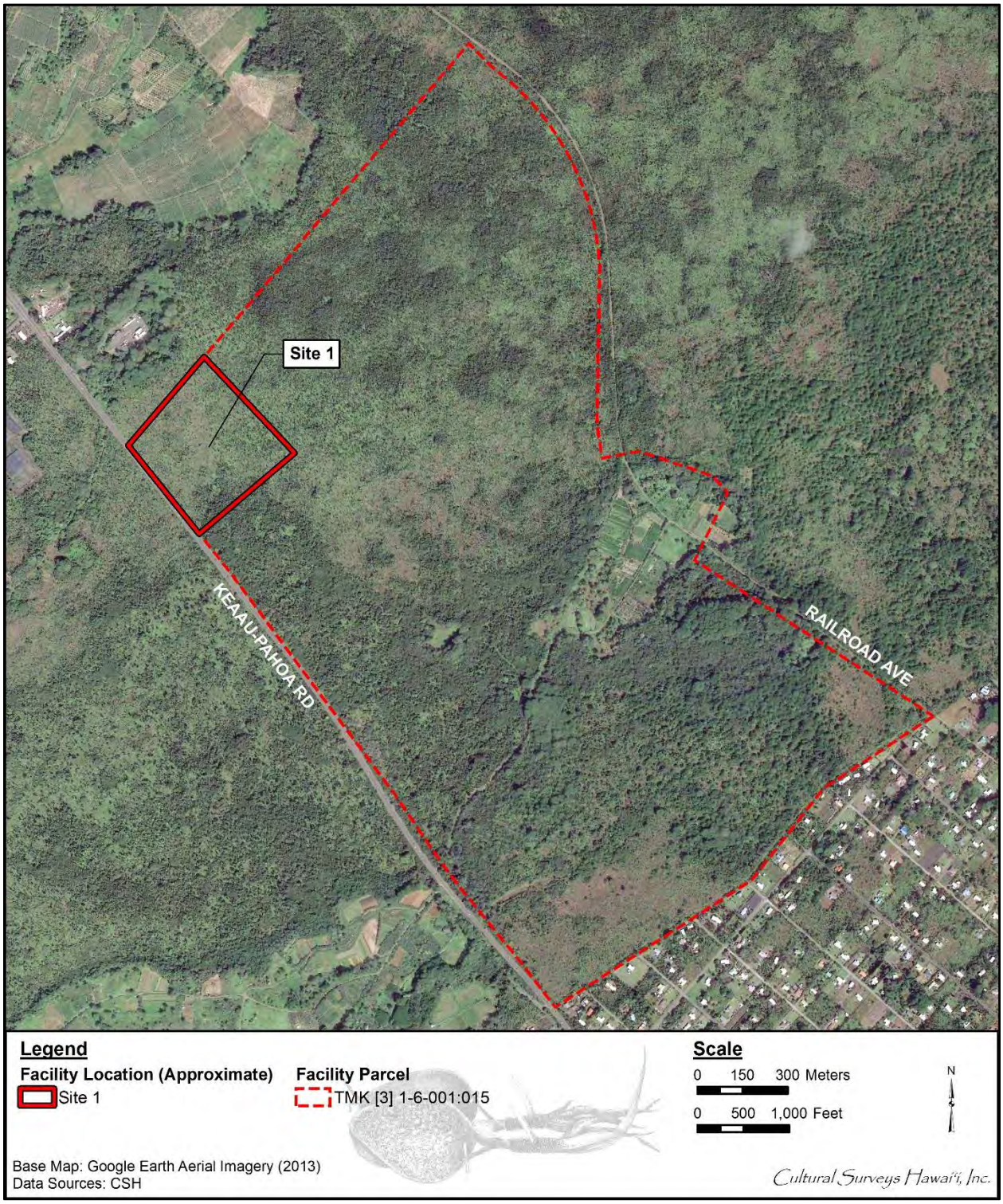


Figure 4. Aerial photograph showing the approximate location of Compost Facility Site 1 within TMK: [3] 1-6-001:015 (Google Earth 2013)

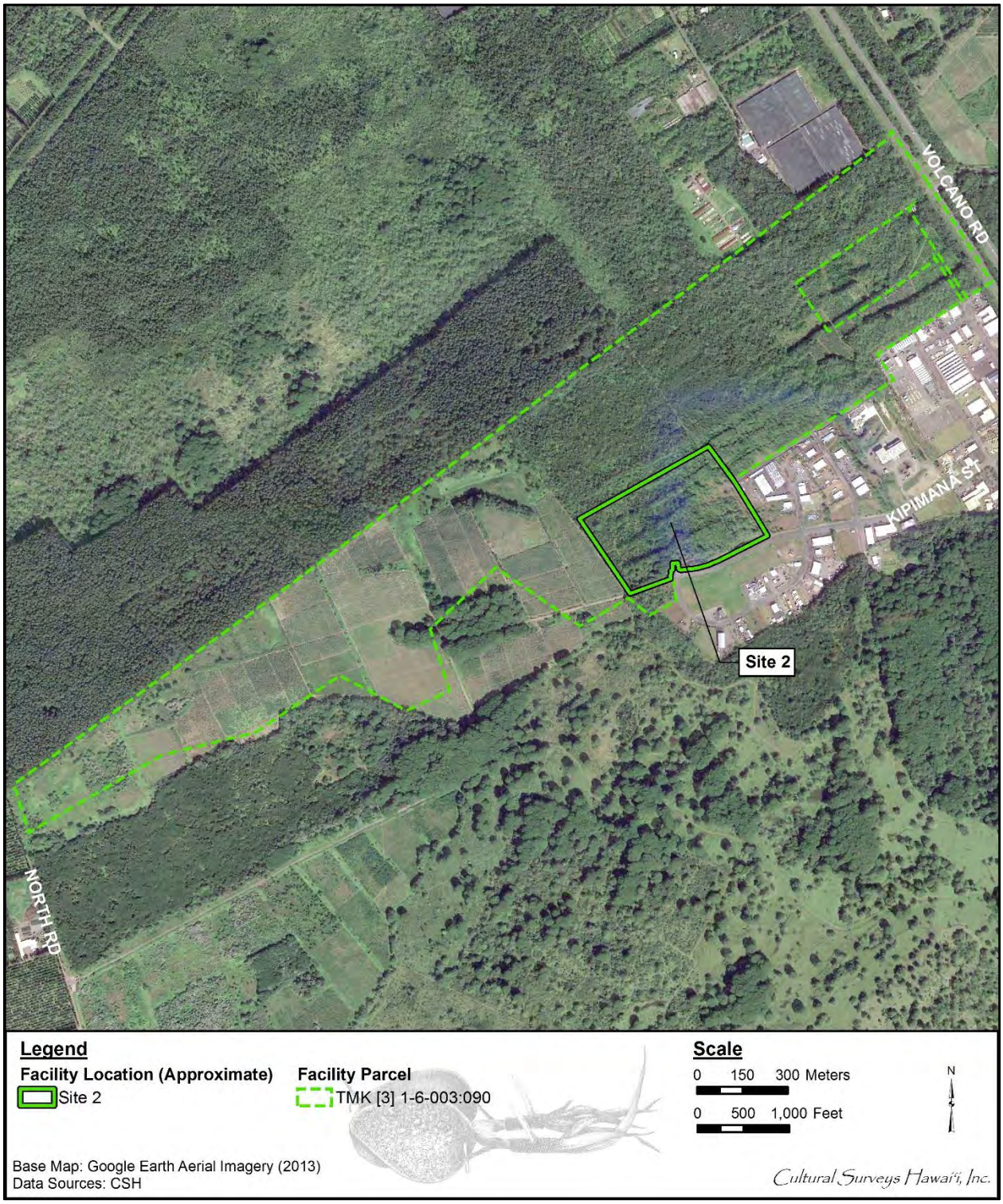


Figure 5. Aerial photograph showing the approximate location of Compost Facility Site 2 within TMK: [3] 1-6-003:090 (Google Earth 2013)

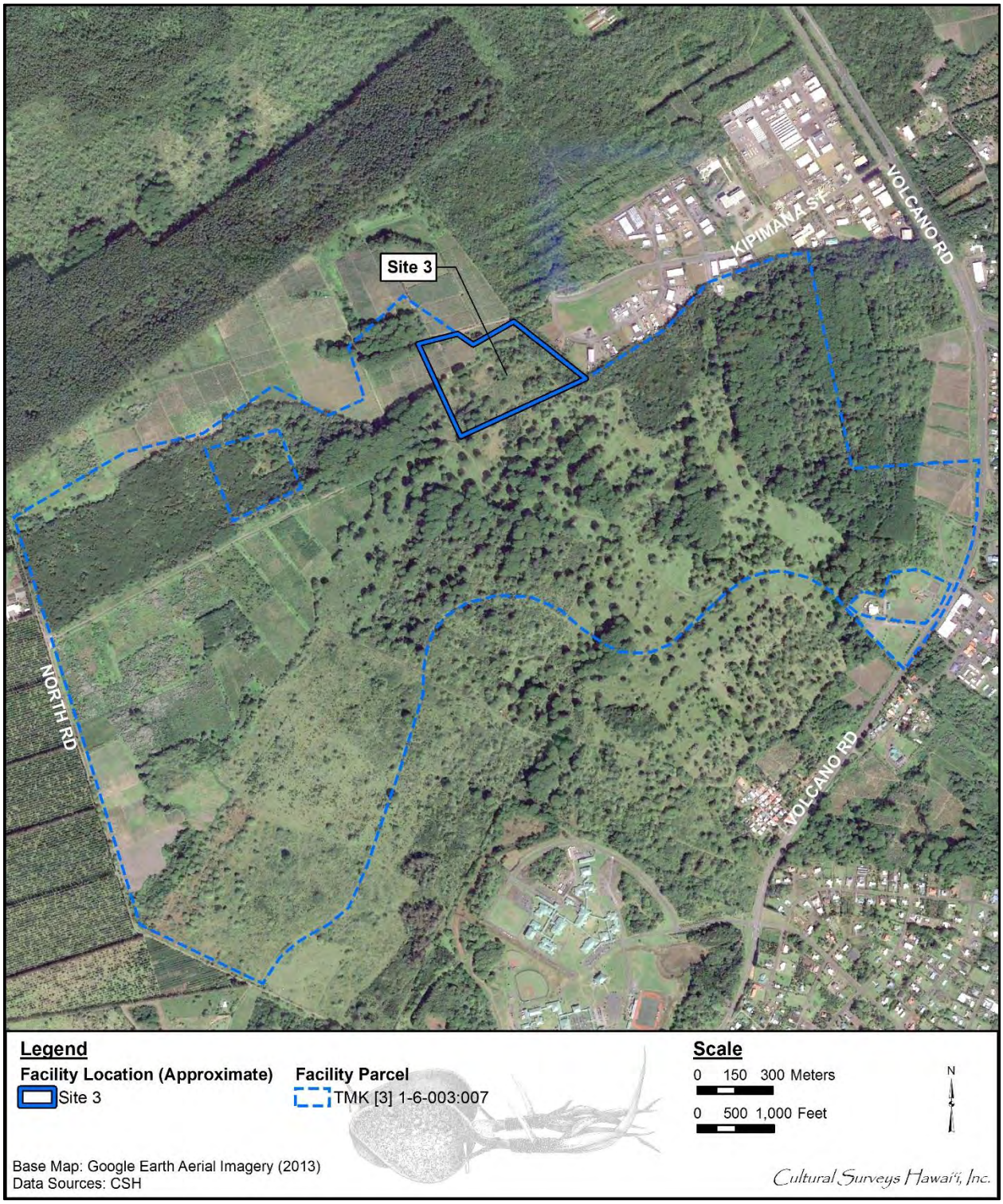


Figure 6. Aerial photograph showing the approximate location of Compost Facility Site 3 within TMK: [3] 1-6-003:007 (Google Earth 2013)

Setting

The three parcels proposed for the Compost Facility sites are located on the outskirts of Kea‘au Village on the windward side of Hawai‘i Island. The Kea‘au town center, accessed from Hawai‘i Belt Road/Route 11 and Kea‘au-Pahoa Road (Route 130), is surrounded by agricultural fields and residential subdivisions. Mean annual rainfall in Kea‘au Village is 3,612 mm (142 inches) (Giambelluca et al. 2013), or more than enough to support non-irrigated agriculture. Papaya and macadamia nuts are the predominant commercial crops in the area.

Kea‘au is situated along the boundary between the volcanoes of Mauna Loa and Kīlauea. According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Sato et al. (1973), Compost Facility Site 1 overlies Lava flows, pahoehoe (rLW), a miscellaneous land type exhibiting “a billowy, glassy surface that is relatively smooth” which “has no soil covering and is typically bare of vegetation,” (Sato et al. 1973:34). The soils in Compost Facility Sites 2 and 3 consist almost entirely of Papai extremely stony muck, 3 to 25% slopes (rPAE); the eastern corner of Compost Facility Site 3 overlies Keaukaha extremely rocky muck, 6 to 25% slopes (rKFD). Both the rPAE and rKFD soils are well-drained organic soils used for woodland or pasture; some areas of Papai soils are also used for orchards or truck crops (Sato et al. 1973:27, 46).

Compost Facility Site 1 (within 989.5-acre TMK: [3] 1-6-001:015) is located approximately 5.6 km (3.5 miles) back from the coast at an elevation of 92–105 m (302–344 feet [ft]) AMSL (above mean sea level). Compost Facility Site 2 (within 424.3-acre TMK: [3] 1-6-003:090) is located 7.5 km (4.7 miles) back from the coast at an elevation of 119–134 m (390–440 ft) AMSL. Compost Facility Site 3 (within 1,235.8-acre TMK: [3] 1-6-003:007) is located 7.7 km (4.8 miles) back from the coast at an elevation of 126–147 m (413–482 ft) AMSL. Compost Facility Site 1 is located along the *makai* (seaward) side of Highway 130 adjacent to the existing County Solid Waste Transfer and Recycling Station. The parcel is undeveloped land. Compost Facility Site 2 is located within and Compost Facility Site 3 is located directly adjacent to the *mauka* (upslope) portion of W.H. Shipman Business Park, accessed from Highway 11. The presence of former agricultural features (field boundaries/windbreaks/cane roads) visible on aerial photographs indicate Compost Facility Sites 2 and 3 were largely if not completely impacted by past historic and/or modern agricultural activity; only a small portion of Compost Facility Site 3 is indicated to be in active agricultural use.

Traditional and Historical Background

The project area is in the *ahupua‘a* (traditional land division) of Kea‘au. Few mythological and traditional accounts specifically discuss Kea‘au. Traditions imply that Puna was one of Hawai‘i’s wealthiest agricultural regions; it is only in relatively recent times that volcanic eruptions have destroyed much of Puna’s best land (Handy and Handy 1972:542).

Missionary William Ellis (1963:212) described Kea‘au in 1823 as “extensive and populous, abounding with well-cultivated plantations of taro, sweet potatoes, and sugar-cane; and probably owes its fertility to a fine rapid stream of water, which, descending from the mountains, runs through it into the sea…” Most the population inhabited the coast, where “the towns and villages of the natives are thickly scattered” (Ellis 1963:4). These accounts by Ellis and similar accounts

of other early foreign visitors to Hilo and Puna informed McEldowney's (1979:64) model for traditional settlement zones in Hilo and eastern Puna, summarized as follows:

I.	Coastal Settlement	20–50 ft in elevation	0–1.5 miles inland
II.	Upland Agricultural	50–1,500 ft in elevation	1.5–4.5 miles inland
III.	Lower Forest	1,500–2,500 ft in elevation	
IV.	Rainforest	2,599–5,500 ft in elevation	
V.	Subalpine/Montane	Over 5,500 ft in elevation	

Following this model, the current project area is in the "Upland Agricultural" zone. McEldowney (1979) discusses this zone as follows:

> Although estimates as to the extent of this zone vary in early journal accounts, most confirm an expanse of unwooded grasslands or a 'plain' behind Hilo and in a band from Kea'au to roughly Mountain View, basically corresponding to the distribution of ash soils . . . On the widely spread pahoehoe flows of Kilauea that fall within Zone II, land-use may have focused on the extensive lava tube channels underlying the area. Within this zone, the possibilities of remnant agricultural complexes could be high on both ash and older aa or pahoehoe substrates that have not been disrupted by historic agricultural practices. [McEldowney 1979:18, 19]

High amounts of rainfall and porous substrate would have quickly leached nutrients from the soil, a fact that supports McEldowney's (1979:21) hypothesis that traditional agriculture in this windward Upland Agricultural zone involved swidden or slash-and-burn practices that may have altered forested areas into the open grasslands observed by early foreign visitors. Compost Facility Sites 2 and 3 may be situated along the boundary between these grassland areas and the Pana'ewa Forest, which McEldowney (1979:20) notes "in the early 1800s was one of the few forests to nearly reach the ocean." Komori (1987:31) remarks "The establishment of agricultural complexes, far from the primary areas used for settlement on the coast (circa 5 km.) sometime after A.D. 1450 is consistent with Kirch's [1985:284–308] model for the development of Hawaiian culture."

Cordy (2000:49–50) has estimated the population of each *ahupua'a* in Puna may have ranged from 50 to 100 residents, based on the size of the *ahupua'a* and the availability of food resources. By the time of the first missionary census (1831–1832), the combined population of the districts of Hilo and Puna was 12,500, a decline of over 50% for Puna (Cordy 2000:49). Soon after Contact, people began to move to port cities or other trading areas. Since Puna has no good harbor, it lost a large portion of its population.

In the mid-nineteenth century, the Kingdom of Hawai'i initiated a program of massive land reform known as the Māhele (land division of 1848) and Kuleana (land division, right, privilege, property) Act. By examining the patterns of *kuleana* Land Commission Award (LCA) parcels in the vicinity of the project area, insight can be gained to the likely intensity and nature of Hawaiian activity. In the Māhele, Kea'au Ahupua'a was granted as chief lands to William C. Lunalilo (LCA 8559-B). Only one *kuleana* award, comprising 13.64 acres, was granted in Kea'au: LCA 8081, RP 4360, to Hewahewa. This award is not located in proximity to the proposed Compost Facility sites. The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst and Schilz 1994:12–13, 17).

During the latter half of the nineteenth century the guardians of Lunalilo's estate leased portions of Kea'au Ahupua'a to various parties. The entire *ahupua'a* was finally sold to Samuel Damon, William H. Shipman, and J. Elderts in January 1882. By 1884, Shipman bought the interests of the other partners and became the sole owner. The lands were used as pasture for grazing cattle which were stock for the Hilo Meat Market and Waiakea Stock Ranch, also owned by Shipman. In 1889, a 40-ft right-of-way was granted by Shipman for the construction of Volcano Road. The road was completed sometime after 1893.

The Olaa Sugar Company/Puna Sugar Company leased portions of Kea'au and neighboring Ōla'a Ahupua'ā from 1899 to 1982, and became the driving factor for twentieth-century settlement in the town of Kea'au (at that time called 'Ōla'a). The plantation employed Japanese, Puerto Ricans, Chinese, Portuguese, Caucasians, and Hawaiians living in segregated areas within camps along Old Volcano Road.

According to Dorrance and Morgan (2000:106), "[b]y 1905 Olaa Sugar Company had a modern mill and 7,676 acres under cultivation serviced by the only standard gauge plantation railway in Hawai'i." Cane grown in Pāhoa and Kapoho to the southeast were also processed at the mill, which is located along Route 130 between the proposed Compost Facility sites. This industrial expansion in Kea'au marks the beginning of massive landscape alterations and clearing operations, which would have obliterated most, if not all, traditional archaeological sites present on the leased plantation lands. In the 1930s, over 15,000 acres were under cultivation.

For the first half of the twentieth century, the Hilo Railroad Company operated a line through Kea'au toward its fields *mauka* (inland) in Mountain View and Glenwood and south in Pāhoa and Kapoho. Historic maps indicate the rail lines through Kea'au were not located in proximity to the proposed Compost Facility sites. After 1948 the rail lines were abandoned and cane was hauled in trucks.

The lands of Kea'au south of the sugar plantation continued to be used for grazing. According to McEldowney (1979:41), "Shipman Ranch land between the Pana'ewa Forest and Kapoho was burned regularly to retain grass as the dominant ground cover." In the 1950s prior to Statehood, the Shipman Estate began to subdivide and sell off large pieces of land to developers. The result was the gradual development of large residential subdivisions including but not limited to Orchidland Estates, Hawaiian Paradise Park, and Hawaiian Acres (Wilkinson et al. 2010:55).

The closure of Puna Sugar Company in the 1980s caused the economy of Kea'au to contract for a time, though the town is currently experiencing expansion as nearby residential subdivisions have seen substantial population growth in recent years. The W.H. Shipman Business Park, considered a light industrial area, was established in 1999.

Previous Archaeological Research

Several archaeological investigations have been conducted in the vicinity of the current project area. These studies are outlined in Table 1, and the investigations conducted from the 1980s to present are depicted on Figure 7. The earliest archaeological investigations in the Kea'au vicinity were part of island-wide surveys by Thomas G. Thrum (1908) and John F.G. Stokes (1919), and Alfred Hudson's (1932) study of eastern Hawai'i Island (Table 1). These early investigations were typically limited to the old trails between towns and along the coast, focusing mainly on *heiau*

Table 1. Previous archaeological studies in the vicinity of the project area

Reference	Type of Study	Location	Results
Thrum 1908	Survey of *heiau*	Hawai‘i Island	Documented 18 *heiau* in Puna, none within Kea‘au (not shown in Figure 7)
Stokes 1919	Survey of *heiau*	Hawai‘i Island	Documented 12 *heiau* in Puna, many previously identified by Thrum (1908); none within Kea‘au (not shown in Figure 7)
Hudson 1932	Archaeological survey	Eastern Hawai‘i Island	Documented sites along coast in Puna, including some in vicinity of Pāpa‘i where Kamehameha declared the “Law of the Splintered Paddle” (not shown in Figure 7)
Emory 1945	Archaeological exploration	Shipman Cave, Kea‘au, TMK: [3] 1-6	State Inventory of Historic Places (SIHP) # 50-10-36-20678 (“Shipman Cave”), a lava tube used for refuge and burial (not shown in Figure 7)
Rosendahl 1982	Archaeological reconnaissance survey	Shipman Industrial Park, Kea‘au, TMK: [3] 1-6-003:012 por.	No historic properties or cultural materials identified; study noted prior land disturbance within TMKs: [3] 1-6-003:090 and 007 (Sites 2 and 3)
Komori 1987	Cultural and biological resources survey	Pohoiki to Puna-Substation 69KV Transmission Corridor, Kapoho to Kea‘au, Puna TMKs: [3] 1-4, 1-5 and 1-6	Identified 11 archaeological and three historic sites (not assigned SIHP numbers), including mostly agricultural features with associated habitation areas; feature types included irrigation ditches, terraces, platforms, modified outcrops, refuge and burial caves, petroglyphs, and a historic cement and stone foundation; one agricultural complex is located in TMK: [3] 1-6-001:015 outside Site 1
Rosendahl and Walker 1992	Archaeological reconnaissance survey	46 acres in ‘Ōla‘a, TMK: [3] 1-7-017:003	No historic properties or cultural materials identified
Hunt 1993	Archaeological reconnaissance survey	600 acres of Shipman Lands in Kea‘au, TMKs: [3] 1-6-003:003, 007, 008, 011, 012, 027, 029, 058, 073, 075, 084, 086, and 090	Identified 50 archaeological features (not assigned SIHP numbers) in areas less impacted by cane cultivation, likely associated with historic plantation activities; features included walls, platforms, and mounds; features concentrated near Kea‘au town away from the current project area
Hurst and Schilz 1994	Archaeological inventory survey	Kea‘au–Pāhoa Rd, Kea‘au, TMK: [3] 1-6-003	No historic properties or cultural materials identified

Reference	Type of Study	Location	Results
Walker et al. 1997	Archaeological inventory survey	75 acres for Kea‘au High School site, TMKs: [3] 1-6-003:003 (por.), 015 (por.), 084 (por.)	Documented SIHP # 50-10-44-21191, Hilo Railway Co. Right-of-Way (ROW)
Masterson and Hammatt 1998	Archaeological inventory survey	2.46 acres for Kea‘au Elderly Housing project, Kea‘au, TMKs: [3] 1-6-143:018 and 039 (por.)	No historic properties or cultural materials identified; modern Filipino Camp noted
McGerty and Spear 2000	Archaeological inventory survey	300 acres for proposed KSBE East Hawai‘i Campus, Kea‘au, TMK: [3] 1-6-03:012 (por.)	Documented SIHP # 50-10-44-21823 comprising seven mounds related to sugarcane clearing activities; no further work recommended
Haun and Henry 2004	Archaeological inventory survey	2-mile-long Kea‘au-Pāhoa Rd Shoulder Lane Conversion project, Kea‘au, multiple TMKs	No historic properties or cultural materials identified
Haun and Henry 2008	Archaeological inventory survey	8 acres in Kea‘au, TMKs: [3] 1-6-004:011, 047–053, 055, 056, and 1-6-064:266–269, 283–286	Documented SIHP # 50-10-44-26874 (Waipāhoehoe Stream Bridge), a historic-era concrete bridge
Wilkinson et al. 2008	Archaeological monitoring	Kea‘au Middle School, TMKs: [3] 1-6-002:001 and 1-6-003:059	No historic properties or cultural materials identified
Wilkinson et al. 2010	Archaeological inventory survey	Kea‘au-Pāhoa Rd, Kea‘au to Waiakahiula Ahupua‘a, TMKs: [3] 1-5 and 1-6	Documented one historic property previously recorded by Haun and Henry (2008): SIHP # 50-10-44-26874 (Waipāhoehoe Stream Bridge)
Wheeler et al. 2015	Archaeological field inspection	Kea‘au Middle School, TMKs: [3] 1-6-002:001 and 1-6-003:059	Buildings B, C, D, and E found to be greater than 50 years old; consultation with SHPD Architecture Branch recommended; portion of an *‘auwai* (irrigation ditch) documented adjacent to Buildings D and G
Wilkinson et al. 2017	Archaeological field inspection	Kea‘au High School, TMKs: [3] 1-6-003:110 (por.), 111, 112 (por.), and 118	No historic properties or cultural materials identified; remnants of a historic railroad berm (SIHP # 50-10-44-21191) once located on property not relocated

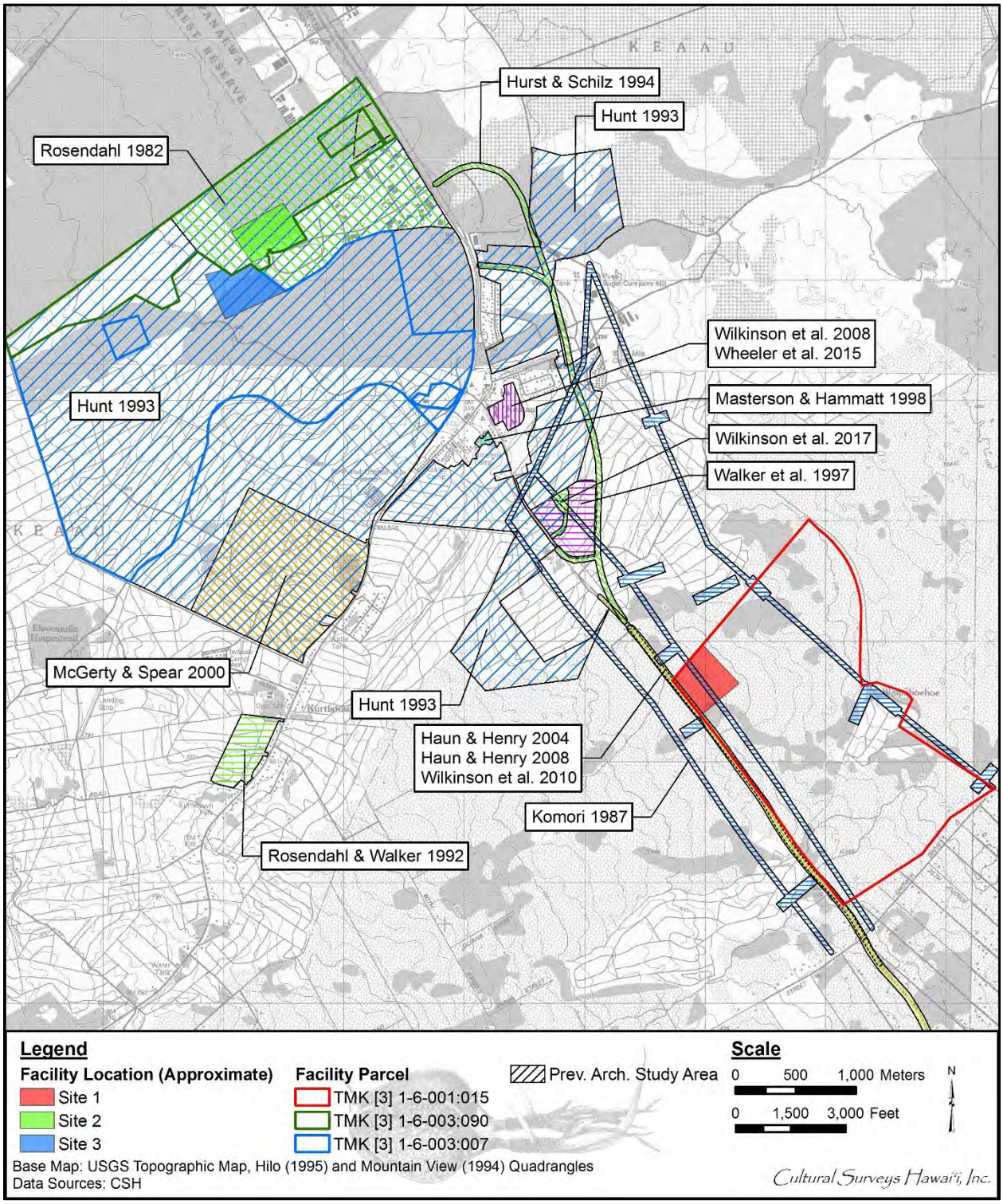


Figure 7. Portions of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangles showing the proposed Compost Facility sites in relation to previous archaeological studies in the vicinity

(traditional places of worship) and other major sites. Emory's (1945) work at Shipman Cave near the southern Kea'au boundary provided the first evidence of traditional lava tube use for refuge and burial placement in the Puna District. These early investigations took place away from the project area and are therefore not included on Figure 7.

Figure 7 depicts three previous studies overlapping the proposed Compost Facility sites: Compost Facility Site 1 is bisected by the Komori (1987) study area, with additional sections of the Komori (1987) study area crossing portions of TMK: [3] 1-6-001:015 outside Compost Facility Site 1; Compost Facility Site 2 (and overall TMK: [3] 1-6-003:090) is entirely overlapped by the Rosendahl (1982) study area; and Compost Facility Sites 2 and 3 (and overall respective TMKs: [3] 1-6-003:090 and 007) are entirely overlapped by the Hunt (1993) study area (see Figure 7). Discussions of these three previous studies follow. Furthermore, it is noted that the *mauka* side of Compost Facility Site 1 and overall TMK: [3] 1-6-001:015 bound the Route 130 right-of-way and are therefore directly adjacent to a series of previous studies conducted for highway-related projects (Haun and Henry [2004, 2008] and Wilkinson et al. [2011]; see Figure 7). Haun and Henry (2008) and Wilkinson et al. (2011) documented a single historic property: State Inventory of Historic Places (SIHP) # 50-10-44-26874 (Waipāhoehoe Stream Bridge), a historic-era concrete bridge located approximately 1.3 km (0.8 miles) south of Compost Facility Site 1.

In 1982, Paul H. Rosendahl, Inc. (PHRI) conducted an archaeological reconnaissance of approximately 490 acres for the proposed W.H. Shipman Industrial Park, in which the present proposed Compost Facility Site 2 is situated (Rosendahl 1982; see Figure 7). Rosendahl (1982:1–2) noted "[active] cane fields of Puna Sugar Co. border the parcel on the SE and SW boundaries," and that the 1982 project area was bisected by a cinder road running parallel to and approximately 0.65 miles *mauka* of the highway. This cinder road divided the property into a 170-acre western or inland portion and a 320-acre eastern or seaward portion. Compost Facility Site 2 is located within the inland 170-acre portion of the 1982 study area; of this portion Rosendahl (1982:2) wrote, "[T]he area had been bulldozed according to [a county planner] and was confirmed by a field check." The remaining lands *makai* (seaward) of the cinder road were found to contain a quarry, abandoned cane field, an orchid farm, and an area of undisturbed forest. No archaeological sites were encountered and no further work was recommended.

In 1987, Bernice Pauahi Bishop Museum (BPBM) conducted a cultural and biological resources survey of the proposed Pohoiki to Puna-substation 69kv Transmission Corridor (Komori 1987; see Figure 7). The project area consisted of 36 transects intended "to assess the potential for archaeological resources in the area" (Komori 1987:i). These transects were organized within several larger geographical "areas"; TMK: [3] 1-6-001:015 overlaps Areas A and I at the northern (Kea'au) end of the 1987 project area. In total, Komori (1987:13) recorded "11 archaeological and three historic sites . . ." One of these archaeological sites (A1-47, a complex of agricultural features) was documented within the western portion of TMK: [3] 1-6-001:015 well outside Compost Facility Site 1. The site is noted to be bound "on the west by one of the sugar cane fields at Waipahoehoe and on the east by forest" (Komori 1987:15). Two similar complexes were found outside TMK: [3] 1-6-001:015 to the north. These findings are in line with the scattered agricultural practices in McEldowney's (1979) Upland Agricultural zone. Komori (1987:32) recommended additional archaeological study of locations along the corridor planned for future development.

In 1993, Terry Hunt undertook an archaeological reconnaissance (termed an assessment) of 600 acres of Shipman Company lands in Kea‘au overlapping Compost Facility Sites 2 and 3 (and overall respective TMKs: [3] 1-6-003:090 and 007) (Hunt 1993; see Figure 7). No archaeological features were observed throughout the majority of the survey area, which had been heavily impacted by cane cultivation, including the lands of the current project area. However, 50 features including walls, mounds, platforms, and multi-feature complexes were documented within five areas that were not heavily impacted, located close to Kea‘au Town and not in the vicinity of the current project sites. Hunt (1993:11–12) interpreted these features as likely “associated with historic plantation activities, such as field clearing, and other cultivation work. It is possible that some features may date to earlier, prehistoric times, but further research, including test excavations would be needed to evaluate such an hypothesis.” Archaeological inventory survey was recommended for areas of future development in which resources were identified (Hunt 1993:14).

Summary and Recommendations

Background research indicates all three proposed Compost Facility sites are in McEldowney’s (1979) Upland Agricultural zone, traditionally used for scattered agricultural plots and associated settlements. Archaeological features documented by Komori (1987) in the general vicinity of Compost Facility Site 1 support this pattern of land use. In the historic era Compost Facility Site 1 was used by Shipman Ranch for cattle grazing, which may have caused some damage to existing archaeological features but likely would not have obliterated them. Compost Facility Sites 2 and 3 are located near the boundary of the grasslands of the Upland Agricultural zone and the Pana‘ewa Forest. Research suggests that while Compost Facility Site 2 may have never been under sugarcane, it was bulldozed for other purposes by the early 1980s, as reported by Rosendahl (1982). Hunt (1993) also did not locate any archaeological sites in this area, and described the area as completely disturbed. Examination of vegetation patterns in recent aerial imagery (Google Earth 2013) supports these assessments of prior disturbance. Compost Facility Site 3 is located on the fringes of the former sugarcane fields. Hunt (1993) did not find any archaeological features in this area, which he described as completely disturbed. Examination of recent aerial imagery (Google Earth 2013) indicates portions of Compost Facility Site 3 may be in active agricultural use, and field boundaries and roads likely associated with the former sugar plantation are visible.

For each candidate site, CSH proposes the following “pros” and “cons” for selection based on perceived archaeological sensitivities. These assessments take into consideration coverage by past archaeological study (or lack thereof), degree of prior land disturbance, and present conditions.

Proposed Compost Facility Site 1:

- **Pros:** Lack of archaeological features found along Komori’s (1987) transect bisecting the site; lack of findings in vicinity during adjacent studies for the highway (Haun and Henry [2004, 2008] and Wilkinson et al. [2010]);
- **Cons:** Lack of complete previous archaeological coverage; results of Komori (1987) study indicate scattered agricultural features in vicinity; historic land use (grazing) not as destructive to archaeological features; lava tubes (which may contain archaeological features) may be more common in this area.

Proposed Compost Facility Site 2:

- **Pros:** Complete prior archaeological coverage by Rosendahl (1982) and Hunt (1993); extensive prior disturbance noted during both previous studies; no archaeological features encountered during prior archaeological studies; indicated to be located just outside sugar plantation lands meaning low probability for associated historic features;
- **Cons:** Densely vegetated, increasing difficulty of site access for further survey.

Proposed Compost Facility Site 3:

- **Pros:** Complete prior archaeological coverage by Hunt (1993); extensive prior disturbance noted by Hunt (1993); no archaeological features encountered by Hunt (1993);
- **Cons:** Historic-era features associated with sugar plantation may be present.

Following the assessments above, CSH recommends selection of Compost Facility Site 2 at its currently proposed located in TMK: [3] 1-6-003:090. This recommendation is primarily based on the understanding that bulldozing occurred on the property in modern times destroying any pre-Contact or historic-era archaeological features that may have once been located there. If Compost Facility Site 2 is not found ideal for development based on other factors, we would recommend selection of Compost Facility Site 3. Please feel free to contact me by email at wfolk@culturalsurveys.com or by telephone at (808) 262-9972 with any questions.

Thank you,



William Folk
Project Manager
Cultural Surveys Hawai‘i, Inc.

References Cited

Cordy, Ross
2000 *Exalted Sits the Chief: The Ancient History of Hawai‘i Island*. Mutual Publishing, Honolulu.

Dorrance, William H. and Francis S. Morgan
2000 *The 165-Year Story of Sugar in Hawai‘i*. Mutual Publishing, Honolulu.

Ellis, William
1963 *Journal of William Ellis: Narrative of a Tour through Hawaii, or Owhyhee; With Observations on the Natural History of the Sandwich Islands and Remarks on the Manners, Customs, Traditions, History, and Language of their Inhabitants*. Advertiser Publishing Company, Honolulu.

Emory, Kenneth P.
1945 *Exploration of Herbert C. Shipman Cave, Keaau Division of Puna, Hawaii, Sept.13 and 14, 1945*. Bernice Pauahi Bishop Museum, Honolulu.

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.L. Chen, P.S. Chu, J.K. Eischeid, and D.M. Delparte
2013 Online Rainfall Atlas of Hawai‘i. *Bulletin of the American Meteorological Society volume 94, pp. 313-316, doi: 10.1175/BAMS-D-11-00228.1*. University of Hawai‘i at Mānoa, Honolulu. Electronic resource, http://rainfall.geography.hawaii.edu (accessed 25 March 2016).

Google Earth
2013 Aerial photographs of Hawai‘i. Google Inc., Mountain View, California. Available online at www.google.com/earth.html.

Handy, E.S. Craighill and Elizabeth Green Handy
1972 *Native Planters in Old Hawai‘i: their Life, Lore, and Environment*. Bishop Museum Bulletin No. 233. Bishop Museum Press, Honolulu.

Haun, Alan E. and Dave Henry
2004 *Archaeological Assessment Survey, Keaau-Pahoa Road Shoulder Lane Conversion, Land of Keaau, Puna District, Island of Hawaii*. Haun and Associates, Kea‘au, Hawai‘i.

2008 *Archaeological Inventory Survey, Portions of TMK: (3) 1-6-04: 11, 47-53, 55, 56, and 1-6-64:266-269, 283-286, Land of Kea‘au, Puna District, Island of Hawaii*. Haun and Associates, Kea‘au, Hawai‘i.

Hawai‘i Tax Map Key (TMK)
2014 Hawai‘i Tax Map Key (TMK) [3] 1-6-001, 003. Hawai‘i TMK Service, Honolulu.

Hudson, Alfred E.
1932 *The Archaeology of Eastern Hawaii*. Manuscript prepared for the Bishop Museum, Honolulu.

Hunt, Terry l.
1993 *Assessment of Shipman Lands in Kea‘au, Puna Island of Hawai‘i*. University of Hawai‘i, Honolulu.

Hurst, Gwen and Allan Schilz
1994 *Revised Archaeological Survey of the Kea‘au Town Section Project no. 130B-01-92 Puna, Hawai‘i (TMK 1-6-03)*. Ogden Environmental and Energy Services, Inc., Honolulu.

Kirch, Patrick V.
1985 *Feathered God and Fishhooks*. University of Hawai‘i Press, Honolulu.

Komori, Eric
1987 *Cultural and Biological Resources Survey of the Pohoiki to Puna-Substation 69KV Transmission Corridor, Kapoho to Kea‘au, Puna, Hawai‘i Island.* Bernice Pauahi Bishop Museum, Honolulu.

Masterson, Ian and Hallett H. Hammatt
1998 *Archaeological Inventory Survey for the Proposed Kea‘au Elderly Housing Project, Kea‘au, Puna District, Hawai‘i Island (TMK: 1-6-143: por. of 18 and 39)*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

McEldowney, Holly
1979 *Archaeological and Historical Literature Search and Research Design: Lava Flow Control Study, Hilo, Hawai‘i.* Department of Anthropology, Bernice Pauahi Bishop Museum, Honolulu.

McGerty, Leann and Robert Spear
2000 *An Archaeological Inventory Survey of the Proposed K.S.B.E. East Hawai‘i Campus, Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i (TMK 1-6-03: por. 12)*. Scientific Consultant Services, Inc., Honolulu.

Rosendahl, Margaret L.K.
1982 *Archaeological Reconnaissance Survey, Proposed W.H. Shipman Industrial Park, TMK: 3-1-6-03: Por. 12*. Paul H. Rosendahl, Ph.D., Inc., Kurtistown, Hawai‘i.

Rosendahl, Paul and Alan Walker

1992 *Archaeological Field Inspection of TMK 3-1-7-17:3, Land of Olaʻa, Puna District, Hawaiʻi*. Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawaiʻi.

Sato, Harry H., Warren Ikeda, Robert Paeth, Richard Smythe, and Minoru Takehiro, Jr.

1973 *Soil Survey of the Island of Hawaii, State of Hawaii*. U.S. Department of Agriculture, U.S. Government Printing Office, Washington, D.C.

Stokes, John F.G.

1919 *Notes on Hawaiian Heiaus*. Bishop Museum, Honolulu.

Thrum, Thomas G.

1908 Heiaus and Heiau Sites Throughout the Hawaiian Islands, Kauai. In *Hawaiian Almanac and Annual 1908*. Thos. G. Thrum, Honolulu.

USDA (U.S. Department of Agriculture)

2001 Soil Survey Geographic (SSURGO) database. U.S. Department of Agriculture, Natural Resources Conservation Service. Fort Worth, Texas. http://www.ncgc.nrcs.usda.gov/ products/datasets/ssurgo/ (accessed March 2005).

Walker, Alan, Kepā Maly, and Paul Rosendahl

1997 *Historical and Archaeological Research Proposed Keaʻau High School Site Land of Keaʻau, Puna District, Island of Hawaiʻi (TMK: 1-6-03: Por 3, 15, 84)*. Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawaiʻi.

Wheeler, Momi, Sarah Wilkinson, and Hallett H. Hammatt

2015 *Archaeological Literature Review and Field Inspection for Buildings B, D, E and G Demolition Project at Keaʻau Middle School, Keaʻau Ahupuaʻa, Puna District, Island of Hawaiʻi, TMK [3] 1-6-002:001 and 1-6-003:059*. Cultural Surveys Hawaiʻi, Inc., Kailua, Hawaiʻi.

Wilkinson, Sarah, Aulii Mitchell, and Hallett H. Hammatt

2010 *Archaeological Inventory Survey Report for the Keaʻau-Pāhoa Road Widening Project, Keaʻau Ahupuaʻa to Waiakahiula Ahupuaʻa, Puna District, Island of Hawaiʻi TMK [3] 1-5 (various plats and parcels); 1-6 (various plats and parcels)*. Cultural Surveys Hawaiʻi, Inc., Kailua, Hawaiʻi.

Wilkinson, Sarah, Olivier Bautista, and Hallett H. Hammatt

2017 *Archaeological Literature Review and Field Inspection Report for the Keaʻau High School Proposed Clearing and Grubbing of Approximately 4 Acres Project, Keaʻau Ahupuaʻa, Puna District, Hawaiʻi Island, TMKs: [3] 1-6-003:110 (por.), 111, 112 (por.), and 118*. Cultural Surveys Hawaiʻi, Inc., Kailua, Hawaiʻi.

Wilkinson, Sarah, Rosanna Runyon, and Hallett H. Hammatt

2008 *Archaeological Monitoring Report for Keaʻau Middle School, Hawaiʻi Inter-Island DOE Cesspool Project, Keaʻau Ahupuaʻa, Puna District, Island of Hawaiʻi, TMK: [3] 1-6-002:001 and 1-6-003:059*. Cultural Surveys Hawaiʻi, Inc., Kailua, Hawaiʻi.

USGS (U.S. Geological Survey)

1994 Mountain View USGS Survey 7.5-Minute Series Topographic Quadrangle. USGS Information Services, Denver, Colorado.

1995 Hilo USGS Survey 7.5-Minute Series Topographic Quadrangle. USGS Information Services, Denver, Colorado.

Appendix C:
Transportation Evaluation

This page is intentionally left blank.

TRANSPORTATION EVALUATION

1.0 BACKGROUND

The County of Hawai'i is evaluating three potential sites in east Hawai'i for its Compost Facility. All three sites are located in the Kea'au area.

This transportation evaluation focuses on a comparison of site accessibility.

The magnitude of projected traffic generated by the proposed Compost Facility is assumed to be the same as that estimated in a previous Transportation Impact Analysis Report (TIAR) completed for the County of Hawaii East Hawaii Organics Facility in August 2016 by Fehr-Peers and Associates. Table 5 of that report is excerpted below.

TABLE 5: PROJECT TRIP GENERATION ESTIMATES

Compost Facility	Daily[2]	AM Peak Hour[2]			PM Peak Hour[2]		
		In	Out	Total	In	Out	Total
Year 1 (Green Waste/Wood Pallet Diversion Only)							
Green Waste/Wood Pallet Diversion[1]	150	23	15	38	5	10	15
New Employees	8	4	0	4	0	4	4
Mulch Pick-up	10	0	0	0	1	2	3
Year 2 (Full Composting Operations – Green Waste/Wood Pallet/Organic Materials)							
Organic Materials[2]	31	5	3	8	1	2	3
TOTAL NEW TRIPS							
	189	**32**	**18**	**50**	**7**	**18**	**25**

Source: Fehr & Peers, 2016

Notes:
1. Green Waste/Wood Pallet traffic diversion based on WHOF data provided for the months of February and March 2016.
2. Organic materials estimated to be 20% of the total green waste/wood pallet volume

The key traffic volumes used to assess site access are the AM and PM peak hour traffic volumes. In the previous Fehr-Peers TIAR, their analyses assumed that the green waste/wood pallet diversion, mulch pick-up, and organic materials traffic was comprised mostly of medium and heavy truck traffic. Traffic generated by new employees was assumed to be comprised of passenger vehicles. Note that the total new daily trips should be 199 (not 189).

2.0 EVALUATION OF ACCESS FOR ALTERNATIVE SITES

2.1 SITE 1 – TMK 1-6-001:015 - KEA'AU-PAHOA ROAD

Figure 3-1 illustrates the location of the proposed Site 1 of the Compost Facility.



FIGURE 1-3: SITE 1 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study
AECOM
March 2018

Access to Site 1 is proposed to be through the existing Kea'au Transfer Station to Kea'au-Pahoa Road. As proposed, this will be the longest driveway of the three site alternatives. The existing Kea'au-Pahoa Road (SH 130) is a 4-lane arterial roadway under jurisdiction of the State of Hawaii Department of Transportation (DOT). A median left-turn lane is provided for traffic turning into the Kea'au Transfer Station and a median refuge lane is provided for traffic turning out of Kea'au Transfer Station. The intersection of Kea'au-Pahoa Road and Kea'au Transfer Station Driveway is unsignalized with stop-sign control on the Kea'au Transfer Station Driveway approach. Posted speed limit on this segment of Kea'au-Pahoa Road is 45 miles per hour (mph).

An advantage of Site 1 is that it utilizes the existing Kea'au Transfer Station Driveway for access to Kea'au-Pahoa Road. Kea'au-Pahoa Road is an access-controlled roadway facility, and on such facilities, DOT encourages consolidation of accesses when feasible. Another advantage is that this existing access has design features such as a median left-turn lane and a median refuge lane that facilitates operation as an unsignalized intersection. The median left-turn lanes may need to be lengthened to accommodate the increased left-turning demand estimated for the Compost Facility, but there appears to be room in the painted median to lengthen the left-turn lane if necessary.

One of the issues of utilizing the existing Kea'au Transfer Station Driveway for access to the Compost Facility is the high magnitude of peak period commuter traffic demand on this segment of Kea'au-Pahoa Road, especially during the AM peak period. It would be prudent to conduct

intersection operational analyses at the Kea‘au Transfer Station Driveway/Kea‘au-Pahoa Road intersection that takes into consideration the traffic volumes that would be added by the Compost Facility to understand more fully the costs that would be associated with access improvements.

2.2 SITE 2 – TMK 1-6-003:090 – SHIPMAN BUSINESS PARK #1

Figure 3-2 illustrates the location of the proposed Site 2 of the Compost Facility.



FIGURE 3-2: SITE 2 CONCEPTUAL LAYOUT
County of Hawai‘i Compost Facility Siting Study

AECOM
January 2018

Access to Site 2 is proposed through the existing Shipman Business Park. The access to the proposed Compost Facility would be located at the Kipimana Street/Mikahala Street intersection, an intersection of two internal Shipman Business Park roadways. Kipimana Street is the main street within Shipman Business Park and provides access to Hawaii Belt Road, the primary arterial roadway in this region. Hawaii Belt Road is under the jurisdiction of DOT, while Kipimana Street is under the jurisdiction of the County of Hawai‘i. Kipimana Street is a four-lane commercial collector roadway. It is asphalt-paved and has a curb and gutters. The Kipimana Street/Mikahala Street intersection is fully constructed with stub outs for the west Kipimana Street and north Mikahala Street legs. The intersection is currently configured as an unsignalized intersection with two-way stop-sign control on the Mikahala Street approach. There appear to be non-standard cross-walks across the Mikahala Street approaches to the intersection. Kipimana Street is posted with a 25 mph speed limit.

Site 2 is proposed to tie its driveway into the Mikahala Street stub of the Kipimana Street/Mikahala Street intersection. Site 2 has the shortest driveway of the three alternative sites. As this intersection is at the end of Kipimana Street with low competing demand for traffic, it is likely to have the capacity to handle the traffic generated by the proposed Compost Facility. As previously stated, the intersection is fully constructed and additional improvements needed appear to be relatively minor in nature.

Kipimana Street intersects Hawaii Belt Road at a major intersection. Because Hawaii Belt Road is a divided highway at this location, this intersection is actually two closely spaced intersections separated by a connecting roadway between the two directions of Hawaii Belt Road. Both intersections are unsignalized with stop-sign control on the Kipimana Street approaches. Deceleration and acceleration lanes are provided for traffic turning off of and on to Hawaii Belt Road. These intersections were designed for a fully built out Shipman Business Park and should be able to accommodate the traffic generated by the proposed Compost Facility. Commuter peak period intersection operations with the proposed Compost Facility should be evaluated as part of the final selection process.

2.3 SITE 3 – TMK 1-6-003:007 – SHIPMAN BUSINESS PARK #2

Figure 3-3 illustrates the location of Site 3 of the proposed Compost Facility.



FIGURE 3-3: SITE 3 CONCEPTUAL LAYOUT
County of Hawai'i Compost Facility Siting Study

AECOM
January 2018

Like Site 2, the access to Site 3 is through the Shipman Business Park. The access to the proposed Compost Facility would be located at the same Kipimana Street/Mikahala Street intersection as described in the evaluation of access to Site 2. All the descriptions of roadway configurations and traffic control are the same.

The primary difference is that Site 3 is proposed to tie its driveway into the Kipimana Street stub of the Kipimana Street/Mikahala Street intersection instead of the Mikahala Street stub. The length of the driveway as proposed is longer than the driveway for Site 2 but shorter than the driveway for Site 1. As this intersection is at the end of Kipimana Street with low competing demand for traffic, it probably has the capacity to handle the traffic generated by the proposed Compost Facility. As previously stated, the intersection is fully constructed and additional improvements needed appear to be relatively minor in nature. Because Kipimana Street is the major road within Shipman Business

Park, it is configured to have the right-of-way at the internal intersections. If Site 3 is selected and its driveway makes use of the Kipimana Street stub, an evaluation of intersection control would be prudent. One possibility would be to configure the Kipimana Street/Mikahala Street intersection as an all-way STOP-controlled intersection to reduce the potential that a driver would mistake the Site 3 driveway as a through roadway.

As in the discussion of Site 2, the Kipimana Street/Hawaii Belt Road intersections should be able to accommodate the traffic generated by the proposed Compost Facility. Commuter peak period intersection operations with the proposed Compost Facility should be evaluated as part of the final selection process.

3.0 SUMMARY OF TRANSPORTATION EVALUATION OF SITE ACCESS

A summary of the transportation issues evaluated are included in the table below.

Features	Site 1 – Kea‘au-Pahoa Road	Site 2 – Shipman Business Park #1	Site 3 – Shipman Business Park #2
Major Road Issues	Kea‘au-Pahoa Road has high traffic demand during commuter peak periods.	Hawaii Belt Road has high traffic demand during commuter peak periods.	Hawaii Belt Road has high traffic demand during commuter peak periods.
Compatibility with Adjacent Use	Transfer Facility has similar type of operation.	Shipman Business Park compatible with Compost Facility.	Shipman Business Park compatible with Compost Facility
Need for Roadway Improvements	Potential need to lengthen median left-turn lane in Kea‘au-Pahoa Road at its intersection with Kea‘au Transfer Station Driveway.	Likely only relatively minor Kipimana/Mikahala intersection improvements.	Likely only relatively minor Kipimana/Mikahala intersection improvements -potential for traffic control modification.
Driveway Construction	Potentially the longest driveway needed.	Appears to have the shortest driveway needed.	Potentially moderate length driveway needed.

This page is intentionally left blank.

Appendix C

Proposed Composting Technology

This page intentionally blank.

Scalable Food Waste Composting Solutions

Sustainable Generation

Right For The Environment.
Right For Business.





Sustainable Generation's proven food waste composting solutions, utilizing the GORE® Cover, are backed by firsthand owner-operator knowledge and the reliability of twenty years of successful GORE® Cover applications.

Most Flexible Design/Small Footprint
- Proprietary design concepts unique in the industry. Our modular, expandable technology is repeatable for standard and customized designs – scalable from 1 heap to +100 heaps
- More material can be processed on smaller site

Lowest Total Cost of Ownership
- Balanced cost/performance ratio
- Treatment cost per ton is lower compared to other systems because of simplicity of design with few moving parts and low energy consumption
- Energy consumption during composting phase: 2 kWh/t input material

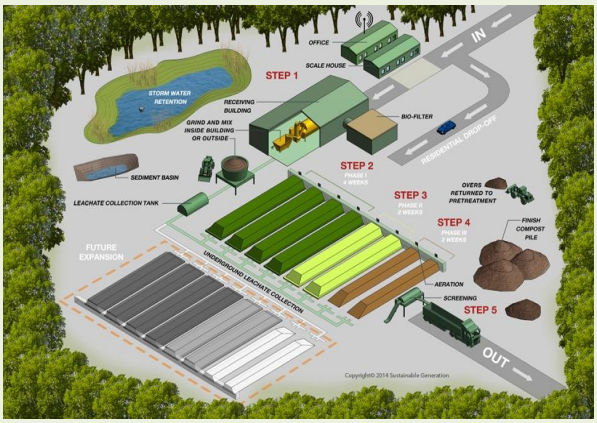
Effective In All Climate Conditions
- Hot, Dry, Wet, Subfreezing Climate Regions
- Encapsulated technology is not influenced by weather or climate and does not need an enclosed building

Food Waste Inputs
- Spoiled and post date food items, meat, fish, vegetables, fruits, dairy, all dry goods (pasta, bean, flour, rice, cereal, sugar, coffee, tea, etc.)

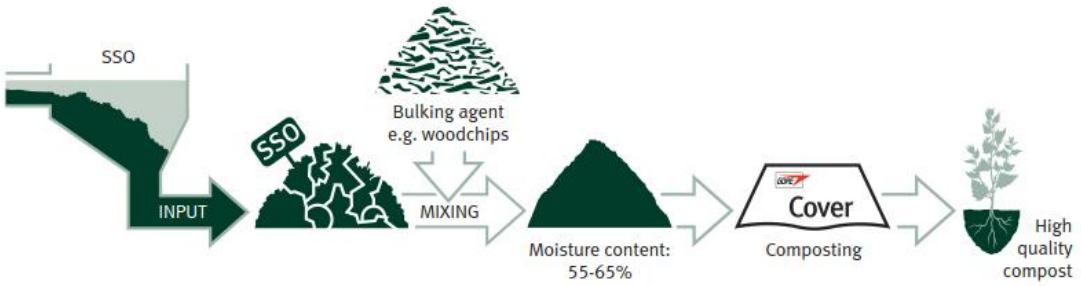
Consistent High Quality Compost in Shortest Time
- Highest quality compost meeting all regulatory requirements
- Compost contains plant available nutrients such as nitrogen, phosphorus, potassium, iron, calcium, magnesium and zinc

Sustainable solutions
- High quality compost enhances the sustainability of agriculture, landscapes and gardens

Typical Process

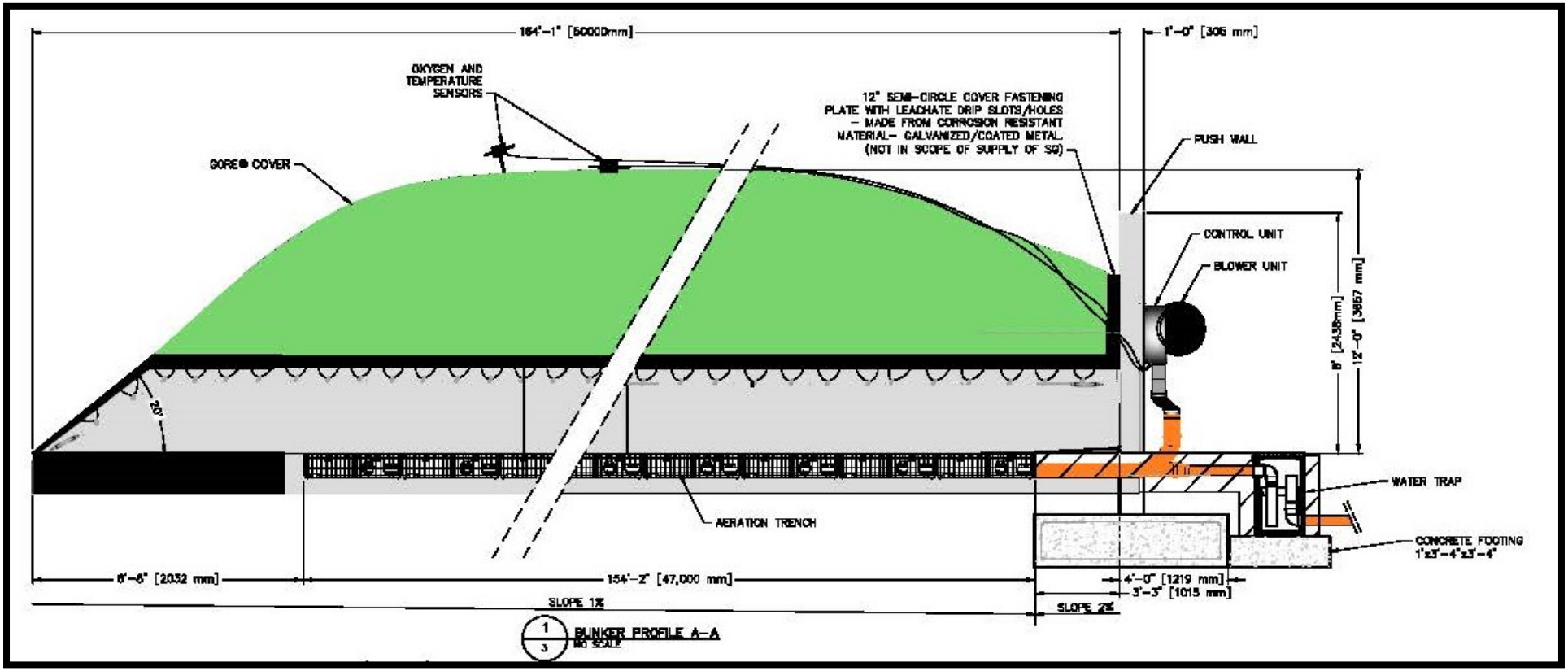






info@sustainable-generation.com
www.sustainable-generation.com

Composting System Profile



Sustainable Generation and GORE® Cover
A Membrane Covered Positive ASP Composting Technology

W. L. Gore & Associates

The company began in 1958, when Bill and Vieve Gore set out to explore opportunities for Fluorocarbon polymers, especially Polytetrafluoroethylene (PTFE). Within the first twelve years, Gore had wire and cables on the moon and operations worldwide.

Today, the Gore enterprise is comprised of approximately 10,000 associates in 45 locations around the world. Annual revenues top $3.0 billion USD. Gore fluoropolymer products provide innovative solutions throughout industry, in next-generation electronics, for medical products, and with high-performance fabrics. Gore has repeatedly been named among the '100 Best Companies to Work for in America,' and the culture is a model for contemporary organizations seeking growth by unleashing creativity and fostering team-work.

While Gore may be best known for their GORE-TEX® fabrics, all Gore products are distinguished in their markets. Gore technologies and fluoropolymer expertise are unsurpassed.

GORE® Cover Introduction

The GORE® Cover technology is the most widely distributed composting system in the world with over 200 facilities located in more than 20 countries treating more than 3.5 million tons of organic waste annually. The system has proven to provide a low risk, cost effective solution which can sustainably process a wide range of organic waste in the most varied climate conditions while controlling odors and emissions. More importantly, its simplicity in both construction and operation ensures that a facility can be maintained many years into the future without escalating operating costs which is not often the case with other technologies. Facilities can be built to any size and can also be easily expanded after construction which provides the most flexibility to the end user during the development of its organics processing facility. Composting is the most logical component in any organics management program and we hope to add your project to the growing list of commercially and publically operated facilities across the globe that have chosen the GORE® Cover system as the best choice for composting their organic waste.

The GORE® Cover has been proven in facilities processing quantities from 2,000 to over 200,000 ton/year, in a variety of feed stocks including and not limited to; green waste, food waste, biosolids, animal manures, fish and animal waste and MSW.

It has been implemented as a pre-treatment system for Waste-to-Energy facilities and existing Gore facilities have added “front end” anaerobic digesters (AD) to further optimize the process through the production of bio-gas.



Source Separated Organics, WA USA 2004

© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Sustainable Generation LLC – Authorized supplier of GORE® Cover for North America

Sustainable Generation brings to the North American market the experience and know-how from more than 200 installations for the design, build, own, and operation of organic recycling facilities based on GORE® Cover technology.

The SG Team is comprised of a deeply experienced and diverse group of dedicated industry leaders with track record of success in composting Source Separated Organics (SSO), Green Waste, Biosolids, Animal Waste, Sludges, and MSW. Our team expertise includes professionals with over 20 years composting experience using GORE® Cover technology. Combined, our team has over 100 years of know-how and hands-on experience with GORE® Cover system.

- Design and construction engineers – have built a combined 200 GORE® Cover composting facilities worldwide.
- Business development associates – have 20+ years' experience in delivering organic treatment solutions.
- Application engineers – have 20+ years providing project management and regulatory compliance performance.
- Compost operators – have 20+ years' experience in composting.
- Compost owner operators – have 20+ years in the business.
- Global partner network of supply partners and technical consultants.
- Project Team members have supplied equipment and services similar in scope for every GORE® Cover facility built in North America.

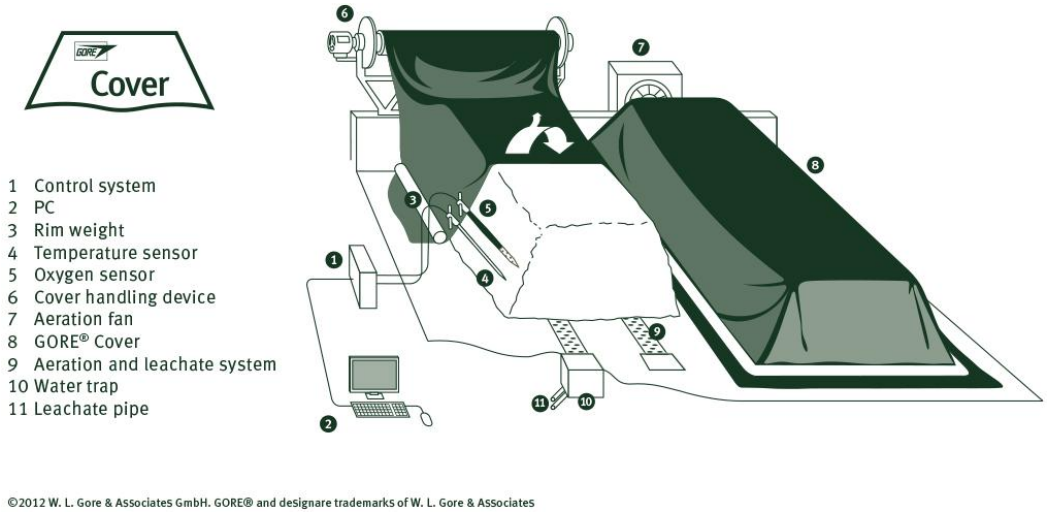
SG Team members have supplied equipment and services similar in scope for every GORE® Cover facility built in North America. The SG project personnel have performed Scope of Work for projects which included the supply of equipment and services for a composting system for the purpose of composting source separated organics (SSO) and yard waste from residential and commercial collected food waste and green waste materials, biosolids (BS) and municipal solid waste (MSW).

The work included the following:

- System sizing and Mass Balance Calculations
- Design meeting.
- Construction meeting.
- Shipment Delivery and Logistics
- Installation Supervision of In-ground components
- Installation Supervision of Above Ground components
- Assembly assistance for Cover Winding machine
- Start-up and Commissioning of the compost plant
- Operator Training Module #1.
- Operator Training Module #2.
- Operator Training Module #3.
- Air Quality VOC Emission Reduction Validation Test
- Responsible for on-going technical support, repairs, and spare parts.

© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

GORE® Cover Equipment and Service Supply Package



©2012 W. L. Gore & Associates GmbH. GORE® and designare trademarks of W. L. Gore & Associates

The system supply includes:

- GORE® Cover
- In-floor aeration
- Oxygen and Temperature sensors
- Aeration system
- Controllers/data loggers and software
- Mobile Winder Machine
- Operation Manual
- Remote Wireless (Optional)
- Web Based System Monitoring, Inventory Management and Technical Support

The service supply includes:

- Experience gained from GORE® Cover System Global Users
- GORE® Cover System Guarantees and Warranty on covers and system components
- Engineering and System Design Consultation
    - Installation and Start Up Services
    - Post Commissioning and On Going Technical Support
- Comprehensive Training for Site Management and Operators
    - Classroom and On-site training
        - Training I – at a GORE® Cover System reference plant
        - Training II – during system check and start-up
        - Training III – 12 weeks after commissioning
- Additional Customized Trainings upon request
- Periodic Site Visitation and System Performance Check Up

© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

SG Heap™, Bunker™, Mobile™ System using GORE® Cover

The GORE® Cover technology is the most widely distributed composting system in the world with over 200 facilities located in more than 20 countries treating more than 3.5 million tons of organic waste annually. The system has proven to provide a low risk, low cost solution which can sustainably process a wide range of organic waste in the most varied climate conditions while controlling odors and emissions. More importantly, its simplicity in both construction and operation ensures that a facility can be maintained many years into the future without escalating operating costs which is not often the case with other technologies. Facilities can be built to any size and can also be easily expanded after construction which provides the most flexibility to the end user during the development of its organics processing facility.

W.L. Gore & Associate's "GORE® Cover" is centered on membrane laminate technology similar to that of its world famous GORE-TEX® fabrics used for outerwear and footwear. The integrated system includes the GORE® Cover, in-floor aeration, aeration blowers, oxygen and temperature sensors, controllers, computers, software, cover handling systems, training, engineering guidance, installation support and the experience gained through the many installations over the last ten years. Official certificates and approvals have been granted to the GORE® Cover as delivering "in-vessel" performance and approved as meeting strict regulatory compliance standards worldwide**.**

Facilities using the GORE® Cover technology experience a reduction in odor and is California compliant for reduction of VOCs through the GORE® Cover as recently proven in a demonstration for the Los Angeles County Sanitation Districts, CA USA (pictured right). Taking the odor dispersion modelling of a defined location with the same throughput into consideration the GORE® Cover System has been assessed as equal or better to a tunnel/building system using a biofilters as air treatment. The German Environmental Protection Agency showed that the GORE® Cover technology compared to other in-vessel and open windrow technologies showed lowest GHG emission, Gore having the best control. Other system attributes include a small facility footprint, low energy requirements, low operating costs, short installation times, greater than 99% containment of bio-aerosols and particulate matter, and the production of stable compost in 4-8 weeks.



Making the right choice of membrane impacts the air permeability and the extraction of moisture during composting. The membrane influences the composting process; it prevents the compost product from being too dry or too wet. The membrane allows for an even distribution of air through the entire volume of material, thus ensuring temperatures are achieved throughout the heap. The micro-porous structure of the GORE® Cover membrane practically avoids the penetration of microbes and particulate matter through the membrane.



© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Operating Process Description

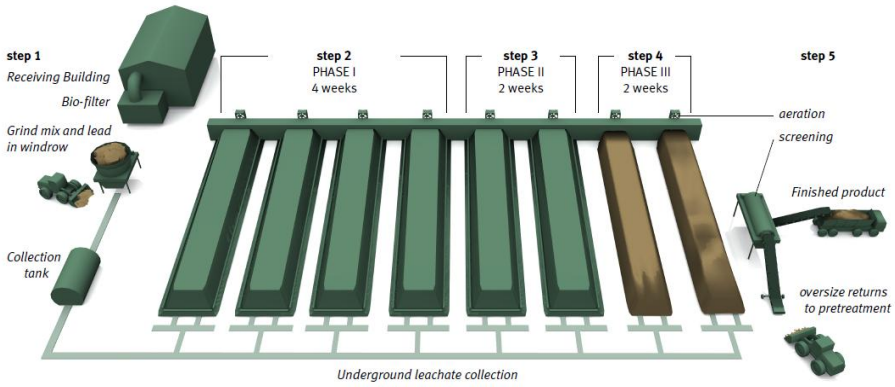
Composting process can be as short as 2 weeks to as long as 8 weeks depending on the local regulations and end user finished product specification. **Described below is typical 6-8 week 3 phase process.**

Phase 1: High Rate Active Composting –21-28 Days (step 2)
The composting process begins with a front end loader moving the material from the mixing area to a heap in the Phase I section to begin the 3 phase – 8 week composting period. Once a heap is built, it is covered, the temperature and oxygen probes are installed and the software is turned on, which then controls the rate of aeration.

Phase 2: Maturation Curing Composting – 14-21 Days (step 3)
After 28 days in Phase I, the GORE® Cover is removed from the heap and the compost is moved by front end loader to a heap in the Phase II area. The material remains in the Phase II area for 2 weeks.

Phase 3: Finishing – 14 Days (optional) (step 4)
After 14 days in Phase II, the GORE® Cover is removed from the heap and the compost is moved by front end loader to a heap in the Phase III area. By the time the material reaches Phase III the compost is sufficiently stable such that the cover is not required. In some cases, such as extreme hot or cold climates, some facilities may option to cover Phase III. The material remains in the Phase III area for 2 weeks.

Typical Composting Operation Layout:



Process flow chart

The GORE® Cover heap model utilizes composting with forced aeration coupled with a semi permeable membrane cover. A standard heap is 26 feet (8m) wide at the base, 164 feet (50m) long and 10-12 feet (3 – 3.5m) in height, each heap contains approximately 1,000-1,200 cubic yards of composting material. Our bunker design allows additional capacity up to 1350 cubic yards. The size and number of heaps is determined based on the total capacity of the project. The heaps are the same size in each of the three Phases. GORE® Covers are used only in Phase I and II. Each heap may have a concrete head wall and side walls to retain the material in each heap on the compost pad. Two aeration trenches are under each heap. These trenches serve as ducts to provide air to the heap and also to collect leachate coming from the heap. Each heap has a blower to provide air to the composting material via the aeration trenches. The trenches are cast in concrete to provide a solid impervious surface. The entire compost pad consists of a concrete slab or asphalt, which allows for the collection of all storm water and leachate.

© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Power Requirements/ Energy Consumption *****New Solar Powered Option*****

The energy demand by the GORE® Cover system is calculated **at 1.5 - 2.0 kwH per ton of throughput**, plus the energy used for adjacent equipment, facilities and fuel used for the movement of material. The mobile winder used to deploy the GORE® Cover meets regulatory emission control standards (including California) and is capable to operate in extreme cold climates. The GORE® Cover process is known for having the total lowest cost to operate as compared to other technologies.

Most recently, a solar option has been made available for remote locations.





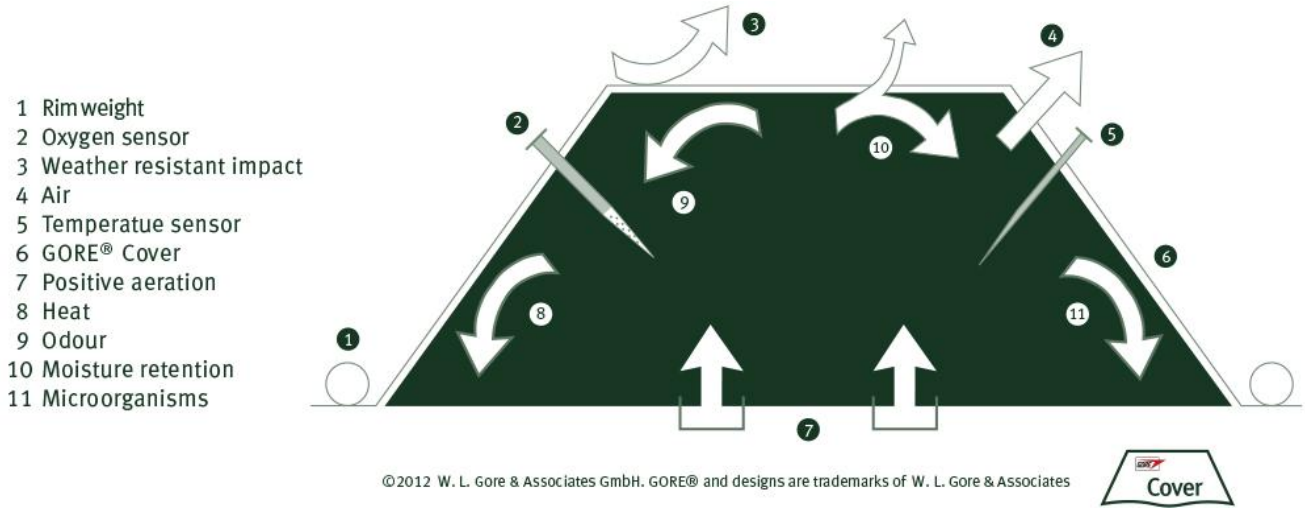


© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Process Control Mechanism – Positive Aeration in Combination with GORE® Cover

GORE® Cover is based on positive aeration in combination with the GORE® Cover. Composting is a biological process with naturally occurring batch to batch variations in input material. The processing technology has to flexibly adapt to these changing conditions. The oxygen controlled aeration of the GORE® Cover System reliably adapts the aeration intensity to the batch by batch variations as well as to the changing oxygen demand in the course of the composting cycle.

- The GORE® Cover has unique physical properties in regards to air permeability which is selectively designed into the membrane and allows evenly distributed air and pressure within a heap.
- The GORE® Cover has unique physical properties in regards to control of moisture transportation which is selectively designed into the membrane and allows specific control of moisture to optimize the composting process.
- The GORE® Cover is weighted (sealed), creating a complete in-vessel enclosure the entire pile can then be pressurized ensuring an even distribution of air throughout the pile.
- The GORE® Cover has even distribution of temperatures across the composting volume.



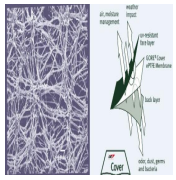
© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Storm Water and Process Liquids Management

The GORE® Cover composting system's water management efficiency is achieved by the well-balanced interaction of the system components and the site's constructed infrastructure.

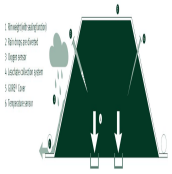
The GORE® Cover - as the critical component - allows for effective management of leachate reduction by two means:

Separation of storm water from leachate: Separation of storm water is achieved by physically covering the organic material with the GORE® Cover and the GORE® Cover must be sealed to the ground.

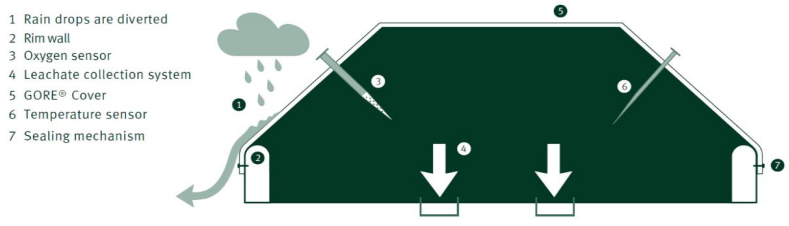


Each membrane pore is 20,000 times smaller than the smallest water drop

Whereas the rain or snow is carried away as run off across the GORE® Cover; the GORE® Cover is impermeable to liquids, comparable to a hard paved surface. The run-off water can then be directed by the slope of the hard paved surface or by drainage trench to a storm water system for treatment, holding or discharge as would be the same for an enclosed building or roofed structure. GORE® Cover delivers in-vessel performance without the need for a building or roofed structure.



Process Water is collected under the heaps by a built in-ground trenching system, the built in-ground trench is used both to deliver air to the composting process as well as act as a leachate collection and delivery mechanism. The leachate is directed by drainage piping to a holding system for treatment, reuse or discharge.



© 2017 W. L. Gore & Associates GmbH. GORE®, GORE® Cover and designs are trademarks of W. L. Gore & Associates.
Confidential and Proprietary Information
Sustainable Generation LLC

Appendix D

Biological Resources Survey Report

This page intentionally blank.

BIOLOGICAL RESOURCES SURVEY REPORT FOR THE KEA‘AU COMPOST FACILITY PROJECT

MAY 2018

PREPARED FOR

SSFM International

PREPARED BY

SWCA Environmental Consultants

BIOLOGICAL RESOURCES SURVEY REPORT FOR THE KEAʻAU COMPOST FACILITY PROJECT

Prepared for

SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaiʻi 96817
Attn: Jennifer Scheffel, Environmental Planner

Prepared by

SWCA Environmental Consultants
Bishop Square ASB Tower
1001 Bishop Street, Suite 2800
Honolulu, Hawaiʻi
(808) 548-7899
www.swca.com

SWCA Project No. 48632.00

May 2018

EXECUTIVE SUMMARY

SSFM International requested that SWCA Environmental Consultants (SWCA) conduct a terrestrial flora and fauna biological resources survey for the proposed Kea'au Compost Facility, approximately 10 miles south of Hilo on the island of Hawai'i.

This report summarizes the findings of the biological resources survey conducted for the project by SWCA Botanist Alex Lau and SWCA Wildlife Biologist James Breeden on April 18, 2018. The flora and fauna survey area is approximately 40 acres of a property (TMK 1-6-003:090) located in the town of Kea'au at the corner of Kipimana and Mokihana Streets. All vascular plant species (and their relative abundance), vegetation types, and wildlife species were recorded.

The vegetation types and plant species identified during the survey are not considered unique. Three indigenous plant species observed—'ōhi'a (*Metrosideros polymorpha*), Forked fimbery (*Fimbristylis dichotoma)*, and uluhe (*Dicranopteris linearis*)—are common. One of the species found—ti (*Cordyline fruticosa*)—was introduced by Polynesians prior to European contact. Another, pōpolo (*Solanum americanum*), is indigenous, or possibly indigenous. One of the species found—yellow wood sorrel (*Oxalis corniculata*)—was introduced, or possibly introduced, by Polynesians prior to European contact (Wagner et al. 1999). These species are not considered rare and are not federally or state-listed as threatened or endangered species, species proposed for listing, or candidate species. No federally or state-listed endangered plant species were observed in or near the survey area. Therefore, the proposed project is not expected to have a significant, adverse effect on terrestrial vegetation.

No federally or state-listed endangered birds were observed in the survey area. Ten bird species in total were observed in the survey area; only one of the bird species was native, and the rest are common, non-native introduced species. Two of the species—the Hawaiian short-eared owl (*Asio flammeus sandwichensis*) and northern cardinal (*Cardinalis cardinalis*)—are protected under the Migratory Bird Treaty Act. No federally or state-listed endangered wildlife species were observed in or near the survey area; however, potential roosting trees for the Hawaiian hoary bat (*Lasiurus cinereus semotus*), a federally and state-listed endangered mammal, exist in the survey area. Mitigation recommendations to address potential roosting habitat are outlined in the report. The survey area does not overlap critical habitat of any listed terrestrial faunal species. For these reasons, the proposed project is not expected to have a significant, adverse effect on terrestrial wildlife.

This page intentionally left blank.

CONTENTS

1 Description of the Project Site 1
2 Introduction 1
3 Methods 1
3.1 Flora 3
3.2 Fauna 3
4 Results 3
4.1 Flora 3
4.1.1 Mixed Non-Native Forest 3
4.1.2 Cultivated Fields 4
4.2 Fauna 4
4.2.1 Avifauna 5
4.2.2 Mammals 6
4.2.3 Terrestrial Reptiles and Amphibians 6
4.2.4 Insects and Other Invertebrates 6
5 Discussion and Recommendations 6
5.1 Flora 6
5.2 Fauna 7
5.2.1 Hawaiian Hawk 8
5.2.2 Hawaiian Goose 9
5.2.3 Hawaiian Hoary Bat 9
5.2.4 Seabirds 10
6 Literature Cited 11

Appendices

Appendix A. Checklist of Plant Species Observed during the Flora Survey for the Kea‘au Composting Facility Environmental Assessment on April 18, 2018

Figures

Figure 1. Survey area. 2
Figure 2. Mixed non-native forest vegetation type. Shown here are bingabing, gunpowder trees, and other non-native canopy species, with an understory dominated by Guinea grass. 4
Figure 3. Cultivated fields of papaya. Understory weeds include artillery plant and yellow wood sorrel. 5

Tables

Table 1. Birds Observed by SWCA in and near the Survey Area 5
Table 2. Federally and State Endangered, Threatened, and Proposed Species That Could Occur in the Survey Area 8

This page intentionally left blank.

1 DESCRIPTION OF THE PROJECT SITE

The County of Hawai'i's Department of Environmental Management selected the site based on a siting study of three potential project sites conducted by AECOM Inc. in 2017. Site 2—TMK 1-6-003:090—ranked highest based on 26 project-specific siting criteria and was therefore selected as the project site to build the compost facility.

The project site is on an undeveloped section of a commercial business park. The land adjacent to the project area, on the same lot, is currently used for commercial agriculture and producing papaya. The 40-acre project area consist of mainly mixed non-native vegetation, which was likely altered when the land was converted to agriculture use (Figure 1).

The mean annual rainfall in the project area is approximately 142.2 inches (3612.2 millimeters). Rainfall is typically higher in November and lower in June through August (Giambelluca et al. 2013). Average temperatures range from a low of 75 degrees Fahrenheit to an average high of 85 degrees Fahrenheit (National Oceanic and Atmospheric Administration 2018).

2 INTRODUCTION

SSFM International requested that SWCA Environmental Consultants (SWCA) conduct a biological resources survey for the proposed Kea'au Compost Facility project located 10 miles south of Hilo, in the town of Kea'au, on the Island of Hawai'i.

This report summarizes the findings of the biological resources survey conducted for the project by SWCA Botanist Alex Lau and Wildlife Biologist James Breeden on April 18, 2018. The flora and fauna survey area (also referred to as the project area) is approximately 40 acres of a larger 424-acre property (TMK 1-6-003:090) located in the town of Kea'au at the corner of Kipimana and Mokihana Streets. All vascular plant species (and their relative abundance), vegetation types, and wildlife species were recorded.

3 METHODS

SWCA reviewed available scientific and technical literature regarding natural resources in and near the study area. A desktop analysis of the study area was conducted to determine if habitat for Migratory Bird Treaty Act (MBTA), Endangered Species Act, and Hawaii Revised Statutes Chapter 195-D protected species may be present. This analysis consisted of reviewing aerial imagery, the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation website (USFWS 2018a), and the USFWS Environmental Conservation Online System (USFWS 2018b).

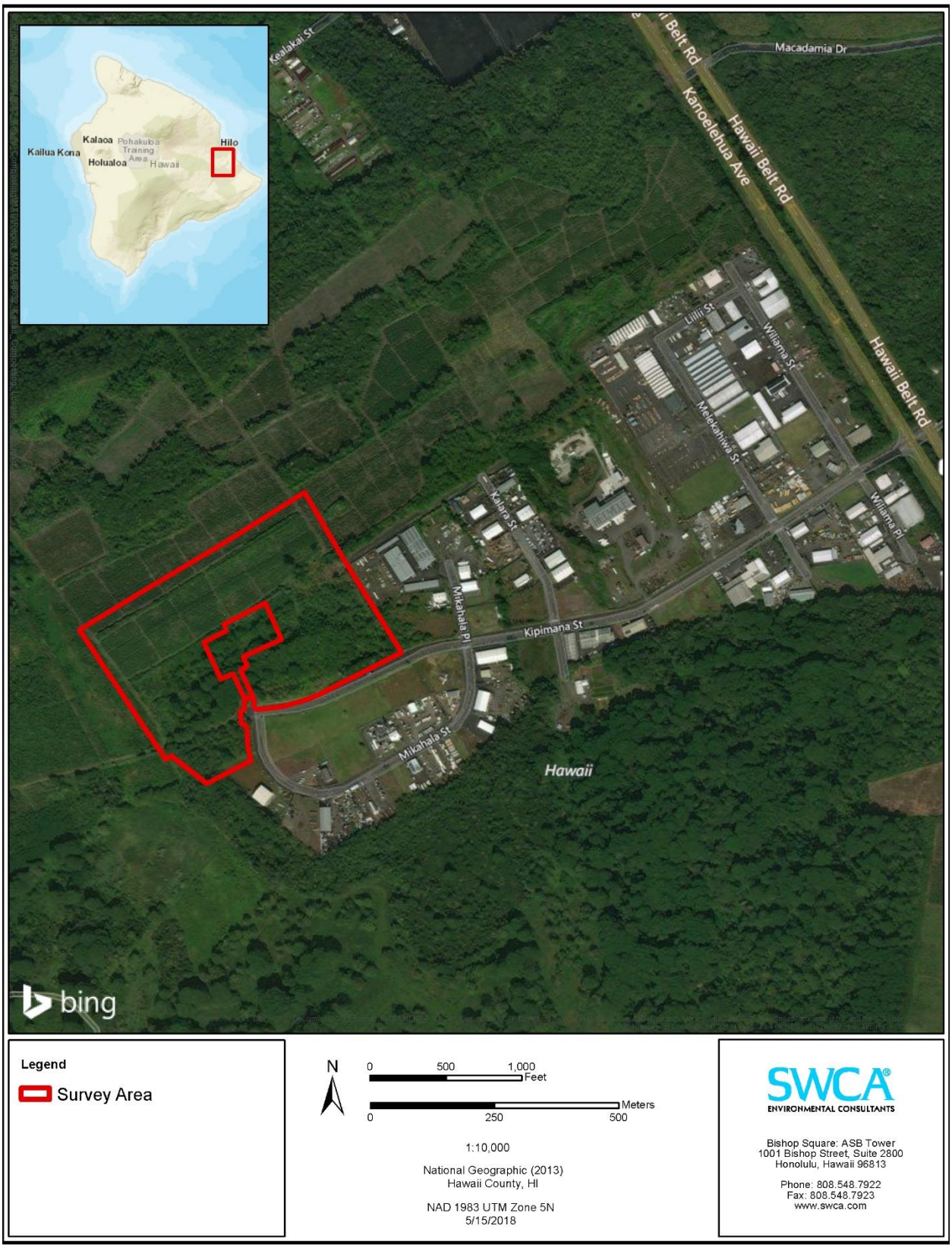


Figure 1. Survey area.

3.1 Flora

SWCA conducted a pedestrian flora (botanical) survey to document all vascular plant species and vegetation types present in the survey area. Areas more likely to support native plants (e.g., rocky outcrops, gulches, and shady areas) were more intensively examined.

Plants recorded during the survey are indicative of the season (rainy versus dry) and the environmental conditions at the time of the survey. It is likely that additional surveys conducted at a different time of the year would result in minor variations in the species and abundances of plants observed.

3.2 Fauna

The fauna survey consisted of a pedestrian survey within the survey area from 9:00 a.m. to 1:00 p.m., when wildlife is most likely to be active. Visual and auditory observations were recorded. All birds, mammals, reptiles, amphibians, and large invertebrate species seen or heard and any sign (scat or tracks) were noted. Field surveys for the federally and state-endangered Hawaiian goose (*Branta sandvicensis*), Hawaiian hawk (*Buteo solitarius*), Hawaiian hoary bat, or ʻOpeʻapeʻa (*Lasiurus cinereus semotus*) were conducted by noting areas of suitable foraging and roosting habitat as indicators of potential presence.

4 RESULTS

4.1 Flora

No federally and state-listed threatened, endangered, or candidate plant species or rare native Hawaiian plant species were observed in the survey area. In all, 74 plant species were recorded in the survey area, three of which are native to the Hawaiian Islands. All three native species seen are common. They are ʻōhiʻa (*Metrosideros polymorpha*), forked fimbry (*Fimbristylis dichotoma*), and uluhe (*Dicranopteris linearis*). One of the species found—ti (*Cordyline fruticosa*)—was introduced by Polynesians prior to European contact. Another, pōpolo (*Solanum americanum*), is indigenous, or possibly indigenous. One of the species found—yellow wood sorrel (*Oxalis corniculata*)—was introduced, or possibly introduced, by Polynesians prior to European contact (Wagner et al. 1999). Appendix A provides a list of all plant species observed by an SWCA botanist during the April 18, 2018 survey.

The vegetation in the survey area consists of two vegetation types: mixed non-native forest and cultivated fields.

4.1.1 Mixed Non-Native Forest

Mixed non-native forest is characterized by a mix of non-native trees with a non-native understory. The vegetation is heterogeneous and includes a matrix of *Macaranga tanarius*, albizia (*Falcataria moluccana*), gunpowder tree (*Trema orientalis*), and cecropia (*Cecropia obtusifolia*). A closed canopy forest of *Macaranga tanarius* is present. Understory plants form a dense layer of a somewhat heterogenous mix as well, with the most common species being Guinea grass (*Urochloa maxima*), Spanish Shawl (*Dissotis rotundifolia*), and wedelia (*Sphagneticola trilobata*). Gaps in this vegetation type created by roads or other edges are typically dominated by Guinea grass. Native species in this vegetation type are rare but were present and include ōhi'a and uluhe.

One particular understory plant of some significance is miconia (*Miconia calvescens*). This species has proven to be highly invasive outside of Hawaii and may be becoming highly invasive on some Hawaiian

islands. This species was seen occasionally within the survey area; stands of mature trees and plants of all size classes were seen.

4.1.2 Cultivated Fields

Portions of the site are used for growing papaya (*Carica papaya*). The canopy in these areas is entirely occupied by papaya, with a low-growing understory of diverse herbaceous weeds, including artillery plant (*Pilea microphylla*) and yellow wood sorrel.

4.2 Fauna

No federally or state-listed threatened, endangered, or candidate animal species were observed in the survey area. In all, 23 animal species were recorded during the survey. Of these, only two species—Hawaiian short-eared owl (*Asio flammeus sandwichensis*) and green darner dragonfly (*Anax junius*)—are native to the Hawaiian Islands.



Figure 2. Mixed non-native forest vegetation type. Shown here are bingabing, gunpowder trees, and other non-native canopy species, with an understory dominated by Guinea grass.



Figure 3. Cultivated fields of papaya. Understory weeds include artillery plant and yellow wood sorrel.

4.2.1 Avifauna

The bird species observed in the survey area are species commonly found in disturbed, low- to mid-elevation areas on Hawai'i Island. In all, 10 bird species were documented, and 9 are non-native introductions (Table 2). Of these, two species—the Hawaiian short-eared owl and northern cardinal (*Cardinalis cardinalis*)—are protected under the MBTA.

Table 1. Birds Observed by SWCA in and near the Survey Area

Common Name	Scientific Name	Status	MBTA
Chinese hwamei	*Garrulax canorus*	NN	–
Common myna	*Acridotheres tristis*	NN	–
Common waxbill	*Estrilda astrild*	NN	–
Japanese white-eye	*Zosterops japonicus*	NN	–
Hawaiian short-eared owl	*Asio flammeus sandwichensis*	E	X
House finch	*Haemorhous mexicanus*	NN	X
Northern cardinal	*Cardinalis cardinalis*	NN	X
Nutmeg mannikin	*Lonchura punctulata*	NN	–
Spotted dove	*Streptopelia chinensis*	NN	–
Zebra dove	*Geopelia striata*	NN	–
Total		**10**	**6**

Notes: Status: E = endemic; MBTA = protected under the Migratory Bird Treaty Act; NN = non-native permanent resident.

The Information for Planning and Consultation (IPaC) resource query for this project listed 12 MBTA-protected birds that could occur in the study area (USFWS 2018). Based on geographic location, available habitat, and SWCA's best professional judgement, only one MBTA bird on the IPaC resource list is likely to occur—Hawai'i amakihi (*Chlorodrepanis virens*). Additional MBTA-listed birds that were not listed by IPaC but that may occur include, but are not limited to, the cattle egret (*Bubulcus ibis*) and Pacific golden-plover (*Pluvialis fulva*). Forage and nest habitat for the federally and state-listed endangered Hawaiian hawk and endangered Hawaiian goose occurs in the survey area.

The Hawaiian hawk is known to nest in trees that are typically 32.81 to 78.74 feet (10.0–24.0 meters [m]) in height, and the nests are typically located 11.48 to 59.06 feet (3.5–18.0 m) above the ground. Nests are constructed on stable platforms such as on top of birds-nest ferns (*Asplenium nidus*), in the crotches of tree trunks, on branches 7.87 to 19.67 inches (20–50 centimeters [cm]) in diameter, and at the intersections of the trunks and branches smaller than 7.87 inches (20 cm) in diameter (Griffin et al. 1998).

4.2.2 Mammals

Mammals detected during the survey include the small Indian mongoose (*Herpestes javanicus*) and feral pig (*Sus scrofa*). No other mammals were observed during the pedestrian survey, although the feral cat (*Felis catus*), rat (*Rattus* spp.), and mouse (*Mus musculus*) could be expected to occur.

The potential for the presence of Hawaiian hoary bat was assessed based on the presence of suitable habitat and vegetation types. The Hawaiian hoary bat has been documented roosting in ōhi'a and avocado trees and could roost in other tree species with similar structure, such as African tulip and papaya trees. In addition, the Hawaiian hoary bat could forage over the mixed non-native secondary forest and cultivated fields vegetation types throughout the survey area.

4.2.3 Terrestrial Reptiles and Amphibians

There are no native terrestrial reptiles and amphibians native to Hawai'i. One reptile, the gold dust day gecko (*Phelsuma laticauda*), and one amphibian, the coqui frog (*Eleutherodactylus coqui*), were observed during the survey. No other terrestrial reptiles and amphibians were observed.

4.2.4 Insects and Other Invertebrates

Nine species of terrestrial invertebrates were noted during the survey. The non-native, introduced species include one snail, the giant African snail (*Achatina fulica*); two butterflies, the small cabbage white (*Pieris rapae*) and the spring azure butterfly (*Celastrina ladon*); one mosquito, *Aedes* sp.; one wasp, Evaniidae; one spider, the Asian spiny-backed spider (*Gasteracantha mammosa*); one beetle, the seven-spotted lady beetle (*Coccinella septempunctata*); and one unidentified hawk or sphinx moth. The green darner dragonfly was the only native invertebrate observed.

5 DISCUSSION AND RECOMMENDATIONS

5.1 Flora

Overall, the vegetation in the survey area is disturbed from previous and current land use activities. The vegetation types and species identified are not considered unique. Three of the observed plant species are native to the Hawaiian Islands and are commonly found. No plants listed as threatened or endangered

were found during the survey, and no designated plant critical habitat occurs in the area. Therefore, the proposed project is not expected to have a significant adverse effect on flora (botanical) resources.

Weedy, non-native plant species are common in the survey area. Most of these weedy species are widespread on Hawai'i island, and their control is not expected to result in a significant decrease in their overall number or distribution. However, some species are highly invasive and not common in every region of Hawai'i Island or on other islands where significant resources are spent on their eradication, such as miconia and cane tibouchina (*Tibouchina herbacea*). For this reason, steps should be taken to limit the movement of soil or plant material to other islands or to new areas on Hawai'i Island from this site. For example, construction activities are known to spread invasive species to new areas through the movement of vehicles and materials. For this reason, SWCA recommends the following invasive species minimization measures to avoid the unintentional introduction or transport of new terrestrial invasive species:

- All construction equipment and vehicles should be washed and inspected before entering the project area.
- Construction materials should also be washed and/or visually inspected (as appropriate) for excessive debris, plant materials, and invasive or harmful non-native species (plants, amphibians, reptiles, and insects).
- Inspection and cleaning activities should be conducted at a designated location. The inspector should be a qualified botanist and/or entomologist who is able to identify invasive species that are of concern relevant to the point of origin of the equipment, vehicle, or material.
- When possible, raw materials (e.g., fill and construction materials) should be purchased from a local supplier to avoid introducing non-native species not present on the island.

If landscaping occurs as part of the project, native Hawaiian plants or non-invasive plants should be used to the maximum extent possible. If native plants do not meet landscaping objectives, plants with a low risk of becoming invasive could be substituted. Additional information on selecting appropriate plants for landscaping can be obtained from the following online sources:

- Plant Pono: http://www.plantpono.org/
- Native Plants Hawai'i: http://nativeplants.hawaii.edu/

5.2 Fauna

Based on current distribution and habitat requirements, three federally and state-listed species—Hawaiian hawk, Hawaiian goose, and Hawaiian hoary bat—could occur in the survey area. Although not observed during the survey, three federally and state endangered seabirds—band-rumped storm-petrel (*Oceanodroma castro*), Hawaiian petrel (*Pterodroma sandwichensis*), and Newell's shearwater (*Puffinus auricularis newelli*)—have a low potential to occur in the survey area because they may fly over the survey area while en route to inland nesting sites. These species are summarized in Table 2 and discussed below. Recommendations to avoid and minimize impacts to them are also provided. All other listed species with the potential to occur on the Island of Hawai'i are not likely to occur in the survey area because it is either outside the range of the species or appropriate habitat does not occur.

Table 2. Federally and State Endangered, Threatened, and Proposed Species That Could Occur in the Survey Area

Species	Status	Potential for Occurrence in the Survey Area
Hawaiian hawk	Federally and state endangered	May occur in the survey area. Suitable foraging and nesting habitat is present.
Hawaiian goose	Federally and state endangered	May occurs in the survey area. Suitable foraging and nesting habitat is present.
Band-rumped storm-petrel	Federally and state endangered	Unlikely to occur in the survey area. Band-rumped storm petrels may fly over the area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the survey area.
Hawaiian petrel	Federally and state endangered	Unlikely to occur in the survey area. Hawaiian petrels may fly over the project area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the survey area.
Newell's shearwater	Federally and state threatened	Unlikely to occur in the survey area. Newell's shearwater may fly over the project area while transiting between nest sites and the ocean, but they are not likely to land or use habitat because nesting habitat does not exist in the project area.
Hawaiian hoary bat	Federally and state endangered	May occur in the survey area. Hawaiian hoary bats have been documented roosting in tree species that occur in the survey area.

5.2.1 Hawaiian Hawk

The Hawaiian hawk is the only broad-winged hawk that breeds on the Big Island of Hawai'i (USFWS 2012). They can be found from sea level to above 8,990 feet (2,740 m) (Pyle and Pyle 2009). Surveys in 2007 indicated that approximately 3,085 Hawaiian hawks inhabited the Big Island (Gorressen et al. 2008). These hawks construct their nests approximately 2 months before laying eggs, and the nests may be used for several years as the hawks add new material. Nest trees are typically 32.81 to 78.74 feet (10.0–24.0 m) in height, and the nests are typically located 11.48 to 59.06 feet (3.5–18.0 m) above the ground. Nest trees have a diameter at breast height averaging 19.68 inches (50 cm), although some trees with a diameter at breast height of 4.02 inches (10.2 cm) are used. Nests are constructed on stable platforms such as on top of birds-nest ferns, in the crotches of tree trunks, on branches 7.87 to 19.67 inches (20–50 cm) in diameter, and at the intersections of the trunks and branches smaller than 7.87 inches (20 cm) in diameter (Griffin et al. 1998).

Hawaiian hawk individuals were not seen during the survey. The survey area is within the known distribution of the Hawaiian hawk, but this area is known to have a lower hawk density than other areas within the hawk's distribution area (Gorressen et al. 2008). Based on current distribution and habitat requirements, the Hawaiian hawk may use the survey area for foraging in the mixed non-native forest, and cultivated fields vegetation types and nesting in the mixed non-native forest vegetation type. Many songbirds were detected during the survey, indicating that food resources are available for the hawk. Other food resources such as rodents (*Mus* sp. and *Rattus* sp.) were not detected, although they are likely present. It is likely that Hawaiian hawks that inhabit the area are habituated to noises associated with human activity.

The following conservation measures are recommended during construction to avoid impacts to the Hawaiian hawk:

- If construction is anticipated to occur during the Hawaiian hawk breeding season (March through September), SWCA recommends that a nest survey be conducted at least 10 days prior to

construction to ensure that no new nests have been built. This survey should be conducted by a qualified biologist using appropriate survey methods and should focus on the large trees that could provide nesting habitat (Gorressen et al. 2008; USFWS 2008).

- If an active Hawaiian hawk nest is discovered, no construction should occur within 1,600 feet of it until the chicks fledge or the nest is otherwise abandoned. Construction may take place outside of this buffer as long as construction would not destroy the nest or force the birds to prematurely abandon the nest.
- If a Hawaiian hawk individual is detected in the area during ongoing construction activities, all activities within 100 feet (30 m) of the bird should cease and the bird should not be approached. Work may continue when the bird has left the area on its own.

5.2.2 Hawaiian Goose

The Hawaiian goose was not observed during the site visit, but suitable habitat for nesting and foraging was noted during the survey. The mixed non-native forest and cultivated fields vegetation types are suitable for Hawaiian goose foraging. The Hawaiian goose has been observed nesting under ʻōhiʻa and could nest in the mixed non-native forest vegetation type in the survey area.

The following best management practices (BMPs) are recommended during construction to avoid impacts to Hawaiian geese:

- All regular on-site staff should be trained to identify Hawaiian geese and should know the appropriate steps to take if Hawaiian geese are present on-site.
- If a Hawaiian goose is found in the area during ongoing construction activities, all activities within 100 feet (30 m) of the bird should cease and the bird should not be approached. If a nest is discovered, the USFWS should be contacted. If a nest is not discovered, work may continue after the bird leaves the area of its own accord.

5.2.3 Hawaiian Hoary Bat

Hawaiian hoary bats have been documented roosting in tree species that occur at the site, and they may roost in other foliose trees at the site. However, direct impacts to bats would only occur if a juvenile bat that is too small to fly, but too large to be carried by a parent, was present in a tree that was cut down. Other potential effects include displacement from roosting and foraging areas from construction activities.

Although the chances of adversely affecting Hawaiian hoary bats as a result of the proposed project are likely small, the following BMPs are recommended as impact avoidance measures:

- Any fences that are erected as part of the project should have barbless top-strand wire to prevent entanglements of the Hawaiian hoary bat with barbed wire. During the survey, no barbed wire fences were observed; however, if barbed wire fences are present, the top strand of barbed wire should be removed or replaced with barbless wire.
- No trees taller than 15 feet (4.6 m) should be trimmed or removed as a result of this project between June 1 and September 15, when juvenile bats that are not yet capable of flying may be roosting in the trees.

Implementation of these guidelines, which have been promulgated by the USFWS (1998), is expected to avoid all direct impacts to Hawaiian hoary bats.

5.2.4 Seabirds

Major threats to seabirds include the attraction of adults and newly fledged juveniles to bright lights while transiting between their nest sites and the ocean. Juvenile birds are particularly vulnerable to light attraction and are sometimes grounded when they become disoriented by lights (Mitchell et al. 2005). Many of these grounded birds are vulnerable to mammalian predators or vehicle strikes. The following recommendations are provided to avoid and minimize light attraction of these seabirds to the project area:

- Construction activity should be restricted to daylight hours during the seabird peak fallout period (September 15–December 15) to avoid the use of nighttime lighting that could attract seabirds.
- All outdoor lights should be shielded to prevent upward radiation. This has been shown to reduce the potential for seabird attraction (Reed et al. 1985; Telfer et al. 1987).
- Outside lights that are not needed for security and safety should be turned off from dusk through dawn during the fledgling fallout period (September 15–December 15).

6 LITERATURE CITED

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.L. Chen, P.S. Chu, J.K. Eischeid, and D.M. Delparte. 2013. Online Rainfall Atlas of Hawai'i. Bulletin of the American Meteorological Society 94:313–316, doi: 10.1175/BAMS-D-11-00228.1. Available at: http://rainfall.geography.hawaii.edu. Accessed May 15, 2018.

Gorressen M.P., R.J. Camp, J.L. Klavitter, and T.K. Pratt. 2008. Abundance, Distribution, And Population Trend of the Hawaiian Hawk: 1998–2007 (HSCU-009). Hawai'i Cooperative Studies Unit, Hilo.

Griffin, C.R., P.W.C. Paton, and T.S. Baskett. 1998. Breeding Ecology and Behavior of the Hawaiian Hawk. *Condor* 100:654–662.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. *Hawaii's Comprehensive Wildlife Conservation Strategy.* Department of Land and Natural Resources, Honolulu. Available at: https://dlnr.hawaii.gov/wildlife/files/2013/09/CWCS-Full-Document-2005Oct01.pdf. Accessed April 23, 2018.

Pyle, R.L., and P. Pyle. 2009. *The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status*. Honolulu, Hawai'i: B.P. Bishop Museum. Version 1. Available at: http://hbs.bishopmuseum.org/birds/rlp-monograph/. Accessed April 23, 2018.

National Oceanic and Atmospheric Administration (NOAA). 2018. National Weather Service, Weather Forecast Office. Hydrology in Hawai'i. Available at: http://www.prh.noaa.gov/hnl/climate/retrieve_norms.php?site=021504&date=0. Accessed May 15, 2018

Reed, J.R., J.L. Sincock, and J.P. Hailman. 1985. Light Attraction in Endangered Procelliariiform Birds: Reduction by Shielding Upward Radiation. *Auk* 102:377–383.

Telfer, T.C., J.L. Sincock, and G.V. Byrd. 1987. Attraction of Hawaiian Seabirds to Lights: Conservation Efforts and Effects of Moon Phase. *Wildlife Society Bulletin* 15:406–413.

U.S. Fish and Wildlife Service (USFWS). 1998. *Recovery Plan for the Hawaiian Hoary Bat (Lasiurus cinereus semotus).* U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

———. 2008. *Draft Post-Delisting Monitoring Plan for the Hawaiian Hawk, or Io (*Buteo solitarius*).* Endangered Species Division, Pacific Island Fish and Wildlife Office, Honolulu.

———. 2012. Endangered Species in the Pacific Islands: Hawaiian Hawk. Available at: http://www.fws.gov/pacificislands/fauna/HIhawk.html. Accessed April 23, 2018.

———. 2018a. Information for Planning and Consultation (IPaC). Migratory Birds. Available at: https://ecos.fws.gov/ipac/location/PGSFJ3BJIBGOFOPZJIRSONZ7T4/resources#migratory-birds. Accessed April 20, 2018.

———. 2018b. Environmental Conservation Online System (ECOS). Available at: https://ecos.fws.gov/ecp/. Accessed April 20, 2018.

Wagner, W.L., and D.R. Herbst. 2003. *Supplement to the Manual of the Flowering Plants of Hawai'i.* Version 3.1. Honolulu: University of Hawai'i Press.

Wagner, W.L., D.R. Herbst, N. Khan, and T. Flynn. 2012. *Hawaiian Vascular Plant Updates: A Supplement to the Manual of the Flowering Plants of Hawai'i and Hawai'i's Ferns and Fern Allies.* Version 1.3. Honolulu: University of Hawai'i Press.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. *Manual of the Flowering Plants of Hawai'i.* Volumes I and II. Revised edition. Honolulu: University of Hawai'i Press.

APPENDIX A.

Checklist of Plant Species Observed during the Flora Survey for the Kea‘au Composting Facility Environmental Assessment on April 18, 2018

Table A-1 provides an inventory checklist of plant species observed by SWCA on April 18, 2018, at the Kea‘au Composting Facility environmental assessment survey area. The plant names are arranged alphabetically by family and then by species into three groups: monocots, dicots, and gymnosperms. The taxonomy and nomenclature are in accordance with Wagner et al. (1999), Wagner and Herbst (2003), and Staples and Herbst (2005). Recent name changes are those recorded in Wagner et al. (2012).

Table A-1. Inventory Checklist of Observed Plant Species

Family	Scientific Name and Authorship	Hawaiian and/or Common Name	Status
MONOCOTS			
Agavaceae	*Cordyline fruticosa* (L.) A. Chev.	kï, ti	P
Commelinaceae	*Commelina diffusa* Burm.f.	honohono, honohono wai, mākolokolo, dayflower	X
Cyperaceae	*Fimbristylis dichotoma* (L.) Vahl		I
Cyperaceae	*Kyllinga brevifolia* Rottb.	kili‘o‘opu, kaluhā, manunēnē, mau‘u mokae	X
Orchidaceae	*Arundina graminifolia* (D. Don) Hochr.	bamboo orchid	X
Orchidaceae	*Phaius tankarvilleae* (Banks ex L’Hér.) Blume	Chinese ground orchid, nun's orchid, nun’s-hood	X
Orchidaceae	*Spathoglottis plicata* Blume	Malayan ground orchid, Philippine ground orchid	X
Poaceae	*Cenchrus purpureus* (Schumach.) Morrone	elephant grass, Napier grass	X
Poaceae	*Coix lachryma-jobi* L.	Job’s-tears, pū‘ohe‘ohe, kūkaekōlea, ‘ohe‘ohe, pūpū kōlea	X
Poaceae	*Eleusine indica* (L.) Gaertn.	wiregrass, mānienie ali‘i	X
Poaceae	*Melinis minutiflora* P. Beauv.	molasses grass	X
Poaceae	*Oplismenus hirtellus* ssp. *hirtellus*	basketgrass, honohono kukui, honohono, honohono maoli	X
Poaceae	*Paspalum conjugatum* P.J. Bergius	Hilo grass, mau‘u Hilo, sour paspalum	X
Poaceae	*Sacciolepis indica* (L.) Chase	Glenwood grass	X
Poaceae	*Schizachyrium condensatum* (Kunth) Nees	little bluestem, beardgrass	X
Poaceae	*Setaria palmifolia* (J. Kōnig) Stapf	palmgrass	X
Poaceae	*Themeda villosa* (Poir) A. Camus	Lyon’s grass	X
Poaceae	*Urochloa maxima* (Jacq.) R.D. Webster	Guinea grass	X
DICOTS			
Acanthaceae	*Thunbergia fragrans* Roxb.	white thunbergia, sweet clock-vine	X
Apocynaceae	*Alstonia macrophylla* Wall. ex G. Don		X
Asteraceae	*Ageratum conyzoides* L.	maile hohono, maile honohono, maile kula	X

Table A-1. Inventory Checklist of Observed Plant Species

Family	Scientific Name and Authorship	Hawaiian and/or Common Name	Status
Asteraceae	*Bidens pilosa* L.	Spanish needle, beggartick, kĩ, kĩ nehe, kĩ pipili, nehe	X
Asteraceae	*Conyza canadensis* var. *pusilla* (Nutt.) Cronquist	horseweed, lani wela, ilioha, ʻawiʻawĩ, pua mana	X
Asteraceae	*Crassocephalum crepidioides* (Benth.) S. Moore		X
Asteraceae	*Pluchea carolinensis* (Jacq.) G. Don	sourbush, marsh fleabane	X
Asteraceae	*Sphagneticola trilobata* (L.) Pruski	wedelia	X
Asteraceae	*Youngia japonica* (L.) DC.	Oriental hawksbeard	X
Begoniaceae	*Begonia hirtella* Link		X
Bignoniaceae	*Spathodea campanulata* P. Beauv.	African tulip tree, fountain tree	X
Buddlejaceae	*Buddleja asiatica* Lour.	huelo ʻĩlio, dog tail, butterfly bush	X
Caricaceae	*Carica papaya* L.	papaya, mĩkana, hēʻĩ, milikana, papaia, pawpaw	X
Cecropiaceae	*Cecropia obtusifolia* Bertol.	guarumo, trumpet tree	X
Clusiaceae	*Clusia rosea* Jacq.	autograph tree, copey, Scotch attorney	X
Convolvulaceae	*Ipomoea triloba* L.	little bell	X
Cucurbitaceae	*Momordica charantia* L.	balsam pear, bitter melon	X
Euphorbiaceae	*Euphorbia hirta* L.	hairy spurge, garden spurge, koko kahiki	X
Euphorbiaceae	*Macaranga mappa* (L.) Mūll.Arg.	bingabing	X
Euphorbiaceae	*Macaranga tanarius* (L.) Mūll.Arg.		X
Euphorbiaceae	*Phyllanthus tenellus* Roxb.		X
Fabaceae	*Chamaecrista nictitans* subsp. *patellaria* var. *glabrata* (Vogel) H.S. Irwin and Barneby	partridge pea, laukĩ	X
Fabaceae	*Crotalaria assamica* Benth.	rattlepod	X
Fabaceae	*Desmodium triflorum* (L.) DC.	tick trefoil, tick clover	X
Fabaceae	*Falcataria moluccana* (Miq.) Barneby and J.W. Grimes		X
Fabaceae	*Macroptilium atropurpureum* (DC.) Urb.		X
Fabaceae	*Mimosa pudica* var. *unijuga* (Duchass. and Walp.) Griseb.	sensitive plant, sleeping grass	X
Lamiaceae	*Hyptis pectinata* (L.) Poit.	comb hyptis	X
Lauraceae	*Persea americana* Mill.	avocado, alligator pear	X
Lythraceae	*Cuphea carthagenensis* (Jacq.) J.F. Macbr.	tarweed, Colombian cuphea	X

Table A-1. Inventory Checklist of Observed Plant Species

Family	Scientific Name and Authorship	Hawaiian and/or Common Name	Status
Melastomataceae	*Arthrostemma ciliatum* Pav. ex D. Don		X
Melastomataceae	*Clidemia hirta* var. *hirta*	Koster's curse	X
Melastomataceae	*Dissotis rotundifolia* (Sm.) Triana		X
Melastomataceae	*Melastoma septemnervium* Lour.		X
Melastomataceae	*Miconia calvescens* DC.		X
Melastomataceae	*Tibouchina herbacea* (DC.) Cogn.	glorybush	X
Myrtaceae	*Metrosideros polymorpha* var. *glaberrima* (H. Lév.) H. St. John	ʻōhiʻa, ʻōhiʻa lehua, lehua	E
Myrtaceae	*Psidium cattleianum* Sabine	strawberry guava, waiawï ʻulaʻula	X
Oxalidaceae	*Oxalis corniculata* L.	yellow wood sorrel	P?
Passifloraceae	*Passiflora edulis* Sims	passion fruit, purple granadilla, purple water lemon, liliko'i	X
Polygalaceae	*Polygala paniculata* L.	milkwort	X
Rosaceae	*Rubus rosifolius* Sm.	thimbleberry, Mauritius raspberry, ōlaʻa, ʻākala, ʻākalakala	X
Rubiaceae	*Mitracarpus hirtus* (L.) DC.		X
Rubiaceae	*Oldenlandia corymbosa* L.		X
Rubiaceae	*Paederia foetida* L.	maile pilau, maile kā kahiki	X
Rubiaceae	*Spermacoce assurgens* Ruiz and Pav.	buttonweed	X
Sapindaceae	*Cardiospermum halicacabum* L.	heartseed, balloon vine, pōniu, haleakaiʻa (Niʻihau), ʻinalua, pōhuehue uka	X
Scrophulariaceae	*Castilleja arvensis* Cham. and Schltdl.	Indian paintbrush, painted cup	X
Solanaceae	*Solanum americanum* Mill.	glossy nightshade, pōpolo, ʻolohua, polopolo, pōpolohua (Niʻihau)	I?
Sterculiaceae	*Melochia umbellata* (Houtt.) Stapf		X
Ulmaceae	*Trema orientalis* (L.) Blume	gunpowder tree, charcoal tree	X
Urticaceae	*Pilea microphylla* (L.) Liebm.	artillery plant, rockweed	X
PTERIDOPHYTES			
Gleicheniaceae	*Dicranopteris linearis* f. *linearis*	uluhe, unuhe	I
Nephrolepidaceae	*Nephrolepis brownii* (Desv.) Hovenkamp and Miyam.		X
Polypodiaceae	*Phlebodium aureum* (L.) J.Sm.	lauaʻe haole, rabbit's-foot fern, golden polypody	X
Polypodiaceae	*Phymatosorus grossus* (Langsd. and Fisch.) Brownlie	lauaʻe, maile-scented fern	X

Table A-1. Inventory Checklist of Observed Plant Species

Family	Scientific Name and Authorship	Hawaiian and/or Common Name	Status
Thelypteridaceae	*Cyclosorus parasiticus* (L.) Farw.		X

Notes: E = endemic; I = indigenous; I? = probably indigenous, but possibly naturalized; P = Polynesian introduced; P? = probably Polynesian introduced, but possibly introduced in historic times; X = non-native.

Appendix E

Cultural Impact Assessment

This page intentionally blank.

A Cultural Impact Assessment for the Proposed East Hawai‘i Organics Facility

TMK: (3) 1-6-003:090 por.

Kea‘au Ahupua‘a
Puna District
Island of Hawai‘i

DRAFT VERSION



Prepared By:
Lokelani Brandt, M.A.,
Lauren M.U.K. Tam Sing, B.A.,
and
Robert B. Rechtman, Ph.D.

Prepared For:
Jennifer Scheffel
SSFM International
501 Sumner Street, Suite 620
Honolulu, HI 96817

May 2018

ASM affiliates
Archaeology • History • Anthropology • Architectural History
Hilo Office: (808) 969-6066 Fax: (808) 443-0065
507-A E. Lanikaula Street, Hilo, HI 96720
Honolulu Office: (808) 439-8089 Fax: (808) 439-8087
820 Mililani Street, Suite 700, Honolulu, HI 96813

ASM Project Number 29960.00

A Cultural Impact Assessment for the Proposed East Hawai‘i Organics Facility

TMK: (3) 1-6-003:090 por.

Kea‘au Ahupua‘a
Puna District
Island of Hawai‘i

ASM affiliates

CHAPTERS

Page

1. INTRODUCTION **1**
STUDY AREA DESCRIPTION 4
PROPOSED DEVELOPMENT ACTIVITY 6
2. BACKGROUND **7**
CULTURE-HISTORICAL CONTEXT 7
A Generalized Model of Hawaiian Prehistory 7
A Brief History of Hawai‘i After Western Contact 8
KEA‘AU AHUPUA‘A AND THE GREATER PUNA DISTRICT 9
Celebrated Landscape and Agricultural Practices of the Puna District 11
Select Mo‘olelo for the Kea‘au Ahupua‘a and the Greater Puna District 16
‘Ōlelo No‘eau of Puna 22
Chiefly Rule in Puna 24
The Death of Kamehameha and Early Historical Accounts of Puna (1823-1847) 28
The Māhele ‘Āina of 1848 32
Kea‘au and the Greater Puna Area After the Māhele 37
Late Nineteenth and Early Twentieth Century Industrialization in Puna 49
PREVIOUS STUDIES 66
3. CONSULTATION **70**
JAY HATAYAMA 70
DR. J.B. FRIDAY 70
KU‘ULEI KANAHELE 71
KAINANA FRANCISCO 72
4. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS **73**
REFERENCES CITED **76**

FIGURES

Page

1. Study area location plotted on a USGS 7.5 min. series, Hilo, HI Quadrangle, 1995. 2
2. TMK: (3) 1-6-003 showing current study parcel and the proposed East Hawaii Organics Facility location. 3
3. Google Earth™ satellite image showing study area location (outlined in red) and proposed Organics Facility location (shaded yellow). 4
4. Geology in the current study area and nearby vicinity (after Sherrod et al. 2007). 5

5. Soils within the study area (outlined in red) and nearby vicinity (after Soil Survey Staff 2017) 5
6. Location of three sites that were evaluated in the New Compost Facility Sitting Study (AECOM 2018:1-4) 6
7. Portion of Hawai‘i Registered Map No. 2060 (by John M. Donn in 1901) showing general location of Kea‘au Ahupua‘a (shaded gray) within the moku of Puna (shaded pink). 10
8. Land use map showing study area within Zone II, Upland Agricultural Zone (McEldowny 1979:64) 11
9. Man standing in a Puna pū hala grove in 1888 (Brigham and Stokes 1906:28). 13
10. Portion of Hawai‘i Registered Map No. 424 prepared by Wilkes in 1841 showing approximate location of current study area 31
11. Land Commission Award 8559B ‘āpana 16 to William C. Lunalilo (kipukadatabase.com). 34
12. Royal Patent 7223 for Kea‘au Ahupua‘a issued to Lunalilo in 1879 by King Kalākaua 35
Figure 12. continuation of Royal Patent 7223. 36
13. Hawai‘i Registered Map 1665, showing the proposed route to Volcano, by Baldwin 1893. 44
14. Hawai‘i Consolidated Railway alignments at ‘Ōla‘a Sugar Mill. 50
15. Plat Map 0788 prepared by A.S. Chaney, showing flume lines and railroad associated with the ‘Ōla‘a Sugar Company in 1922. ..... **Error! Bookmark not defined.**
16. USGS, Hilo HI, Quadrangle, 1932 showing flumes and plantation related infrastructure near study area. 53
17. Portion of Land Court Application 1053 Map 1 from 1936 showing study area parcel. 54
18. Taniguchi’s general map of Kea‘au/‘Ōla‘a Village. 55
19. Taniguchi’s map showing the major social institutions of Kea‘au/‘Ōla‘a Village. 56
20. Legend for Figure 19. 56
21. Taniguchi’s map showing the physical and social topography of Kea‘au Village. 57
22. Legend for Figure 21. 58
23. Taniguchi’s map showing the ethnic distribution present within Kea‘au Village. 59
24. Legend for Figure 23. 59
25. Detail of a 1954 USGS aerial photograph showing location of the current study area. 60
26. Detail of a 1965 USGS aerial photograph showing location of the current study area. 60
27. Hardwood species planted within the lower section of the Waiākea Forest Reserve adjacent to the study area (Department of Land and Natural Resources 2016:11). . **Error! Bookmark not defined.**
28. Study area location plotted on a USGS, Hilo HI, Quadrangle, 1977 showing the timber plantings in the Waiākea Forest Reserve and the quarry site. 62
29. Puna Sugar Company field map, showing the study are parcel partially cultivated in cane, ca. 1970s. 63
30. View of proposed Organics Facility site, with Albizia trees dominating the upper canopy, view to the northwest 64
31. View of proposed Organics Facility site, view to the northwest. 64
32. Grassy lot located to the south of study area at the corner of Kipimana and Mikahala Street, view to the southeast. 65
33. Gravel paved access road to papaya farms, view to the west. ..... **Error! Bookmark not defined.**
34. Locations of previous studies. 69

TABLES

Page

1. Previous archaeological studies. 66

APPENDIX

Page

A. PUBLIC NOTICE PUBLISHED IN KA WAI OLA NEWSPAPER 85

1. INTRODUCTION

At the request of Jennifer Scheffel of SSFM International on behalf of the County of Hawai‘i, Department of Environmental Management, Solid Waste Division, ASM Affiliates (ASM) has prepared this Cultural Impact Assessment (CIA) to accompany an HRS Chapter 343 Environmental Assessment for the proposed East Hawai‘i Organics Facility. This County facility will be constructed on 40-acres of a larger 424-acre parcel (Tax Map Key [TMK] (3) 1-6-003:090) located in the W.H. Shipman Business Park located in Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i (Figures 1 and 2). The study area is situated along the north boundary of the Shipman Business Park, which is adjacent to the Waiākea Forest Reserve located in the Hilo District (Figure 3). This study was prepared to accompany an Environmental Assessment conducted in compliance with HRS Chapter 343. This CIA was prepared pursuant to Act 50; and in accordance with the Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impact, adopted by the Environmental Council, State of Hawai‘i, on November 19, 1997. As stated in Act 50, which was proposed and passed as Hawai‘i State House of Representatives Bill No. 2895 and signed into law by the Governor on April 26, 2000, “environmental assessments . . . should identify and address effects on Hawaii’s culture, and traditional and customary rights . . . native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the ‘aloha spirit’ in Hawai‘i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.”

Presented below is a description of the study area, which is followed by a detailed culture-historical background and a presentation of prior studies; all of which combine to provide a physical and cultural setting and context for the current study. A summary of consultation is provided next, followed by a discussion of potential cultural impacts along with the appropriate actions and strategies necessary to mitigate any such impacts.

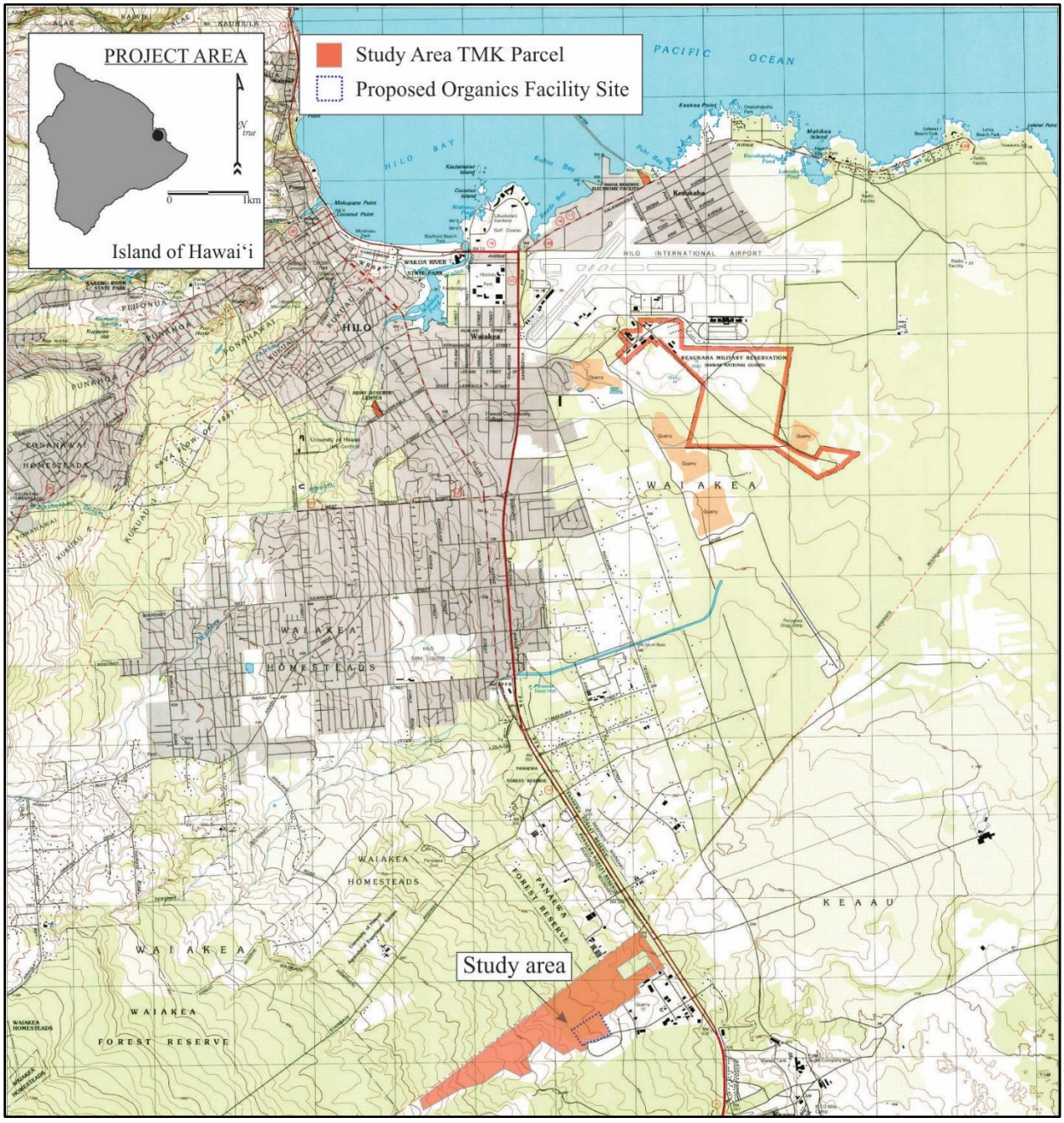


Figure 1. Study area location plotted on a USGS 7.5 min. series, Hilo, HI Quadrangle, 1995.

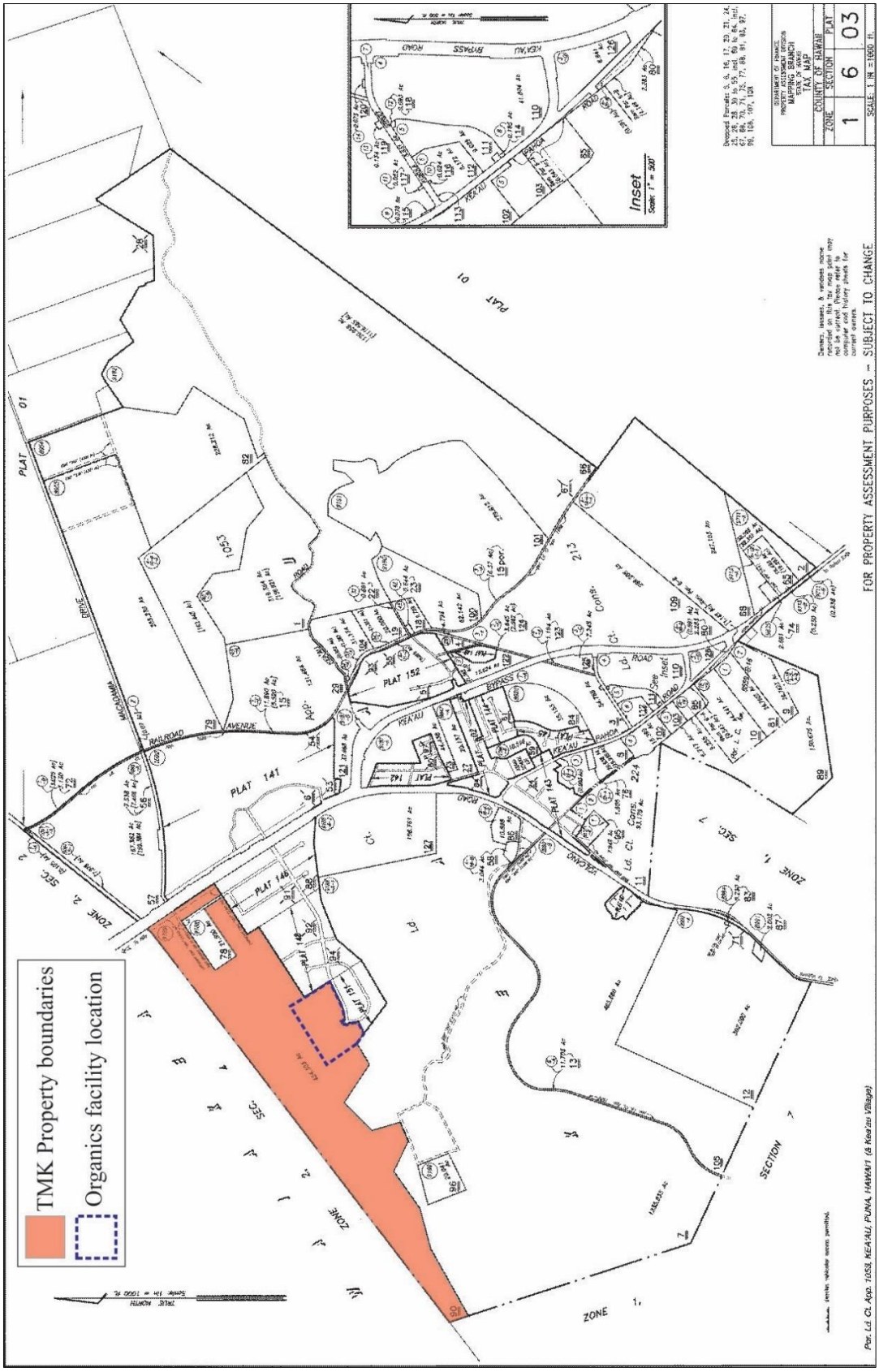


Figure 2. TMK: (3) 1-6-003 showing current study parcel and the proposed East Hawaii Organics Facility location.



Figure 3. Google Earth™ satellite image showing study area location (outlined in red) and proposed Organics Facility location (shaded yellow).

STUDY AREA DESCRIPTION

The current study area consists of a 424-acre TMK parcel, 40-acres of which will be set aside for the proposed facility location (see Figure 2) located in Kea'au Ahupua'a, Puna District, Island of Hawai'i. The west end of the parcel, consisting of roughly 188-acres is Agriculture-Zoned and is currently cultivated in papaya, except for a few thickly vegetated patches. The east end comprising some 236-acres (40-acres of which is set aside for the composting facility site) is vegetated with a predominately guinea grass (*Megathyrsus maximus*) understory, and a canopy of albezia (*Falcataria moluccana*), gunpowder (*Trema orientalis*), octopus (*Schefflera actiophylla*), and melochia (*Melochia umbellata*) trees. Several papaya fields are located within the central portion of the east section of the parcel (see Figures 3). The north boundary of the subject parcel also serves as the northeast boundary of the W.H. Shipman Business Park, which is accessed via the Hawai'i Belt Road (Highway 11). This boundary also serves as the district boundary separating the *moku* (district) of Hilo and Puna. Elevation in the study area range from 87 meters at the east end to 215 meters (285 to 705 feet) above sea level at the west end. It is bounded along the *makai* end by Hawai'i Belt Road; along the north by the Waiākea Forest Reserve; along the southeast end by multiple TMK parcels contained within the W.H. Shipman Business Park and at the west and southwest end by cultivated and undeveloped tracts of land within the Shipman Business Park (see Figure 3). Access to the parcel is from Kipimana Street, which is the main route through the W.H. Shipman Business Park.

Terrain within the project area slopes gently in an east-northeast direction and the underlying geology consists primarily of *pāhoehoe* lava flows that originated from Mauna Loa Volcano 750 to 1,500 years ago (Sherrod et al. 2007). Two patches of older pāhoehoe, also orginating from Mauna Loa Volano some 5,000 to 11,000 years ago have been mapped along the south margin of the property (Figure 4). Soils in this area (Figure 5) overlying the older flow are classified as Papai extremely cobbly highly decomposed plant material on a two to ten percent slope (Soil Survey Staff 2017). This area typically receives 149 inches of rainfall annually with most of the rainfall occurring in November and again in March and April (Giambelluca et al. 2013). The mean annual air temperature ranges between 68 and 74 degrees Farenheit with the highest temperatures peaking between the months of May through August (Giambelluca et al. 2014).

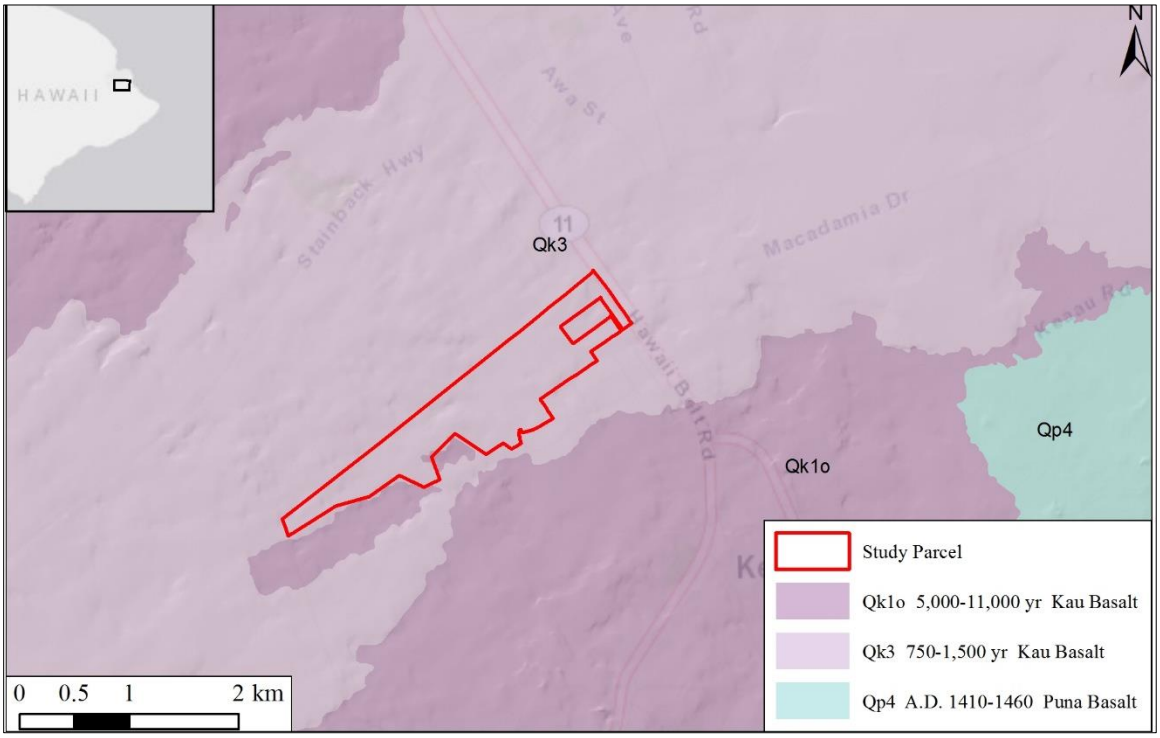


Figure 4. Geology in the current study area and nearby vicinity (after Sherrod et al. 2007).

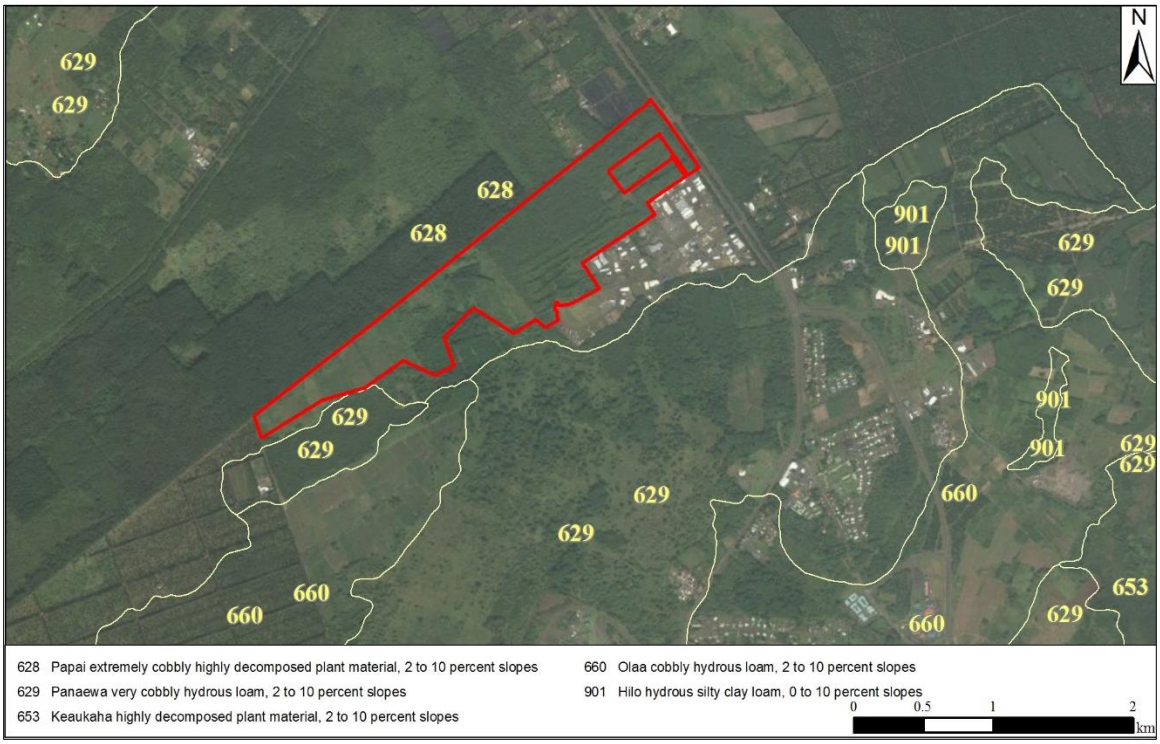


Figure 5. Soils within the study area (outlined in red) and nearby vicinity (after Soil Survey Staff 2017)

PROPOSED DEVELOPMENT ACTIVITY

The County of Hawai‘i Department of Environmental Management, Solid Waste Division seeks to construct an organics composting facility (East Hawai‘i Organics Facility). The purpose of this facility is to divert organics (e.g., green waste, food, paper, and compostable plastics) from disposal at the County landfills as a means to extend the life of the current landfills and to generate compost and mulch to support local subsistence and commercial agriculture.

The current study area is one of three sites selected as part of the *New Compost Facility Siting Study* that was completed in March 2018 by AECOM Technical Services, Inc. The County of Hawai‘i initially proposed an East Hawai‘i Organics Facility to be constructed on TMK (3) 2-1-013:142, 160, 161, and 163, located in the Hilo District, Island of Hawai‘i. However, due to public protest over the proximity of the proposed facility to the nearest residential area, in addition to other concerns, the County’s Department of Environmental Management, Solid Waste Division, withdrew the Draft Environmental Assessment on April 4, 2017. The *New Compost Facility Sitting Study* (2018) identified three new sites all of which are in Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i (Figure 6). Each site was evaluated for technical, environmental, cultural, and social comparisons factors. Based on the findings, Site 2 ranked as the most desirable given the lack of potential archaeological features and for the overall development cost. Therefore, Site 2 is the focus of this Cultural Impact Assessment study.

Conceptual plans for the proposed East Hawai‘i Organics Facility indicate that it will be designed, contracted, and operated by a private contractor, HER, under contract with the County of Hawai‘i. According to AECOM’s (2018:1-1) study, the “facility will include a covered organic receiving building that will allow for acceptance of organic material such as food, paper, and green waste.” Additionally, this facility will be constructed according to U.S. Environmental Protection Agency (EPA)- approved GORE Cover System, “which utilizes forced aeration of the compostable material under a semi-permeable membrane cover” (ibid.). This composting method is designed to minimize environmental impacts including odor, pests, and dust, in addition to decreasing the overall composting time required (ibid.).

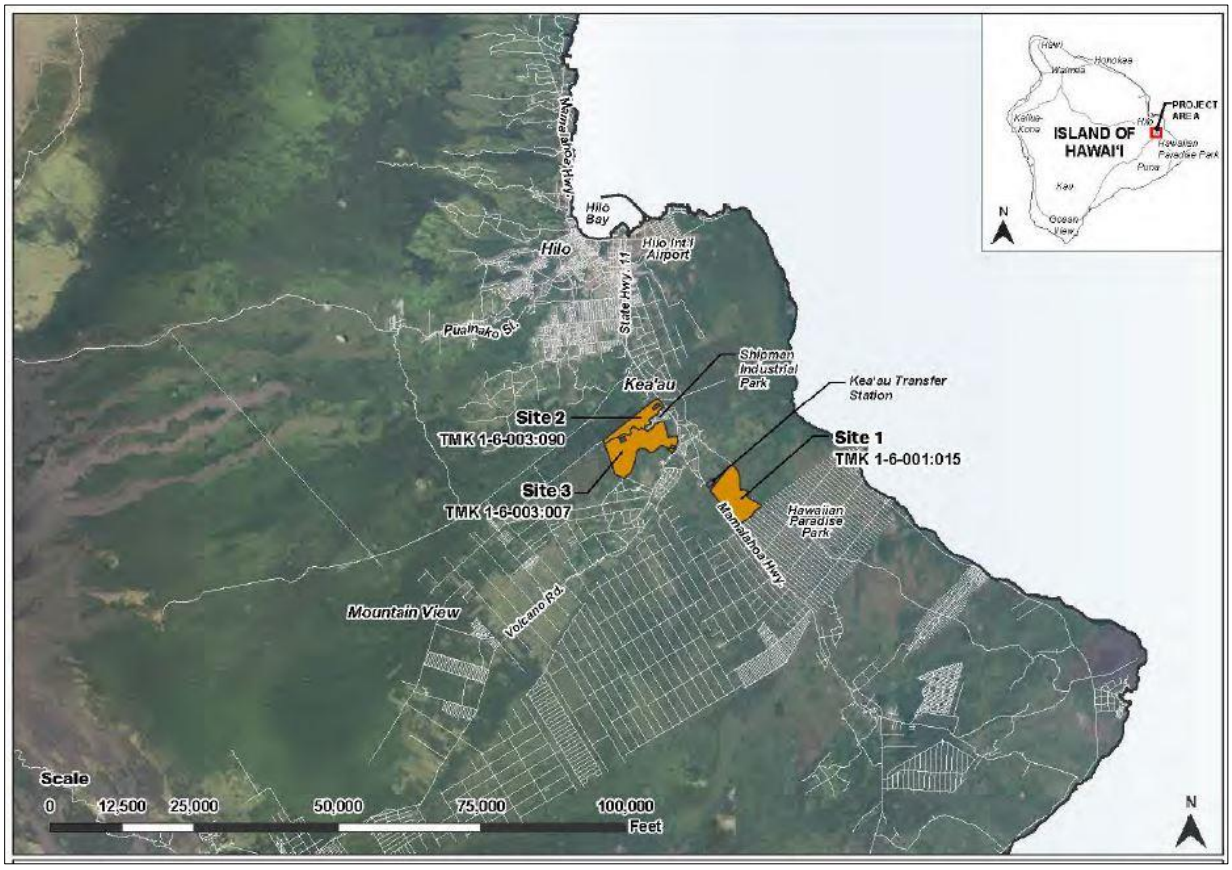


Figure 6. Location of three sites that were evaluated in the *New Compost Facility Sitting Study* (AECOM 2018:1-4).

2. BACKGROUND

This section of the report includes a discussion of the cultural-historical background for the project area and synthesis of relevant prior research. This information is presented to provide a comprehensive understanding of the cultural significance of the study area and general vicinity and to establish an analytical basis for the assessment of any potential cultural impacts. The ability to assess the cultural significance of the current study area parcel is contingent upon developing (at a minimum), a comprehensive understanding of the *ahupua'a* in which the study area is located. As will be demonstrated in the ensuing section and particularly with the traditional Hawaiian legendary accounts, a consideration of the broader region and island landscape is also required at times. The culture-historical context presented below for Kea'au Ahupua'a is based on original research conducted by ASM at various online repositories as well as physical repositories including the University of Hawai'i at Hilo Mo'okini Library, W.H. Shipman Limited, State Historic Preservation Division library, and the Hawai'i State Archives.

CULTURE-HISTORICAL CONTEXT

The chronological summary presented below begins with the peopling of the Hawaiian Islands and a generalized model of Hawaiian Prehistory followed by a review of Historic events in the Hawaiian Islands after the arrival of foreigners. The discussion continues with a collection of legendary and historical references to Kea'au and the greater Puna District. This summary includes oral traditions and Historic first-hand accounts recorded by early visitors and missionaries and a review of horticultural practices. Late Historic land use practices in the study area vicinity are also presented, including an examination of commercial sugar cultivation, lumber production, and the development of the railroad to facilitate economic growth. This chapter closes with a discussion of the transition from commercial sugar cultivation to the current land use within the study area and nearby vicinity.

A Generalized Model of Hawaiian Prehistory

While the question of the timing of the first settlement of Hawai'i by Polynesians remains unanswered, several theories have been offered that derive from various sources of information (i.e., genealogical, oral-historical, mythological, radiometric). However, none of these theories is today universally accepted (c.f., Kirch 2011). What is more widely accepted is the answer to the question of where Hawaiian populations came from and the transformations they went through on their way to establish a uniquely Hawaiian culture. The initial settlement in Hawai'i is believed to have originated from the southern Marquesas Islands (Emory in Tatar 1982). During these early times, Hawai'i's inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1991). This was a period of great exploitation and environmental modification when early Hawaiian farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). Their ancient and ingrained philosophy of life tied them to their environment and kept order; which was further assured by the conical clan principle of genealogical seniority (Kirch 1984). According to Fornander (1880), the Hawaiians brought from their homeland certain universal Polynesian customs and belief: the major gods Kāne, Kū, and Lono; the *kapu* system of law and order; cities of refuge; the *'aumakua* concept; and the concept of *mana*. The initial permanent settlements were established at sheltered bays with access to fresh water and marine resources. These communities shared extended familial relations and there was an occupational focus on the collection of marine resources. Over a period of a few centuries, the areas with the richest natural resources became populated and perhaps even crowded, and there was an increasing separation of the chiefly class from the common people. As populations increased so did societal conflict, which resulted in hostility and war between neighboring groups (Kirch 1985). Soon, large areas of Hawai'i were controlled by a few powerful chiefs.

As time passed, a uniquely Hawaiian culture developed. The portable artifacts found in archaeological sites of this next period reflect an evolution of the traditional tools and distinctly Hawaiian inventions. The adze (*ko'i*) evolved from the typical Polynesian variations of plano-convex, trapezoidal, and reverse-triangular cross-section to a very standard Hawaiian rectangular quadrangular tanged adze. The two-piece fishhook and the octopus-lure breadloaf sinker are Hawaiian inventions of this period, as are *'ulu maika* stones and *lei niho palaoa*. The latter was a status item worn by those of high rank, indicating a trend toward greater status differentiation (Kirch 1985). As the population continued to expand so did social stratification, which was accompanied by major socioeconomic changes and intensive land modification. Most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. During this expansion period, additional migrations to Hawai'i occurred from Tahiti in the Society Islands. Rosendahl (1972) has proposed that settlement at this time was related to seasonal, recurrent occupation in which coastal sites were occupied in the summer to exploit marine resources, and upland sites were occupied during the winter months, with a focus on agriculture. An

increasing reliance on agricultural products may have caused a shift in social networks as well; as Hommon (1976) argues, kinship links between coastal settlements disintegrated as those links within the *mauka-makai* settlements expanded to accommodate the exchange of agricultural products for marine resources. This shift is believed to have resulted in the establishment of the *ahupuaʻa* system sometime during the A.D. 1400s (Kirch 1985), which added another component to an already well-stratified society. The implications of this model include a shift in residential patterns from seasonal, temporary occupation, to permanent dispersed occupation of both coastal and upland areas.

The *ahupuaʻa* became the equivalent of a local community, with its own social, economic, and political significance, which added another component to a then well-stratified society. *Ahupuaʻa* were ruled by *aliʻi ʻai ahupuaʻa* or chiefs who controlled the *ahupuaʻa* resources; who, for the most part, had complete autonomy over this generally economically self-supporting piece of land. *Ahupuaʻa* lands were in turn, managed by an appointed *konohiki* or lesser chief-landlord. The *aliʻi-ʻai-ahupuaʻa*, in turn, answered to an *aliʻi ʻai moku* (chief who claimed the abundance of the entire district). Thus, *ahupuaʻa* resources supported not only the *makaʻāinana* (commoners) and *ʻohana* (families) who lived on the land but also contributed to the support of the royal community of regional and/or island kingdoms. *Ahupuaʻa* are land divisions that typically incorporated all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986). Although the *ahupuaʻa* land division typically incorporated all of the eco-zones, their size and shape varied greatly. This form of district subdividing was integral to Hawaiian life and was the product of resource management planning that was strictly adhered to. In this system, the land provided fruits and vegetables and some meat for the diet, and the ocean provided a wealth of protein resources (Rechtman and Maly 2003). In communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in the procurement of marine resources) were also strictly enforced.

By the 17th century, large areas of Hawaiʻi Island were controlled by a few powerful *aliʻi ʻai moku*. There is island-wide evidence to suggest that growing conflicts between independent chiefdoms were resolved through warfare, culminating in a unified political structure at the district level. It has been suggested that the unification of the island resulted in a partial abandonment of portions of leeward Hawaiʻi, with people moving to more favorable agricultural areas (Barrera 1971; Schilt and Sinoto 1980). ʻUmi a Līloa, a renowned *aliʻi* of the Pili line, is often credited with uniting the Island of Hawaiʻi under one rule during the Precontact Period (Cordy 1994). ʻUmi-a-Līloa is also credited with formalizing the land division system on Hawaiʻi Island and separating the various classes of chiefs, priests, and laborers (Beamer 2014; Cordy 2000; Kamakau 1992). Upon the death of ʻUmi-a-Līloa, Hawaiʻi Island came under the control of his eldest son Keliʻiokāloa-A-ʻUmi (Cordy 2000), whose reign is marked by his mistreatment of the lesser chiefs and commoners. His reign was short lived and by the early eighteenth century Hawaiʻi Island fell under the control of Alapaʻinui, who assembled a robust army and assigned his closests potential usurpers (his nephews Keawemaʻuhili, Kalaniʻōpuʻu, and Keōua) as generals in his militia. The prodigious ʻĪ clan, spread across the districts of Kaʻū, Puna, Hilo, and portion of Hāmākua was also a powerful force and threat to Alapaʻi campaign (Cordy 2000). As Alapaʻi gathered his forces to strike back at Kekaulike, the *aliʻi nui* of Maui, the high ranking *aliʻi wahine* (chiefess) Kekuʻiapoiwa made her way to Kokoiki, Kohala to gave birth to Paiʻea, the birth name of Kamehameha (ibid.). Kamehameha was reared in the traditions and customs of the ancient chiefs and trained under some of the most skilled warriors of that time including Kekūhaupiʻo. Upon Alapaʻi's death, his eldest son Keaweʻōpala was named heir to the kingdom. By the mid eighteenth century, the young and determined Kamehameha directed his efforts toward consolidating Hawaiʻi Island under his rule. To accomplish this monumental task, Kamehameha continued his training under his more experienced kin namely Kalaniʻōpuʻu, who was the *aliʻi nui* of Hawaiʻi Island (ʻĪʻī 1959). During Kalaniʻōpuʻū's reign, the first foreign vessels arrived in Hawaiian waters captained by British explorer, James Cook. Cook first landed at Waimea, Kauaʻi in 1778 and in 1779, he anchored just off the shores of Kealakekua Bay, Kona. Aboard these ships were innovative technologies and diseases unknown to the inhabitants of these islands. Items such as metal, nails, guns, canons, and the large foreign vessels themselves stirred the interest of the *aliʻi* and *makaʻāinana* alike. Acquisition of these technological advancements came through barter. This resulted in the *aliʻi* gaining possession of such items that ultimately set traditional Hawaiian warfare in new trajectory; one that would be forged by none other than Kamehameha. Wars occurred regularly between intra-island and inter-island polities during this period. It was during this time of warfare that Kamehameha, who would eventually rise to power and unite all the Hawaiian Islands under one rule (Kamakau 1992).

A Brief History of Hawaiʻi After Western Contact

The arrival of Western explorers in Hawaiʻi signified the end of the Precontact Period and the beginning of the Historic Period. With the influx of foreigners, Hawaiʻi's culture and economy underwent drastic changes. Demographic trends during the early Historic Period indicate population reduction in some areas, due to war and disease, yet increase in

others, with relatively little change in material culture. At first, there was a continued trend toward craft and status specialization, intensification of agriculture, aliʻi controlled aquaculture, the establishment of upland residential sites, and the enhancement of traditional oral history. The Kū cult, luakini heiau, and the kapu system were at their peaks, although western influence was already altering the cultural fabric of the Islands (Kirch 1985; Kent 1983). Foreigners very quickly introduced the concept of trade for profit, and by the time Kamehameha had conquered Oʻahu, Maui, and Molokaʻi, in 1795, Hawaiʻi saw the beginnings of a market system economy (Kent 1983). Some of the work of the makaʻāinana shifted from subsistence agriculture to the production of foods and goods that they could trade with early visitors. Introduced foods often grown for trade with Westerners included yams, coffee, melons, Irish potatoes, Indian corn, beans, figs, oranges, guavas, and grapes (Wilkes 1845). In 1819, Kamehameha died and the kapu system that governed all aspects of traditional Hawaiian society was symbolically abolished when Liholiho (son of Kamehameha) ate in the presence of his mothers Keōpūolani and Kaʻahumanu. Shortly after 1820, Christianity established a firm foothold in the islands, and introduced diseases and global economic forces began to have a devastating impact on traditional life-ways.

KEAʻAU AHUPUAʻA AND THE GREATER PUNA DISTRICT

The *ahupuaʻa* of Keaʻau (Figure 7) is one of fifty traditional land divisions found in the *moku* (district) of Puna on the eastern shores of Hawaiʻi Island. The *ahupuaʻa* of Keaʻau is bound on the north by Waiākea Ahupuaʻa and to the south by ʻŌlaʻa Ahupuaʻa. The Hawaiian proverb "Puna, mai ʻOkiʻokiaho a Māwae" describes the extent of the district spanning from ʻOkiʻokiaho the southern boundary, to Māwae, the northern boundary. In the book, *Native Planters in Old Hawaii*, Handy and Handy (1991) describe Puna as an agriculturally fertile land that has repeatedly been devastated by lava flows. Writing during the 1930s, they relate that:

> The land division named Puna—one of the six chiefdoms of the island of Hawaii said to have been cut (*ʻoki*) by the son and successor of the island's first unifier, Umi-a-Liloa—lies between Hilo to the north and Kaʻu to the south, and it projects sharply to the east as a great promontory into the Pacific. Kapoho is its most easterly point, at Cape Kumukahi. The uplands of Puna extend back toward the great central heights of Mauna Loa, and in the past its lands have been built, and devastated, and built again by that mountain's fires. In the long intervals, vegetation took hold, beginning with miniscule mosses and lichens, then ferns and hardier shrubs, until the uplands became green and forested and good earth and humus covered much of the lava-strewn terrain, making interior Puna a place of great beauty. . .
>
> …One of the most interesting things about Puna is that Hawaiians believe, and their traditions imply that this was once Hawaii's richest agricultural region and that it is only in relatively recent time that volcanic eruption has destroyed much of its best land. Unquestionably lava flows in historic times have covered more good gardening land here than in any other district. But the present desolation was largely brought about by the gradual abandonment of their country by Hawaiians after sugar and ranching came in… (Handy and Handy 1991:539-542)

The District of Puna is situated mainly on the slopes of Kīlauea Volcano. The east rift zone of the volcano, a broad, low profile ridge (2-4 kilometers wide) formed by eruptions originating from numerous vents along its crest. The zone extends through the district from the Kīlauea Caldera to Cape Kumukahi at the eastern tip of the island, a distance of 55 kilometers. The north side of the rift zone, extending to the slopes of Mauna Loa and to the northeastern Puna coast, is covered primarily by lavas that erupted from the summit of Kīlauea about 200-750 years ago. In contrast, nearly the entire crest of the rift zone is covered by lava that is less than 200 years old, and most of the young lava flows that emanate from vents along the crest have spread southward towards the southeastern coast of the district, covering the older lava flows in the process (Wolfe and Morris 1996).

The current study area falls within the inland section of McEldowney's (1979:18-25) Upland Agricultural Zone (Zone II) (Figure 8), dubbed the Windward Inland Terrain subzone by Burtchard and Moblo (1994). While McEldowney's zones of early Historic land use are largely shaped by early historical accounts and loosely determined by topographic elevations, they also consider environmental variables and human resource needs, offering insight into the prehistoric past (Burtchard and Moblo 1994). In their refinement of the model as it applies to Puna, Burtchard and Moblo elaborate on McEldowney's concept of the Windward Inland Terrain subzone:

> The inland portion of the [Upland Agricultural Zone] includes low to moderate elevation landforms (circa 200 to 700 ft) extending to approximately five miles inland from the coast. Because of relatively easy access and reliable rainfall, this zone is expected to have been linked to the coast, providing agricultural support throughout the prehistoric period. Land-use intensity should have

increased as volcanic destruction of arable ground and/or late prehistoric population population demands increased pressure to exploit agricultural land. Agricultural feature density should be moderate and decrease with distance to the coast. (Burtchard and Moblo 1994:26)

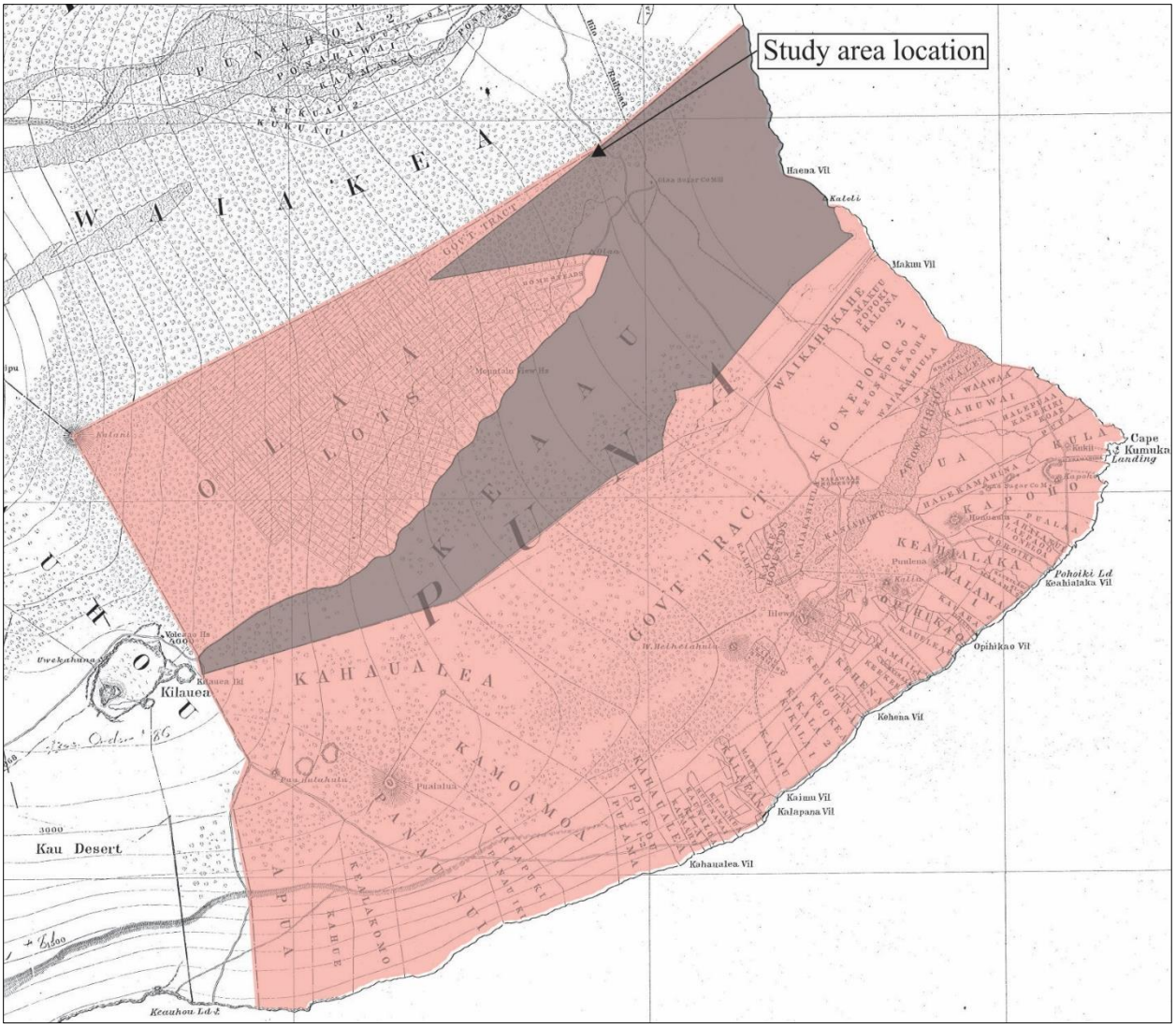


Figure 7. Portion of Hawai‘i Registered Map No. 2060 (by John M. Donn in 1901) showing general location of Kea‘au Ahupua‘a (shaded gray) within the *moku* of Puna (shaded pink).

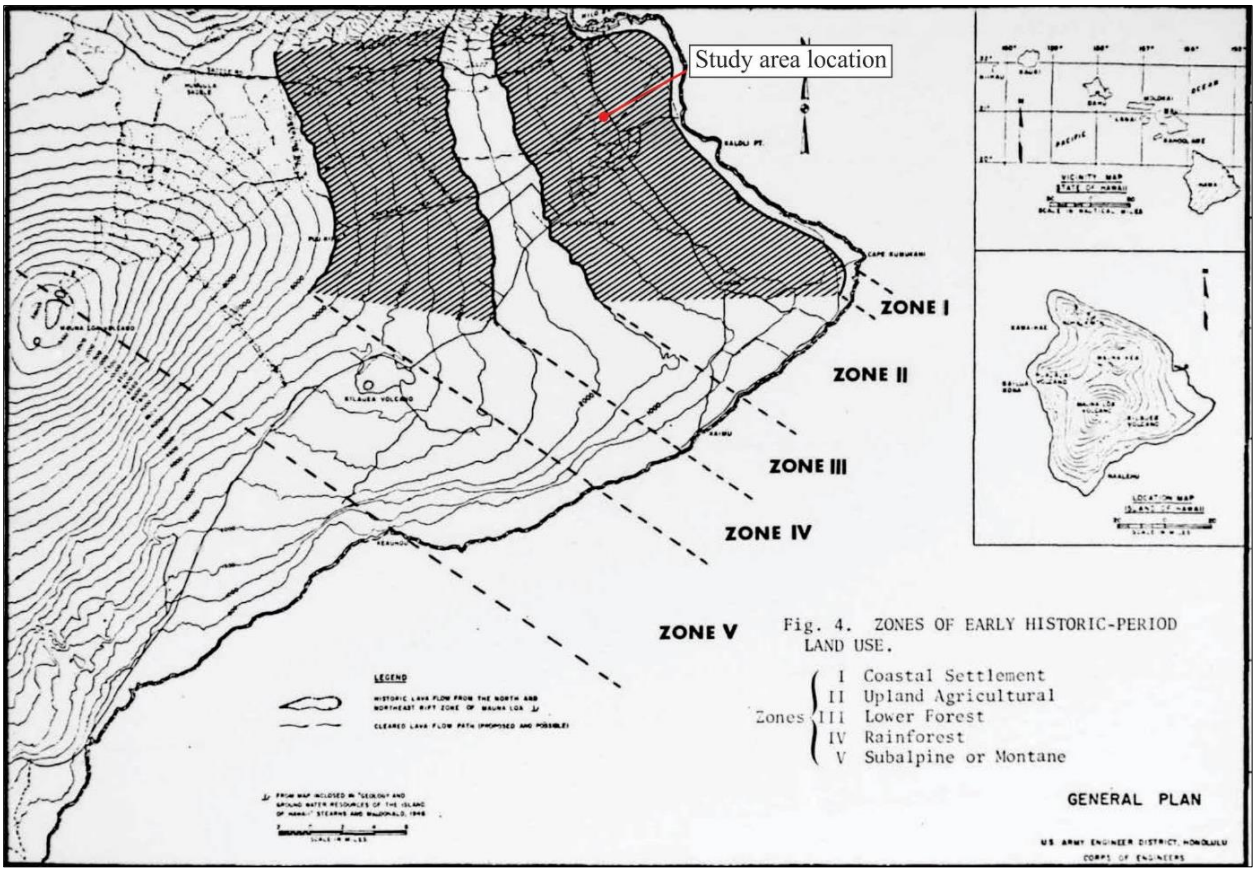


Figure 8. Land use map showing study area within Zone II, Upland Agricultural Zone (McEldowny 1979:64)

Celebrated Landscape and Agricultural Practices of the Puna District

Puna appears to be a seemingly desolate, harsh, lava-coated terrain under the incessant threat of the molten fires of the fierce female goddess Pelehonuamea (Pele). However, Puna's volcanic nature stands as the eternal source of freshly created raw landscapes that symbolically and physically represents the beginning of life for the Hawaiian Islands. Ever-changing and growing, Puna is a land of rebirth and regeneration, which are embodied in its proximity to the volcano, the growth of new vegetation on new land, and the section of the island chain that welcomes the sun (Kanahele 2011). While this district is reknowed as the home of Pele, the traditional text also describes this district as "*'āina i ka houpo a Kāne,*" (land on the bosom of Kāne) (Pukui 1983:11). Pukui (ibid.) explains that before Pele's migration from her homeland, Kahiki, there was no place more beautiful than Puna. Pukui (1983:191) lists another proverb, *ke one lau'ena a Kāne* (the rich, fertile land of Kāne), which Puna "was said to have been a beautiful, fertile land loved by the god Kane" but was transformed into lava beds, cinder, and rock with Pele's arrival. According to Kanahele (2011), the god Kāne manifests as the sun, new life, and fresh water, elements which are synonymous with this district.

The island landscape rejuvenates, as it has done repeatedly over the last 700,000 years, sprouting new life. Puna has and continues to support a hospitable environment favorable for producing abundant vegetation. As Kea'au encompasses both *mauka* agricultural and forest resources and ocean fisheries fronting the coastline, former residents were once able to procure nearly all that they needed to sustain their families and contribute to the larger community from within the land division. The *ahupua'a* resources in turn helped support the *ali'i* that ruled the District of Puna (Maly 1998).

As indicated by Handy (1940:194), Puna is referred to as "*Puna paia ala i ka hala*" (Puna hedged with fragrant *hala*). Additional details are given by Pukui (1983:301) about this proverb, she adds, "[i]n the olden days the people would stick the bracts of hala into the thatching of their houses to bring some of the fragrance indoors." Indeed, the presence of Puna's sweet-smelling famed *hala* (*Pandanus tectorius*) groves are prevalent throughout written historic literature and celebrated in countless Hawaiian *'ōlelo no'eau* (proverbs), *oli* (chants), and *mele* (songs). The *'ōlelo no'eau* "Ka makani hali'ala o Puna" boast of the fragrance bearing winds of Puna scented with *maile* (*Alyxia stellata*),

lehua (*Metrosideros polymorpha*), and *hala* (Pukui 1983:158). Pukui explains that "[i]t was said that when the wind blew from the land, fishermen at sea could smell the fragrance of these leaves and flowers." Another *'ōlelo no'eau* concerning the *hala* groves of Kea'au reads "Ka ua kāhiko hala o Kea'au," which Pukui (ibid:168) translate as "[t]he rain that adorns the pandanus trees of Kea'au." A wealth of traditional accounts for this district can be found in the legend of the volcanic goddess, Pele and her younger sister Hi'iakaikapoliopele. The following *mele, Ke Ha'a Lā Puna i ka Makani*, accompanied the very first recorded *hula* of the Pele and Hi'iaka saga (Kanahele and Wise 1989):

Ke ha'a lā Puna i ka makani	Puna is dancing in the breeze
Ha'a ka ulu hala i Kea'au	The hala groves at Kea'au dance
Ha'a Hā'ena me Hōpoe	Hā'ena and Hōpoe dance
Ha'a ka wahine	The woman dances
'Ami ('oni) i kai o Nānāhuki	[She] dances at the sea of Nānāhuki
Hula le'a wale	Dancing is delightfully pleasing
I kai o Nānāhuki	At the sea of Nānāhuki
'O Puna kai kūwā i ka hala	The voice of Puna resounds
Pae i ka leo o ke kai	The voice of the sea is carried
Ke lū lā i nā pua lehua	While the lehua blossoms are being scattered
Nānā i kai o Hōpoe	Look towards the sea of Hōpoe
Ka wahine 'ami i kai o Nānāhuki	The dancing woman is below, towards Nānāhuki
Hula le'a wale	Dancing is delightfully pleasing
I kai o Nānāhuki	At the sea of Nānāhuki

While frequently exalted for its glorious fragrance, the pandanus tree (*pū hala,* or *hala*) (Figure 9) was also exploited for more utilitarian purposes. The dried leaves were frequently used to plait *lauhala* mats, which could be used for thatching onto house rafters (a method typically employed in Puna and the neighboring district of Hilo in the absence of *pili* grass) and house walls, pillows, fans, floor coverings, canoe sails, baskets, and occasionally as clothing (Handy 1940; Handy and Handy 1991; Summers 1999). William T. Brigham, former Director of the Bernice Pauahi Bishop Museum, described seeing the natives of Puna weaving the mats for which the district was famous:

> Puna was a famous region for hala mats, and in 1864, the author, when journeying through the district with that noble missionary the Reverend Titus Coan, saw many a party in the curious open caves (caused by a breakdown of the lava crust in some of the many streams of lava, ancient and recent, that form much of the surface of Puna) busily engaged in weaving mats, a work for which the comparative coolness and dampness of the caves was most suited. A quarter of a century later in traveling the same road with a younger companion the scene was greatly changed: the caves were there, the hala trees were there, but the inhabitants had gone, and for sixty miles there was nothing but a few deserted churches and some aged breadfruit trees to tell that once people had lived there. Fifteen years later the scene had again changed owing to the opening of roads and the cultivation of sugarcane, but the present inhabitants were not the old natives, and the mat making is only here and there continued when there is a chance to sell to the foreigner. (Bringham and Stokes 1906:29)

The inhabitants of Puna were undoubtedly recognized for their expertise and skill in *lauhala* weaving. Maly relates, "to this day, Puna is known for its growth of *hala*, and the floors and furniture of some of the old households are still covered with fine woven mats and cushions. Weaving remains an important occupation of many native families of Puna." (1998:6). According to Fornander (1918-1919), two particular styles of *lauhala* mats were associated with Puna; the *makali'i*, a braided, small-stranded mat, and the *puahala* or *hīnano* made from the male pandanus blossom. The latter was especially highly valued, and ". . . is only made in Puna where the hala tree is very abundant. It is a regular article of trade among the natives who greatly prize it as a choice mat to sleep on" (Summers 1999:17).

The *hala* tree also carries spiritual significance, some of which is derived from the literal meaning, "to pass; elapse, as time; to pass away" (Pukui and Elbert 1986:50). *Lei* (garland of flowers or foliage commonly worn around the neck) strewn together from the *'āhui hala* (pandanus fruit keys) is often gifted to an individual to commemorate the passing of a major life event or given to a deceased individual to help usher their spirit into the afterlife. Additionally, Handy (1993) conveys the significance of the *hala*, which played a role in the protection of a newborn baby's placenta (*'iewe*). *Hala* groves were abundant in Puna, and concealing the *'iewe* high up in the leaves prevented it from being pilfered. The people of Puna were sometimes referred to as *maka kōkala* (thorny eyes) by the inhabitants of the neighboring district of Ka'ū, correlating the spined leaves of the *hala* with the long eyelashes of the baby whose *'iewe* it was sheltering, providing a "bright keen look" (Handy 1993; Pukui and Elbert 1986:160).



Figure 9. Man standing in a Puna *pū hala* grove in 1888 (Brigham and Stokes 1906:28).

Historical literature reveals that the *hala* groves were also utilized for the cultivation of staple food crops, particularly *kalo*. While the *ʻulu* (breadfruit) appears to be the dominant source of sustenance for residents of Puna, the taro (*kalo*) undoubtedly rivaled it as a staple food source. Unlike the neighboring district of Hilo, Puna lacked continuously flowing streams, which therefore made growing *kalo* using the popular *loʻi* (irrigated fields) method nearly impossible. Despite this, Puna received ample rainfall throughout the year, which made the cultivation of dryland *kalo* possible, even "along the coast as far as Hilo (Handy 1940:126). Handy and Handy (1991:541) relate that "the wet and sometimes marshy pandanus forests from Kapoho through Poho-iki to ʻOpihikao used to be planted with taro in places." The method of planting dryland taro in the lowland forests of Puna is described by Handy and Handy (1991:104) as the "*pa-hala* (pandanus clearing) method." When used to grow *kalo*, the method involved the following:

> . . .Make holes in the *ʻaʻa* (broken lava) by taking out some of the stones. Be sure that the place chosen is in a *pu hala* grove, to save the labor of hauling *hala* branches into the patch later on. Fill the hole with whatever weeds can be found and leave them there for six weeks or more. The weeds will rot and make soil. When the weeds have rotted away, the taro *huli* are wrapped in *lau hala* (*hala* leaves) to keep them moist and are planted. When there or four leaves have appeared on each *huli*, then that is the tame to cut down the *pu hala* to let in the sun. The branches of the *hala* are cut off and the patch covered with them until this is not a trace of the taro to be seen. This is left until sufficiently dry to set on fire. The fire does not hurt the taro much as the *huli* are already well rooted. The *hala* reduced to ashes, give the taro the needed nourishment and they grow so tall that a man can be hidden under their leaves. (Handy and Handy 1991:104–105)

This method of cultivating dryland *kalo* in Puna could also be practiced on grass-covered slopes rather than directly atop lava. Unlike the previous method, the surface organic matter would undergo an initial burn-off before being planted. Handy elaborates:

> On slopes covered with grass, like those of Hamakua on Maui and Hawaii and Kohala on Hawaii, the grass was formerly burned off and the ground cleared (*waele*) of brush and stubble. This was also done in Puna and elsewhere on land covered with staghorn fern. The field then had to be dug over (*ohiki*) and the stubble thrown out. The open soil was left for a few weeks, or until the small rubbish had decayed. On the windy slopes of Kohala the whole field was covered with cut grass to keep the moisture in. In planting, small holes were made in the soft earth several feet apart and a cutting dropped into each. The old procedure, termed *okupe*, was to thrust the digging stick into the

> soft earth with the right hand, lift the soil to one side, and drop the cutting into the hole with the left. The cuttings were left uncovered until the rootlets showed vigorous growth; then each cutting was straightened and soil pressed down around it. Kamakau (40) advised burning over the whole field again when the plants showed four or five leaves, weeds, taro leaves and all, after which he says the taro springs forth so luxuriantly "that a man could be hidden among the leaves." (1940:52)

In slightly more elevated regions of Puna such as lands *mauka* of the current study area, *kalo* could be planted in the depression left by a toppled over *hāpu'u* fern trunk:

> In *pa pulupulu*, where there were fern-tree (*pulupulu*) forests at relatively low altitudes, as in Hilo and Puna districts on the island of Hawaii, the fern trunks were toppled over. The holes made by the removal of the bulbous bases were suited to planting taros without further excavation. Presumably the discarded trunks, with the starchy core removed for use as food for men or feed for hogs, were heaped around the clearing, making an enclosure (*pa*). (Handy and Handy 1991:51)

In addition to *kalo*, *'uala*, or sweet potato, was grown in great quantities throughout Puna, and Handy (1940) suggests that although it was indeed cultivated widely, it does not appear to have been a staple food of the district which was "most famous for its breadfruit" (1940:190):

> . . .The sandy soil southeast of Honolulu must have been utilized for sweet potatoes. As to the interior of northern Puna in ancient times, I have no information. There are a few patches now in Koae and the vicinity of Kapoho; the slopes and higher ground inside Kapoho crater are ideal for sweet potatoes. A variety of wild potato with deeply cut leaf, which had obviously gone wild from cultivation, was found near the rich taro land of Malama homesteads. It is safe to assume that sweet potatoes were cultivated throughout southeast Puna both inland and along the coast wherever there were plantations. They are still grown in small patches at Kaimu, Kalapana, and Kapaahu. It is said that on the barren coast beyond Kapaahu, fishermen scraped together piles of broken lava and rubbish when rains came and successfully grew sweet potatoes in them. Despite the fact that sweet potatoes were planted almost universally and many patches are still maintained, the Puna natives seem to regard this vegetable with little interest, probably because Puna people prided themselves upon and relished their breadfruit, and also because potato was nowhere and at no time the staple for this rainswept district. (Handy 1940:165)

The barrenness of surrounding lava flows was not a limiting factor in propogating *'uala*, which requires practically no soil to flourish. Its propagation is discussed in fair detail by nineteenth and early twentieth century visitors to the district, who describes seeing the *'uala* growing from mounds of lava stones. For example, an account from 1853 relates:

> There is an increasing attention paid to the culture of the sweet potato, to which our soil and climate are admirably adapted. It grows well in almost every part of the Islands, and no where better than among the dry hot stones of Puna, Kau and Kona on Hawaii,—No one who has ever traveled over those districts can fail to have been struck with astonishment at the sight of beautiful sweet potatoes growing in hills of broken lava with not a particle of earth to be seen in their vicinity. The natives sometimes manure these hills of lava by placing a few boughs upon the lava, then piling stones on them, and when they are partially decayed pulling up the stemsor woody part which leaves the leaves and bark to moisten and enrich the hill. The sweet potato is the great article of food in the dry burnt districts of Hawaii, and the cost of raising it is next to nothing. The yield, I am told, is from 50 to 75 bbls. per acre. (Royal Hawaiian Agricultural Society 1853:7)

'Ulu (breadfruit), another important staple crop was a *kinolau* (physical manifestation) of the goddess Haumea, the "patron of childbirth," and the principle staple food of Puna where it was most famous (Beckwith 1970:283; Handy 1991). Careful and gentle propagation was required, which entailed the removal and replanting of the root sucker cutting while ensuring it remained within its original, undisturbed soil casing. Concerning *'ulu* as a sustainable food source, Handy and Handy (1991:152) explain that "except in Puna, Hawaii, breadfruit was wholly secondary to taro and sweet potato as a staple. I am told that in Puna in a good year, breadfruit may be eaten for 8 months of the year, beginning with May."

In addition to these staples, other crops such as *niu* (coconut) and *'awa* were readily produced in Puna. The uses for *niu* recounted by Handy and Handy (1991) were many and varied. It thrived in coastal Puna and is frequently mentioned in historical accounts. With respect to varieties, Handy lists only two: the *niu hiwa* (particularly used for ceremony, medicine, and cooking), and the *niu lelo* (used primarily for nonreligious purposes). The method of propogating *niu* involved burying a sprouted nut on top of an octopus (*he'e*) at a hole deep enough to bury it

completely. The buried *he'e* was purported to "give the root a spread and grip like its own and to produce nuts that were bulbous like its head or body (*pu*)" (ibid.:172). Water from the *niu* was palatable, flavorful, and rich in nutrients. It could also be utilized on a spiritual level by priests practicing divination. The raw meat is edible and could be scraped out of the shell with a large *'opihi* shells and eaten as is or incorporated into the preparation of various sweets including *haupia* (*haukō*), *kūlolo, and pi'epi'e 'ulu*. Besides being utilized for human consumption, coconut meat could also be used to feed animals. Handy and Handy (1991:174) explained:

> In some localities in Puna, pigs were taught to open their own coconuts. When the owners of the pigs expected to be absent for some time, they husked a quantity of the nuts, leaving a strip of husk on each one about two inches in width. When a pig wanted to open a nut, he grasped it by this strip of husk and dashed it against a rock. Thus the pigs were assured of fresh food until the owners returned.

The meat of the coconut could also be crafted into fresh coconut oil. Handy and Handy (1991:192) describes the process as it was done in Puna thusly:

> In Puna, *mano'i* or coconut oil was made as follows: The fresh gratings, with *maile* or other *kupukupu* (any odoriferous plant) to give fragrance, were placed in a container in the hot sun. When the oil separated away from it, the mass was squeezed through *ahuawa* and the refuse (*oka*) thrown away. The oil was used for anointing the body and hair and washing the hair.

Coconuts husk also provided fibers that were plaited to make sennit *'aha* (cordage) that was used for lashing house timbers, adzes, canoe parts. The coconut shell was cleaned and sometimes split in half where it would be fashioned into medicine, food, and drink receptacles, including *'apu* that was used for serving and mixing *'awa*. The trunk of the coconut was carved to form the main body of the *pahu hula* drum. Coconut leaf stems and midribs were used to clean pig intestines, make brooms, shrimp snares, and for stringing *kukui* nuts to be burned as candles. The leaves were plaited to make fans and playing balls for children, and the end of the leaf was used as *kapu* markers along the coastline or to frighten fish out from under ocean ledges (Handy and Handy 1991).

'Awa, a plant described as the "cherished narcotic" of the Hawaiian people by Handy and Handy (1991:192) was utilized by all socioeconomic classes in Hawaiian Prehistory and is mentioned in several *mo'olelo* (traditional accounts) for the Puna District. Pukui (1983) lists the following Hawaiian proverbs describing the district's famed *'awa*:

> *'Awa kau lā'au o Puna.*
> Tree-growing 'awa of Puna.
> Tree-grown *'awa* of Puna was famous for its potency. It was believed that birds carried pieces of *'awa* up into the trees where it would grow (ibid.:29)

> *Puna, 'āina 'awa lau o ka manu.*
> Puna, land of the leafed *'awa* planted by the birds. (300)

> *Ka 'awa lena o Kali'u.*
> The yellowed *'awa* of Kali'u.
> Refers to Kali'u, Kilohana, Kaua'i. People noticed drunken rats in the forest and discovered some very potent *'awa* there. There is a Kali'u in Puna, Hawai'i, where good *'awa* is also grown. (140)

The *'awa* roots were carefully chewed (pounded in later years) into balls (*mana* or *mana 'awa*), strained with the stem fibers of the *ahu'awa*, and presented as offerings or drunken out of polished *niu* shell *'apu 'awa* cups for pleasure, ceremonial, and relaxation purposes. It was also a principal element in the treatment of both physical and spiritual ailments in living subjects by the *kahuna* (priests) and a crucial ingredient in ritualistic use in which its procurement and preparation were handled with the utmost care. Of all the districts of Hawai'i Island, Puna was the most renowned for its *'awa*, producing the finest *'awa kau la'au*:

> *Kau la'au* is the famous *awa* of Puna, Hawaii, which grows in the crotches of trees where, according to the Hawaiians, it becomes planted by birds building pieces of the stem into their nests (M). A line from a mele reads: "Ka manu ahai kanu awa e" (The bird clipping the twig of awa and planting it elsewhere; see 21, p. 30). Kaaikamanu (Ka) identifies it as the same as *Mokihana*, but Mrs. Pukui, who is very well acquainted with Puna (Kaaikamanu came from eastern Maui) tells me that any variety might be found growing in this way. This Puna *awa* was famous for its strength, which was due, in Mrs. Pukui's opinion, to the fact that its roots grew in sunlight. (Handy and Handy 1991:202-203)

Because of this unique cultivation method, the natives of Puna were renowed across the archipelago for producing the most superior and potent *ʻawa*. This notion is expressed in several traditional accounts including, *Ka Moʻolelo o Hiʻiakaikapoliopele* (Hoʻoulumāhiehie 2006) when the infamous Pele introduced herself to the striking Lohiʻauipo from Kauaʻi. After Pele indicated that she was from Puna, Lohiʻau responded, *"no Puna ʻiʻo o kā ʻoe, no ka ʻāina ʻawa lau a ka manu, ka ʻāina i ka polo hīnano*" (is that so, you are from Puna, from the land of the young *ʻawa* plant of the birds, the land of the pandanus trees). This *moʻolelo* as well as that concerning the highly skilled rat shooter named Pīkoi-a-ka-ʻalalā (Kaui 1865-1866), and the legend of Ke-au-nini (Westervelt 1916) suggest that the *ʻawa* found growing in the trees of Puna was spread throughout the forest by birds. The legendary account of Ke-au-nini (ibid.:198) explains that this type of *ʻawa* was also found growing in the Panaʻewa forest. Westervelt writes (1915:198): "he picked up the stones and ran to Pana-ewa and got the awa hanging on the tree…" The intoxicating effects of *ʻawa*, especially the potent Puna variety, induce a supreme state of physical relaxation and ataraxia and are described in a *mele* sung by Hiʻiaka as she traversed a trail through the darkened Panaʻewa forest:

	O honey-dew sipped by the bird,
	Distilled from the fragrant lehua;
Ka wai mukiki ale lehua a ka manu,	O yellow-barked awa that twines
Ka awa ili lena i ka uka o Ka-liʻu,	In the upper lands of Ka-liʻu;
Ka manu ahaʻi lau awa o Puna:	O bird that brews from this leafage
Aia i ka laau ka awa o Puna.	Puna's bitter-sweet awa draught;—
Mapu mai kona aloha iaʻu—	Puna's potentest awa grows
Hoolaau mai ana iaʻu e moe,	Aloft in the crotch of the trees.
E moe no au, e-e!	It wafts the seduction to sleep,
	That I lock my senses in sleep!
	(Emerson 1915:31)

Select *Moʻolelo* for the Keaʻau Ahupuaʻa and the Greater Puna District

As the Hawaiian people had no written language until after the arrival of the first Protestant missionaries in 1820, traditional *moʻolelo* (stories, tales, and myths), *mele* and *oli* (songs and chants), and *ʻōlelo noʻeau* (proverbs and sayings) were passed down orally from one generation to the next. Traditional *moʻolelo* associated with Keaʻau Ahupuaʻa abound with references to Kāne, the god of sunlight, fresh water, verdant growth, and forests as well as the majestic female fire goddess, Pele (Beckwith 1970; Pukui 1983). Legendary sources indicate that Puna was, among other things, renowned for its rain and fertility, fragrant breezes, and potent *ʻawa* that was often cultivated in the trees. Additionally, many legends associated with Puna feature not only humans, gods, goddesses, and *kupua* (demi-gods), but *moʻo* (guardians of fresh water with reptilian features), *pōhaku* (stones), and *ʻaumakua* (family or personal ancestral gods).

Arrival of the Pele Clan to Puna

Most closely associated with the powerful and temperamental volcanoes of Hawaiʻi, Pele was perhaps both feared and respected equally by the people of the islands. Nimmo (1990) relates that, "although the actual worship of Pele was most important in the districts of Hawaiʻi that experienced active volcanism, the mythology of the goddess was widespread throughout the Hawaiian Islands", but that, "there is no evidence that Pele was worshipped extensively beyond the volcano area of Hawaiʻi, although her mythology was apparently widespread throughout the Hawaiian Islands and members of her family were important in ritual throughout the archipelago" (Nimmo 1990:44). It is said that before Pele migrated to Hawaiʻi from Kahiki, there was "no place in the islands was more beautiful than Puna" (Pukui 1983:11).

Kalākaua (1972) indicates that active worship of Pele was ongoing between the 12th and 19th centuries and that the abolition of the *kapu* system in the late 19th century had little to no effect on this practice, which remains ongoing. In addition to being revered as a goddess, Pele was also worshipped as an *ʻaumakua* (ancestor god/guardian spirit) by her descendants. According to Nimmo, "most Hawaiians living in the volcano areas of Hawaiʻi, the districts of Kaʻū, Puna, and Kona, at the time of European contact traced their ancestry to Pele" (1990:43). Pele is frequently and comprehensively referenced in historical and mythological literature, and traditional tales of Pele's migration to Hawaiʻi from Kahiki are many and varied. Beckwith relates:

> The Pele myth is believed to have developed in Hawaiʻi, where it is closely associated with aumakua worship of the deities of the volcano, with the development of the hula dance, and with innumerable stories in which odd rock or cone formations are ascribed to contests between Pele and her rivals,

> human or divine. The myth narrates the migration or expulsion of Pele from her distant homeland and her effort to dig for herself a pit deep enough to house her whole family in cool comfort or to exhibit them in their spirit forms of flame and cloud and other volcanic phenomena. (1970:168)

Several versions of the Pele migration legend exists. According to one version of the migration legend, Pele, daughter of Haumea and Moemoe-a-alii, was tempted with the urge to travel. Nestling her favorite sister (who was born in the shape of an egg), Hi‘iaka-i-ka-poli-o-Pele, safely under her armpit, Pele traveled to the Hawaiian Islands with aid from her brothers Pu-ahiuhiu (whirlwind), Ke-au-lawe/Ke-au-miki (tide), and Ke-au-ka (current). She landed on the island of Kaua‘i and became enamored with a young chief named Lohi‘au. She then continued her journey through the islands to secure a location where she could dig a home for her and her new lover (Beckwith 1970). Beckwith (ibid.:172) presents a *mo‘olelo* that recounts the migration of Pele and company from Kahiki to Hawai‘i:

No Kahiki mai ka wahine o Pele
Mai ka aina mai o Polapola
Mai ka punohu a Kane mai ke ao lapa i ka lani
Mai ka opua lapa i Kahiki
Lap aku i Hawai‘i ka wahine o Pele
Kalai i ka wa‘a o Honua-ia-kea
Ko wa‘a, o kalai Honoua-mea o holo
Mai ke au hele a‘e, ue a‘e ka lani
A i puni mai ka moku, a e a‘e kini o ke ‘kua
Iawai ka hope, ka uli o ka wa‘a?
I na hoali‘i a Pele a e hue, e
Me la hune ka la, kela ho‘onoho kau hoe
O luna o ka wa‘a, o Ku ma laua o Lono
Holo i honua aina, kau aku
I ho‘olewa ka moku, a‘e a‘e Hi‘iaka na‘i au ke ‘kua
Hele a‘e a komo I ka hale o Pele
Huahua‘i Kahiki lapa uila
Uila Pele e hua‘i e
Hua‘ina hoi e

The woman Pele comes from Kahiki,
From the land of Polapola,
From the ascending mist of Kane, from the clouds that move in the sky
From the pointed clouds born at Kahiki.
The woman Pele was restless for Hawai‘i.
‘Fashion the canoe Honua-ia-kea,
As a canoe, O Kamohoali‘i, for venturing to the island.
Completed, equipped, is the canoe of the gods,
The canoe for (Pele)-of-the-sacred-earth to sail in.
From the straight course the heavenly one turned
And went around the island, and the multitude of the gods stepped ashore.
‘Who were behind at the stern of the canoe?’
‘The household of Pele and her company,
Those who bail, those who work the paddles,
On the canoe were Ku and Lono.’
It came to land, rested there,
The island rose before them, Hi‘iaka stepped ashore
seeking for increase of divinity,
Went and came to the house of Pele.
The gods of Kahiki burst into lightening flame with roar and tumult,
Lightning flames gushed forth,
Burst forth with a roar.

Another version of the story describing Pele’s reasons for coming to Hawai‘i is found in an account published in 1865 by P.W. Kaawa in the Hawaiian language newspaper *Ka Nūpepa Kū‘oko‘a*. According to Kaawa’s version, Pele was living peacefully in Kahiki with her elder sister Namakaokahai and their brothers. However, this time of peace was shortlived when a powerful *kupua* (demigod) named Aukelenuiaiku came to live in Kahiki and fell in love with Pele’s elder sister. Namakaokahai eventually became pregnant and one day requested for her husband, Aukelenuiaiku to go down to the ocean and get her some fish to satisfy her cravings. When Aukelenuiaiku arrived at the shore, he saw a beautiful woman and a fervent desire flushed over his body to be with her. This woman was however, Namakaokahai’s sister Pele. Aukelenuiaiku took Pele as his lover and the two would meet regularly at the shore. One day, when Aukelenuiaiku returned home to his wife Namakaokahai, she felt a strong pain in her side and knew that her husband was having an affair with her sister. Namakaokahai became furious and banished Pele, driving her far away from their homeland until she arrived in Hawai‘i and was able to live peacefully.

Kalākaua places the arrival of Pele and Hi‘iaka during the reign of Kamiole, or more specifically, in approximately A.D. 1175, and notes that “every tradition refers to them as deities at the time of their arrival at Hawai‘i” (1972:140). When Pele arrived on the shores of Hawai‘i, she discovered that a fire god by the name of ‘Ai La‘au already had jurisdiction of the island. Westervelt (1916:3) explains:

> When Pele came to the island Hawai‘i, she first stopped at a place called Ke-ahi-a-laka in the district of Puna. From this place she began her inland journey towards the mountains. As she passed on her way there grew within her an intense desire to go at once and see Ai-laau, the god to whom Kilauea

> belonged, and find a resting-place with him as the end of her journey. She came up, but Ai-laau was not in his house. Of a truth he had made himself thoroughly lost. He had vanished because he knew that this one coming toward him was Pele. He had seen her toiling down by the sea at Ke-ahi-a-laka. Trembling dread and heavy fear overpowered him. He ran away and was entirely lost. When Pele came to that pit she laid out the plan for her abiding home, beginning at once to dig up the foundations. She dug day and night and found that this place fulfilled all her desires. Therefore, she fastened herself tight to Hawai‘i for all time.

According to Kalākaua, Pele's "favorite residence was the vast and ever-seething crater of Kīlauea, beneath whose molten flood, in halls of burning adamant and grottoes of fire, she consumed the offerings of her worshippers and devised destruction to those who long neglected her or failed to respect her prerogatives" (1972:139). Ho‘oulumāhiehie (2006) indicates that on her way to Kīlauea Pele initially carved out a crater called Malama, which is inland of her landing place at Keahialaka. Pele was dissatisfied with this crater, and proceeded to feverishly excavate two more craters, Pu‘ulena and Poho-iki, both of which she was also displeased with and abandoned as she continued her pursuit for a suitable home.

Emerson (1915:31) presents an excerpt of a *mele* sung by Hi‘iaka that describes the fires of her sister Laka, the goddess of *hula*, and the District of Puna:

Aia la, lele-iwi o Maka-hana-loa!	See the cape that's a funeral pyre;
Oni ana ka lae Ohi‘a,	The tongue of ohi‘a's grief-smitten.
Ka lae apane, mauka o ka lae Manienie,	Beyond, at peace, lies Maniē;
I uka o Ke-ahi-a-Laka:	Above rage the fires of Laka.
Oni ana ka lae, a me he kanaka la	The cape is passion-moved; how human
Ka leo o ka pohaku i Kilauea.	The groan of rocks in the fire-pit!
Ha‘i Kilauea, pau kekahi aoao o ka mahu nui,	That cauldron of vapor and smoke –
Mahu-nui-akea.	One side-wall has broken away –
E li‘u mai ana ke ahi a ka pohaku.	That covers the earth and the sky:
No Puna au, no ka hikina a ka la i Hae‘eha‘e.	Out pours a deluge of rock a-flame.
	My home-land is Puna, sworn guard
	At the eastern gate of the Sun.

Pele and Hi‘iaka's connection to Kea‘au is most explicit in *Ka Mo‘olelo O Hi‘iakaikapoliopele*, authored by Ho‘oulumāhiehie (2006). As a drawn out epic saga that spans the entire island chain, the following section summarizes select portions of the story most relevant to Kea‘au Ahupua‘a, including the famed Hā‘ena Beach and the Pana‘ewa Forest.

Ka Mo‘olelo O Hi‘iakaikapoliopele

A tale of perseverance, bravery, and spite is recounted in *Ka Mo‘olelo O Hi‘iakaikapoliopele*, initially published in the Hawaiian language newspaper *Ka Na‘i Aupuni* between the years 1905-1906 by Ho‘oulumāhiehie. Throughout the early 21st century, Hawaiian language scholar, Puakea Nogelmeier compiled the individual chapters written by Ho‘oulumāhiehie, translated each page of text, and published it in a double volume (one in Hawaiian and the other in the English). Nogelmeier notes that Ho‘oulumāhiehie's version is one of twelve known published accounts of *Ka Mo‘olelo O Hi‘iakaikapoliopele*, of which select portions are summarized and presented below.

After settling on Hawai‘i Island, Pele and her siblings ventured down to Hā‘ena in Kea‘au to bathe in the sea. While there, Pele was overcome with the desired to sleep. She informed her youngest sister, Hi‘iaka not to allow any of their siblings to awaken her. Hi‘iaka consented to her sister's commands. In her dream state, Pele followed the sound of a *pahu* (drum), which carried her spirit to the island of Kaua‘i, where she saw and met a striking man named Lohi‘au. The two met and fell madly in love, however, given that Pele was in her spirit form, she made it clear to Lohi‘au that she must return to Hawai‘i Island. Pele's long sleep was cause for concern and although tempted to awaken her sister, Hi‘iaka held true to her sister's commands.

Finally, Pele roused from sleep and called upon each of her sisters where she made a proposition, asking which one of them would fetch her dream lover Lohi‘au from Kaua‘i. Knowing Pele's tempestuous temper, each feared possible repercussions and refused to go. After being denied by all but one sister, her youngest sister, Hi‘iaka appeared to her. The irascible Pele demanded that Hi‘iaka travel to Kaua‘i to fetch Lohi‘au, and sent her on her way with strict instructions. Hi‘iaka was not to take him as her husband, she was not to touch him, and she was to take no longer than forty days on her journey. While Hi‘iaka agreed to her sister's demands, she realized that in her absence, Pele would become incensed with a burning and vehement fury and destroy whatever she desired. So Hi‘iaka set forth two

stipulations; her beloved *ʻōhiʻa lehua* grove was to be spared from destruction, and Pele was to protect her dear friend Hōpoe in her absence. In this version of the story, Hōpoe is described as a young girl from Keaʻau that was skilled at riding the surf of Hāʻena, and the one who taught Hiʻiaka the art of *hula*. Pele agreed to Hiʻiaka's requests, and Hiʻiaka departed on her journey to retrieve Pele's lover. In a sympathetic act, Pele bestowed supernatural powers upon Hiʻiaka so that she would be protected against the dangers she would undoubtedly meet along the way.

In preparing for her jounney, Hiʻiaka went first to Kīlauea and performed a sacrificial ritual at the rim of the crater. While en route to Kīlauea, Hiʻiaka met a young female, Wahineʻōmaʻo, who asked to join Hiʻiaka on her journey. After departing Kīlauea, the two girls descend from Laʻa (variation of the name ʻŌlaʻa) to Keaʻau, where they discuss the potential routes into Hilo. The girls were presented with two options: the safest but longest route was along the coast via Hāʻena. The shortest but most dangerous route was through the inland trail that would take them through the dense forest guarded by the ferocious *moʻo*, Panaʻewa. Concerned with meeting the deadline set by her sister, Hiʻiaka and Wahineʻōmaʻo took the inland trail and they soon found themselves engaged in a grueling battle with Panaʻewa. Hiʻiaka eventually defeated Panaʻewa and purged the forest of his malicious presence. She continued on with her journey and at each stop Hiʻiaka was faced with various challenges that required her to battle for her life, and in some instances to restore life. However, with each challenge, Hiʻiaka's understanding of her own power as a goddess continued to grow.

Hiʻiaka hadn't ventured for very long when she realized that the volcano had begun to smoke thickly, trailing towards Hōpoe's home of Keaʻau. It was not long before the smolder of smoke bursted into a scorching fire. Filled with a sense of dread and sensing that her sister had betrayed her promise, Hiʻiaka continued her journey. Days passed slowly, utterly too slow for Pele. At last, Hiʻiaka found Lohiʻau, unfortunately, all that remained of Lohiʻau was his lifeless corpse. Keenly aware that she could not return Lohiʻau to her sister in such a state, Hiʻiaka used her healing powers to return his wandering spirit back into his body.

By this time, Pele was furious. She shook the earth with great ferocity and heaved her lava in a torrent of devastation, annihilating Hiʻiaka's *ʻōhiʻa lehua* forest, obliterating all of Puna, and finally consuming Hōpoe as she lingered by the sea. Enraged by her sister's spiteful acts, Hiʻiaka turned her wrath onto her beloved sister Pele. The two sisters went head-to-head in a brutal battle that could only be subdued by the older gods. Fearing that the two sisters would destroy the entire island, the elder gods intervened and quited the battle between the two powerful sisters.

In her death, Hōpoe was transformed at the coast of Hāʻena. She was rebirthed as a stone, carefully balanced alongside the sea where she could continue her graceful dance throughout the centuries when touched by the soft breeze or the rumbling of the earth. And Hiʻiaka, her heart bitter with her sister's betrayal, brought Lohiʻau back to Pele, faithfully as she swore she would.

Legend of Kepakaʻiliʻula

In the legendary account concerning the mythical being named Kepakaʻiliʻula, Fornander (1916-1917) described the *ahupuaʻa* of Keaʻau as both his birthplace as well as the area that led to a hidden land known as Paliuli. The portion of the story concerning the Keaʻau area is presented below. Kepakaʻiliʻula's parents were two very powerful Puna chiefs, Kū, his father and Hina, his mother. Hina had two brothers, Kiʻihele and Kiʻinoho, who both in a dream state discovered the whereabouts of Paliuli. Before leaving to Paliuli, the brothers learned that their sister had become pregnant. After arriving at Paliuli, the two brothers soon discovered the abundance and beauty of this enchanted land. Fornander described this mythical land as:

> … a very good land, flat, fertile and well filled with many things desired by man; the ohias [*sic*] were as large as breadfruit; they saw a fish pond within the land stocked with all kinds of fish of the sea with the exception of the whale and the shark, so they made their home there. They began to cultivate the soil, raised different animals until the place was filled with everything imaginable. (1916-1917:498)

After filling this land with every kind of food imaginable, the two brothers desired to share their wealth with their nephew Kepakaʻiliʻula. The two brothers proceeded from Paliuli and went down to Keaʻau to where their sister Hina was living. Upon their arrival at their sister's home, they exchanged greetings and wept, at which time "Hina rose and went out to relieve herself" (ibid.:500). As Hina departed from the house, the brother searched for the child, only to find an egg lying on the ground where Hina had been sitting. Kiʻihele picked up the egg and wrapped it in a feathered cape, where they then returned to Paliuli. The brothers looked after the delicate egg and Kiʻinoho exercised all his power to care for it. After ten days, Kiʻinoho unwrapped the feathered cape and saw that the egg had formed into a stunning child. Upon inspecting the child, the brothers decided to leave the child wrapped in the cape for another forty days. After the forty days lapsed, they saw that the child had grown more beautiful and was free from any deformities.

Kepakaʻiliʻula was unlike no other child they had seen for his skin and eyes were as red as the feathered cape that enwrapped him. His skin color is said to have lit up Paliuli both day and night and his only equal was the fire goddess Pelehonuamea. The brothers raised Kepakaʻiliʻula on a strict diet of bananas at Paliuli until he reached maturity, at which time they prepared him for marriage. Here the story departs from the lands of Puna where Kepakaʻiliʻula goes to Kona in search of a suitable wife.

The Legend of Iwa

The namesake of the subject *ahupuaʻa*, a fisherman named Keaʻau, appears in the *Legend of Iwa* presented by Fornander (1918-1919). As the story goes, Keaʻau was in possession of two extraordinary *leho* (cowry) shells named Kalokuna. These lucky *leho* had the wondrous effect of instantly attracting *mūheʻe* (squid) to jump in the canoe. Day after day, Keaʻau would take his canoe and float upon the ocean, lowering Kalokuna into its great depths and returning home with large amounts of *mūheʻe*. Unbeknownst to Keaʻau, word of his spectacular shells had spread, and they became highly desired by the *aliʻi* ʻUmi-a-Līloa (ʻUmi) of Waipiʻo, who was living in Kona at the time. Upon his command, messengers were sent to confiscate the *leho* from Keaʻau.

While ʻUmi enjoyed the benefits of his new possessions, Keaʻau conspired a plan to reclaim his prized shells. Arming himself with valuable gift items including a pig, *ʻawa*, and some of the much-celebrated *kapa māmaki* of ʻŌlaʻa, Keaʻau set sail in search of an exceptional thief who would be able to retrieve his treasured *leho*. He sailed all around Hawaiʻi Island, even touching upon the shores of Lānaʻi, Maui, and Molokaʻi, but was he failed to find anyone clever enough. Once on Molokaʻi, Keaʻau learned that a little thieving boy by the name of Iwa had the skills he was seeking.

Keaʻau sailed his canoe along the shore until he came to a beach and spotted a little boy running about without his *malo* (loincloth). Recognizing him as Iwa, Keaʻau met with the boy's father, Kukui, who instructed him to present Iwa with the gifts he brought from Puna. After receiving the gifts and cooking and feasting on the pig, Iwa agreed to aid Keaʻau in the retrieval of his valued shells. Sailing together, the pair eventually stalled in waters near Keāhole Point in Kona where they spied ʻUmi fishing with Keaʻau's *leho*.

Iwa dove beneath the water and swam towards ʻUmi's canoe, unbeknownst to him. As ʻUmi lowered the pair of *leho* into the great depths, Iwa removed them from the line, and swam the line deeper where he tied it off to some coral. He returned the pair of shells to a grateful Keaʻau who could once again continue his favorite pastime of fishing for *mūheʻe*. Meanwhile, ʻUmi tried to pull up his fishing line, but it appeared to be stuck. He feared that if he pulled too hard his line would break and he would lose the shells, so he refused to pull it, rather he decided to wait until someone could dive down and untangle his line for him. Unfortunately, no one could hold their breath long enough to reach the bottom of the line, so ʻUmi had to expand his search.

The runners ʻUmi sent out located Iwa at Leleiwi, where he made his home with Keaʻau. In an act of betrayal, he divulged the location of Keaʻau's treasured *leho* and agreed to steal them from their hiding place among the house rafters. This moʻolelo contines with Iwa's exploits in Waipiʻo Valley.

Kūkaʻōhiʻaakalaka

A portion of the tale of Kūkaʻōhiʻaakalaka, presented in *Folktales of Hawaiʻi* by Pukui and Green (1995), occurs in Keaʻau. Kūkaʻōhiʻaakalaka (Kūkaʻōhiʻa), or Kū-the-ʻōhiʻa-of-the-forest, was a fisherman who resided with his wife in Keaʻau. His sister, Kauakuahine, lived nearby in ʻŌlaʻa with her farmer husband and their children. Usually, Kauakuahine would trade vegetables for some of her brother's dried fish, however, his wife was quite selfish and did not like to share their catch, opting instead to hide the fish beneath the sleeping mats in their house.

One day, Kauakuahine made her usual trip to Keaʻau with a bundle of vegetables, hoping to trade for fish to feed her family. She arrived at her brother's house, but he was out fishing, and she was instead met by his wife who lied and denied having any fish, indicating she only had salt. Sick of constantly being denied by her sister-in-law, Kauakuahine headed to the shore where she gathered *limu* (seaweed) instead of the delicious fish she had hoped to take home. When she arrived at her home, her husband and children excitedly ran out to greet her. After slapping each of them and turning them into rats, Kauakuahine reformed herself into a water spring.

Meanwhile, Kūkaʻōhiʻa was alerted to the situation by the gods, who appeared to him as he was fishing out at sea. Infuriated, Kūkaʻōhiʻa returned home and saw how his wife had hid the fish from his sister beneath the mats. He could not control his wrath, and after an awful confrontation, he murdered his wife. He traveled to ʻŌlaʻa and was overcome with sadness when he saw his brother-in-law, nieces and nephews who were turned into rats. Overcome with grief, he found the spring of his sister and dove into it. As a result, he was transformed into an *ʻōhiʻa* tree which

"bears only two blossoms to this day, and when a branch is broken off, blood flows from the body of the tree" (Pukui and Green 1995).

The Heart Stirring Story of Ka-Miki

A traditional *mo'olelo*, "The Heart Stirring Story of Ka-Miki" (*Kaao Hooniua Puuwai no Ka-Miki*), originally appeared in *Ka Hoku o Hawai'i* (a Hawaiian language newspaper) between 1914 and 1917. This tale, a portion of which occurs in Kea'au, tells of the two supernatural brothers, Ka-Miki and Maka-'iole, who were skilled *'ōlohe* (skilled fighters) and their travels around Hawai'i Island by way of the ancient trails and paths (*alaloa* and *ala hele*), seeking competition with other *'ōlohe*. As described by Maly:

> The narratives were primarily recorded for the paper by Hawaiian historians John Wise and J.W.H.I. Kihe (with contributions from Steven Desha Sr.). While Ka-Miki is not an ancient account, the authors set the account in the thirteenth century (by association with the chief Pili, who came to Hawai'i with Pā'ao). They used a mixture of local stories, tales, and family traditions in association with place names to tie together fragments of site specific history that had been handed down over the generations. Thus, while in many cases, the personification of individuals and their associated place names may not be "ancient," the site documentation within the "story of Ka-Miki" is of both cultural and historical value. (Maly 1998:17)

A portion of the legend set in Puna, published between October 21 and November 18, 1915 and translated by Maly (1998:17-25), describes many people and places within the district, and is summarized below.

During an expedition through the uplands of Puna, Ka-Miki and Maka-'iole encountered a man named Pōhakuloa who was intensely working on a large *koa* log. They were headed to Kea'au, but had lost their way. They stopped and asked Pōhakuloa for directions, but he was startled by the unexpected appearance of the brothers, and replied impolitely. Taunts were exchanged between the two parties, which led to a physical altercation. It was at this point, that Pōhakuloa realized that these two men were extraordinarily skilled as well as spiritually protected, and he admitted his defeat. Pōhakuloa wished to prepare a meal and drink of *'awa* with his newfound friends, and solicited the help of his brother-in-law, an *'ōlohe* chief named Kapu'euhi. However, Kapu'euhi had plans of his own. He intended to compete with and conquer the brothers, but was defeated by them instead. Kapu'euhi was infuriated by his defeat, and also by Pōhakuloa's refusal to aid in retaliation against Ka-Miki and Maka-'iole.

Kapu'euhi invited the brothers back to his house to partake in a meal and a particularly potent type of *'awa*, scheming to get them drunk. Unbeknownst to Ka-Miki and Maka-'iole, this was common practice for Kapu'euhi, who often housed weary travelers in his guest house, intoxicated them with *'awa*, then killed them and stole their precious belongings. Kapu'euhi waged a bet with the brothers; if they couldn't drink five *'apu* (coconut shell cup) of *'awa*, then he would throw them out and they would be at the mercy of the Puna forest. Ka-Miki and Maka-'iole agreed, and counteracted his bet with one of their own; if they were able to drink five cups, they would throw Kapu'euhi out of his own house. The brothers prayed and chanted to their ancestral goddess, and were able to consume the entire quantity of *'awa* without getting drunk. As agreed upon, Kapu'euhi was thrown out. Stunned, and angered that he was thwarted once again, Kapu'euhi requested assistance from Kaniahiku (a much feared Puna *'ōlohe* and forest guardian) and her grandson Keahialaka. "At that time, Keahialaka was under the guardianship of Pānau and Kaimū, and he enjoyed the ocean waters from Nānāwale to Kaunaloa, Puna" (*Ka Hoku o Hawai'i* October 28, 1915; translated by Maly 1998:20).

Together, Kapu'euhi and Kaniahiku conspired to lead the brothers deep into the Puna forest, where Kaniahiku would be able to murder them, all the while maintaining the façade that they were taking them to the *'awa* grove of Mauānuikananuha. Once Ka-Miki and Maka-'iole were well within the domain of Kaniahiku, she created a dark and murky environment, spreading gloomy mists and an overgrowth of twisted vegetation intended to ensnare the brothers. Ka-Miki and Maka'iole were overcome, and left for dead by Kapu'euhi, who made his way back to safety, led by Kaniahiku's sister. They prayed to their ancestor, Ka-uluhe-nui-hihi-kolo-i-uka for help. All at once, her presence became apparent, and the brothers were able to continue on to the *'awa* grove. Another attempt by Kaniahiku to kill the brothers was made, however, Ka-uluhe's protection over them was too strong, and the endeavor failed.

Ka-Miki and Maka-'iole realized that Kapu'ehi had deceived them and had been in affiliation with Kaniahiku. They were angered, and trapped him in the *'awa* grove. In an effort of retaliation, Kaniahiku summoned for her grandson, Keahialaka, and readied herself for a battle. Ka-Miki and Maka-'iole reprimanded Kaniahiku for her deceitful actions, which only served to anger her even further. Aggressively, Kaniahiku attacked Ka-Miki with her tripping club and spear, but Ka-Miki was far too elusive for her. He swiftly evaded each attempt at injury made on his behalf. In desperate need of assistance, Kaniahiku beckoned to Keahialaka by playing her nose flute, urging him to

hurry to her side. Although Keahialaka was strong and skillful in the arts of *ʻōlohe*, he was all too easily overcome by Ka-Miki. His grandmother, in an attempt to free him from Ka-Miki, was also captured.

Kaniahiku was astounded at the dexterity of the brothers. Their skill was incomparable to any other *ʻōlohe* she had ever encountered, and even her own skill paled in comparison, for she had never been defeated. All at once she surrendered to Ka-Miki and Maka-ʻiole, who in turn released her and her grandson. Back at Kaniahiku's house, a meal was prepared, the *ʻawa* of Kaliʻu was enjoyed, and the gods were honored with offerings. Kaniahiku requested that the brothers take Keahialaka with them as they continued their journey on the *ala loa*, declaring that if they did, they would be welcomed wherever their travels took them in Puna. Ka-Miki and Makaʻiole approved of this request, and took Keahialaka on as their companion. Together, the three men journeyed throughout various districts of Hawaiʻi island, and competed in many *ʻōlohe* competitions.

ʻŌlelo Noʻeau of Puna

The oral tradition of Hawaiʻi is perhaps best preserved in *ʻōlelo noʻeau*, which have been passed down throughout the generations. Many *ʻōlelo noʻeau* speak of Puna, and most describes the land, smudged in a carpeting of inky lava left in Pele's furious wake and the region's breezes—sweetly scented with the heavenly fragrances of *hala*, *maile*, and *lehua* blossoms. The following proverbs illustrate Puna in great detail, and appear below as they were interpreted and published in *ʻŌlelo Noʻeau, Hawaiian Proverbs & Poetical Sayings* by Mary Kawena Pukui (1983):

> *ʻAʻohe ʻalawa wale iho ia Maliʻo.*
> Not even a glance at Maliʻo.
> Said of a haughty person. Pele was once so annoyed with Maliʻo and her brother Halaaniani that she turned them both into stone and let them lie in the sea in Puna, Hawaiʻi. It was at the bay named after Halaaniani that clusters of pandanus were tossed into the sea with tokens to loved ones. These were borne by the current to Kamilo in Kaʻū. (ibid.:16)
>
> *ʻApiki Puna i Leleʻapiki, ke nānā la i Nānāwale.*
> Puna is concerned at Leleʻapiki and looks about at Nānāwale.
> The people are but followers and obedient to their rulers. The people of Puna were not anxious to go to war when a battle was declared between Kiwalaʻo and Kamehameha; it was the will of their chief. Lele-ʻapiki (Tricky-leap) and Nānā-wale (Just-looking) are places in Puna. (27)
>
> *ʻUlu pilo.*
> Stinking breadfruit.
> A term of contempt for the *kauwā* of Puna, Hawaiʻi, comparing them to rotted breadfruit. (314)
>
> *E ake ana i inu i ka wai hū o Koʻolihilihi.*
> Eager to drink of the gushing spring of Koʻolihilihi.
> Eager to make love. Koʻolihilihi (Prop-eyelashes) is a spring in Puna. When royal visitors were expected, the people attached *lehua* blossoms to the makaloa sedge that grew around the spring so that when their guests stooped to drink, the *lehua* fringes touched their cheeks and eyelashes. The last person for whom the spring was bedecked was Keohokalole, mother of Liliʻuokalani. (32)
>
> *E nihi ka helena i ka uka o Puna; mai pūlale i ka ʻike a ka maka.*
> Go quietly in the upland of Puna; do not let anything you see excite you.
> Watch your step and don't let the things you see lead you into trouble. There is an abundance of flowers and berries in the uplands of Puna and it is thought that picking any on the trip up to the volcano will result in being caught in heavy rains; the picking is left until the return trip. Also said to loved ones to imply, "Go carefully and be mindful." (44)
>
> *Haʻalele i Puna na hoaloha e.*
> Left in Puna are the friends.
> Said of one who has deserted his friends. Originally said of Hiʻiaka when she left Puna. (50)
>
> *Haoʻe na ʻale o Hōpoe i ka ʻino.*
> The billows of Hōpoe rise in the storm.
> His anger is mounting. Hōpoe, Puna, has notoriously high seas. (57)
>
> *He iki hala au no Keaʻau, ʻaʻohe pōhaku ʻalā e nahā ai.*
> I am a small *hala* fruit of Keaʻau, but there is no rock hard enough to smash me.

The boast of a Puna man—I am small, perhaps, but mighty. (71)

He moku ʻāleuleu.
District of ragamuffins.
Said by Kamehameha's followers of Kaʻū and Puna because the people there, being hard-working farmers, lived most of the time in old clothes. (90)

Hilinaʻi Puna, kālele ia Kaʻū.
Puna leans and reclines on Kaʻū.
Said of one who leans or depends on another. The ancestors of these two districts were originally of one extended family. The time came when those of each district decided to have a name of their own, without breaking the link entirely. Those in Kaʻū referred to themselves as the Mākaha and those in Puna as the Kumākaha. These names are mentioned in the chants of the chiefs of Kaʻū. (107)

Hoʻohewahewa ke aloha, aia i Puna i Nānāwale.
Love failed to recognize him, for it is gone to Puna, to Nānāwale.
Said when an acquaintance or friend merely looks at another and offers no greeting. A play on *nānā-wale* (merely look). (113)

ʻInā paha he puaʻa, pau i kalua.
If a pig [you], would have been roasted.
Said with laughter when a person forgets to come home on time. A straying pig can end up roasted in an *imu*. A common saying in Puna and eastern Kaʻū. (134)

Ka ua moaniani lehua o Puna.
The rain that brings the fragrance of the *lehua* of Puna.
Puna is known as the land of fragrance. (172)

Ka wahine ʻai lāʻau o Puna.
The tree-eating woman of Puna.
Pele. (177)

Ke nānā la i Nānāwale.
Just look at Nānāwale.
Said of one who has nothing or no one to look to for help. A play on *nānā-wale* (merely look), a Puna place name. (190)

Lilo i Puna i ke au a ka hewahewa, hoʻi mai ua piha ka hale i ke akua.
Gone to Puna on a vagrant current and returning, finds the house full of imps.
From a chant by Hiʻiaka when she faced the lizard god Panaʻewa and his forest full of imps in a battle. It was later used to refer to one who goes on his way and comes home to find things not to his liking. (216)

Lohiʻau Puna i ke akua wahine.
Puna is retarded by the goddess.
Refers to Pele, ruler of volcanoes. The lava flows she pours into the district retard the work and progress of the people. (217)

Maʻemaʻe Puna i ka hala me ka lehua.
Lovely is Puna with the *hala* and the *lehua*.
Refers to Puna, Hawaiʻi. (221)

Mai ka hikina a ka lā i Kumukahi a ka welona a ka lā i Lehua.
From the sunrise at Kumukahi to the fading sunlight at Lehua.
From sunrise to sunset, Kumukahi, in Puna, Hawaiʻi, was called the land of the sunrise and Lehua, the land of the sunset. This saying also refers to a life span—from birth to death. (224)

Mai ka lā ʻōʻili i Haʻehaʻe a hāliʻi i ka mole o Lehua.
From the appearance of the sun at Haʻehaʻe till it spreads its light to the foundation of Lehua.
Haʻehaʻe is a place at Kumukahi, Puna, Hawaiʻi, often referred to in poetry as the gateway of the sun. (224)

Mai ka ʻōʻili ana a ka lā i Kumukahi a ka lā iho aku i ka mole ʻolu o Lehua.
From the appearance of the sun at Kumukahi till its descent beyond the pleasant base of Lehua.
From the sunrise at Kumukahi, in Puna, Hawaiʻi, to the sunset beyond the islet of Lehua. (224)

Makaʻu ka hana hewa i ka uka o Puna.
Wrongdoing is feared in the upland of Puna.
Wrongdoing in the upland of Puna brings the wrath of Pele. (228)

Ma ke kai kuwā e nū ana i ka ulu hala o Keaʻau a ka ʻāina kāʻili lā o lalo o ka Waikūʻauhoe.
From the noisy sea that moans to the hala groves of Keaʻau, to the land that snatches away the sun, below Waikūʻauhoe.
From Puna, Hawaiʻi, where the sun was said to rise, to Lehua, beyond Waikūʻauhoe, where it vanishes out of sight. (225)

Mō ke kī la—make!
Cut is the *kī*—it is death!
Used in riddling contests of old, when persons who failed to guess correctly were often tortured or put to death. A wicked Puna chief once invented a riddle that no one could solve: *He kī e, he kī e, mō ke kī—make*! (It is the *kī*, it is the *kī*, [when it is] cut [there is] death!) The answer? The parts of the body whose names include the word *kī*, such as *kīkala* (hip) and *kihi poʻohiwi* (shoulder). Many people tried and failed to guess the answer and so were put to death. Finally, an old woman took pity on a youthful contestant and secretly told him the solution. In addition, she told the youth about an additional *kī* that the chief himself had forgotten. On the day of his contest, the youth ansered the chief's riddle. Then he challenged the chief with the same riddle. A dispute arose when the chief denied that there were any other body parts with *kī*. The youth pointed to the chief's fingernails (*mikiʻao*) and was declared the winner. The wicked chief was put to death as he had put others to death. (237)

Nani Puna pō i ke ʻala.
Beautiful Puna, heavy with fragrance.
Praise for Puna, Hawaiʻi, where the breath of *maile*, *lehua*, and *hala* blossoms are ever present. (248)

Niuniu Puna, pō i ke ʻala.
Puna is dizzy with fragrance.
Puna is a land heavily scented with the blossoms of *hala* and *lehua*. (252)

Pau Puna ua koʻele ka papa.
Puna is ravaged; the foundation crackles.
Said of anything that is entirely consumed. From a chant by Lohiʻau when Pele sent her sisters to overwhelm him with lava. (288)

Pōʻele ka ʻāina o Puna.
The land of Puna is blackened [by lava flows]. (292)

Puna, kai nehe i ka ulu hala.
Puna, where the sea murmurs to the *hala* grove. (300)

Puna maka kōkala.
Puna of the eyelashes that curve upward like the thorns of the pandanus leaves.
The placenta of a newborn was buried under a pandanus tree so that the child's eyelashes would grow long like the pandanus thorns. (301)

Weliweli Puna i ke akua wahine.
Puna dreads the goddess.
Puna dreads Pele. Said of any dreaded person. (321)

Chiefly Rule in Puna

The following section presents a detailed discussion about the chiefly rule on Hawaiʻi Island with an emphasis on the Puna District. Although Puna does not figure prominently in the historical literature, it is mentioned on several

accounts, which are presented below. In A.D. 1754, after many bloody battles, Kalani‘ōpu‘u, the *ali‘i ‘ai moku* of Ka‘ū, defeated his main rival Keawe‘ōpala in South Kona and declared himself ruler over all of the island of Hawai‘i (Kamakau 1992). Kalani‘ōpu‘u was a clever and able chief, and a famous athlete in all games of strength, but according to Kamakau (1992) he possessed one great fault, he loved war and had no regard for others' land rights. According to Barrère (1959), the chiefs of the Puna District did not figure prominently into the Precontact political strife and turmoil on Hawai‘i Island. Barrère writes:

> Puna, as a political unit, played an insignificant part in shaping the course of history of Hawaii Island. Unlike the other districts of Hawaii, no great family arose upon whose support one or another of the chiefs seeking power had to depend for his success. Puna lands were desirable, and were eagerly sought, but their control did not rest upon conquering Puna itself, but rather upon control of the adjacent districts, Kau and Hilo. (Barrère 1959:15)

The Arrival of Captain James Cook and the End of Kalani‘ōpu‘u's Reign (1778-1782)

British explorer Captain James Cook, in command of the ships *H.M.S. Resolution* and *H.M.S. Discovery*, landed in the Hawaiian Islands on January 18, 1778. The following January 17th [1779], on a return trip to Hawaiian waters, Cook anchored near Ka‘awaloa at Kealakekua Bay in the South Kona District to resupply his ships. This return trip occurred at the time of the annual *Makahiki* festival, and many of chiefs and commoners were gathered around the bay celebrating. According to John Ledyard, a British marine on board Cook's ship, upward of 15,000 inhabitants were present at the bay, and as many as 3,000 canoes came out to greet the ships (Jarves 1847:59). It has been suggested that Captain Cook was mistaken for the god Lono himself returned, as men would not normally be allowed to paddle out during the *Makahiki* without breaking the *kapu* and forfeiting all of their possessions (Kamakau 1992). On January 26th Kalani‘ōpu‘u, the reigning chief of Hawai‘i Island, visited Cook on board the *H.M.S. Resolution*, where they exchanged gifts. Kamehameha, the future ruler of all of Hawai‘i, was present at this meeting (Jarves 1847).

On February 4th, Cook set sail from Kealakekua Bay, but a storm off the Kohala coast damaged the mast of the *H.M.S. Resolution*, and both ships were forced to return to Kealakekua to make repairs. With Cook's return, many of the inhabitants of Kealakekua began to doubt that he was actually the physical manifestation of Lono (Kamakau 1992). On February 13th, several natives were discovered stealing nails from the British ships. They were fired upon by the crew, and a chief close to Kalani‘ōpu‘u named Palea was knocked down, and his canoe taken. That night one of Cook's boats was stolen, and the following morning Cook set ashore at Ka‘awaloa with six marines to ask Kalani‘ōpu‘u for its return. Kalani‘ōpu‘u, however, denied any knowledge of the theft; Cook decided to hold the chief captive until the boat was returned (Kamakau 1992). When Cook tried to seize Kalani‘ōpu‘u, however, a scuffle ensued and Cook was killed (along with four of his men and several natives) there on the shores of Ka‘awaloa, struck down by a metal dagger. When Captain Cook fell, the British ships fired cannons into the crowd at the shore and several more natives were killed. Kalani‘ōpu‘u and his retinue retreated inland, bringing the body of Cook with them.

In March of 1779, after Cook's death, Captain King sailed along the Puna shoreline and described the district as sparsely populated, but verdant and fertile (Maly 1998). Captain King, mentioned that Kalani‘ōpu‘u had one of his residences there, and he provided the following description of the landscape:

> …the SE sides of the districts of Opoona & Kaoo [Puna and Ka‘ū]. The East part of the former is flat, coverd with Coco nut trees, & the land far back is of a Moderate height. As well as we could judge this is a very fine part of the Island, perhaps the best. Terreeoboo [Kalani‘ōpu‘u] has one of his residences here.
>
> On the SW extremity of Opoona the hills rise abruptly from the Sea side, leaving but a narrow border, & although the sides of the hills have a fine Verdure, yet they do not seem Cultivated, & when we saild pretty near & along this end of Opoona, we did not observe that it was equally Populous with the Eastern parts; before we reachd the East point of the Island, & all along this SE side the snowy mountain calls Roa (or extensive) [Mauna Loa] is very conspicuous. It is flattish at the top or makes what we call Table land… (Beaglehole 1967:606)

After the departure of *H.M.S. Resolution* and *Discovery*, Kalani‘ōpu‘u moved to Kona, where he surfed and amused himself with the pleasures of dance (Kamakau 1992). While he was living in Kona, famine struck. Kalani‘ōpu‘u ordered that all the cultivated products of that district be seized, and he then set out on a circuit of the island. Kalani‘ōpu‘u first went to Hinakahua in Kapa‘au, North Kohala where he amused himself with "sports and games such as hula dancing, *kilu* spinning, *maika* rolling, and sliding sticks" (Kamakau 1992:106). During his stay in Kohala, around 1780, Kalani‘ōpu‘u proclaimed that his son Kiwala‘ō would be his successor, and he gave the guardianship of the war god Kūka‘ilimoku to Kamehameha (Fornander 1996; Kamakau 1992). It was during his time

in Kohala that an uprising, led by a highly-esteemed chief of Puna named ʻĪmakakoloa, occurred. Upon hearing of the uprising, Kalaniʻōpuʻu immediately went to Hilo to quell the rebellion.

Though customary at the time, to furnish the king's court with items such as "pigs, fish, taro, fruits and other forms of wealth" (Elkin 1904:26), it is said that ʻĪmakakoloa rebelled because he was tired of the incessant and exorbitant demands of Kalaniʻōpuʻu. As a chief who loved the people of Puna, and was beloved by them in return, ʻĪmakakoloa refused Kalaniʻōpuʻu's demands. He felt that "his own people who cultivated the ground should be provided with the necessaries of life, before the numbers of the royal court, who lived in idleness" (Elkin 1903:26). Rather than allow Kalaniʻōpuʻu access to the toils of the people of Puna, ʻĪmakakoloa:

> …seized the valuable products of his district, which consisted of hogs, gray tapa cloth (*ʻeleuli*), tapas made of *mamaki* bark, fine mats made of young pandanus blossoms (*ʻahu hinalo*), mats made of young pandanus leaves (*ʻahuao*), and feathers of the *ʻoʻo* and *mamo* birds of Puna. (Kamakau 1992:106)

This action angered Kalaniʻōpuʻu, who was insulted by the insubordination. He vowed revenge against ʻĪmakakoloa, and devised a plan to kill him. A battle between the two men ensued, and although ʻĪmakakoloa was a worthy opponent, his army was no match for Kalaniʻōpuʻu's superior force. After the battle, the Puna chief fled and was sheltered in the district by his people for more than a year. Kalaniʻōpuʻu, sworn to vengeance, ruthlessly stalked the fugitive chief for the duration of his emancipation, and in his rage he ordered that Puna be burned to the ground. Fornander (1969:202) indicates that the district was "literally laid in ashes" as a result of Kalaniʻōpuʻu's vengeance.

While the rebel Puna chief was sought, Kalaniʻōpuʻu "went to Ka-ʻu and stayed first at Punaluʻu, then at Waiohinu, then at Kamaʻoa in the southern part of Ka-ʻu, and erected a heiau called Pakini, or Halauwailua, near Kamaʻoa" (Kamakau 1992:108). ʻĪmakakoloa was eventually captured and brought to the *heiau*, where Kiwalaʻō was to sacrifice him. "The routine of the sacrifice required that the presiding chief should first offer up the pigs prepared for the occasion, then bananas, fruit, and lastly the captive chief" (Fornander 1996:202). However, before Kiwalaʻō could finish the first offerings, Kamehameha, "grasped the body of Imakakoloʻa and offered it up to the god, and the freeing of the tabu for the heiau was completed" (Kamakau 1992:109). Upon observing this single act of insubordination, many of the chiefs believed that Kamehameha would eventually rule over all of Hawaiʻi. After usurping Kiwalaʻō's authority with a sacrificial ritual in Kaʻū, Kamehameha retreated to his home district of Kohala.

The Rule of Kamehameha I (1782-1819)

After Kalaniʻōpuʻu died in April of 1782, and as custom dictated, all of the land held by the former chief were to be redistributed by the succeeding chief with the aid of his counselors in a process known as a *kālaiʻāina* (land division). Beamer (2014:45) describes the importance of the *kālaiʻāina*, he writes:

> Given the range and complexity of ʻŌiwi [native] land divisions, such a redistribution was no small task… This relatively uncertain portion of a mōʻī's [high chief] reign could lead to rebellion, since the mōʻī had to care for supporters as well as possible rivals when awarding lands. Tradition has shown a poorly executed kālaiʻāina could result in war if the division did not satisfy all the chiefs…

Following Kalaniʻōpuʻu's death, his son and appointed chief, Kiwalaʻō initiated the *kālaiʻāina*. Disagreements amongst the various chiefs quickly arose over Kiwalaʻō's land distribution. According to John Papa ʻĪʻī, Keōua (half-brother of Kiwalaʻō and chief of Kaʻū), requested for the lands of Waiākea, Keaʻau, and ʻŌlaʻa. In describing a conversation between Keōua and his advisor, ʻĪʻī writes:

> …perhaps you [Keōua] should go to the chief [Kiwalaʻō] and ask that these lands be given to us. Let Waiakea and Keaau be the container from whence our food is to come and Olaa the lid. Keoua did so, but the other Kau chiefs objected to this and spoke disparingly to him. When Keoua returned, his advisor asked, "How as your venture?" When Keoua told him all that had been said, the man remarked seriously, "A break in a gourd container can be meded by patching, but a break in the land cannot be mended that way…(ʻĪʻī 1959:14)

Several chiefs were unhappy with Kiwalaʻō's division of the island's lands, and civil war broke out. Kiwalaʻō, was killed at the battle of Mokuʻōhai, South Kona in July of 1782. Supporters of Kiwalaʻō, including his half-brother Keōua and his uncle Keawemauhili, escaped the battle of Mokuʻōhai with their lives and laid claim to the Hilo, Puna, and Kaʻū Districts. According to ʻĪʻī (1959) nearly ten years of almost continuous warfare followed the death of Kiwalaʻō, as Kamehameha endeavored to unite the Island of Hawaiʻi under one rule and conquered the islands of Maui and Oʻahu.

Fornander (1918-1919) provides an account of a subsequent battle that resulted in Kamehameha landing his war canoes in Keaʻau. Following the battle of Mokuʻōhai, a second battle known as Kauaʻawa ensued in the uplands of Kaʻū between two of Kamehameha's main rivals, Keōua and Keawemauhili. Although neighther side was victorious, Kamehameha retreated to Laupāhoehoe in Hilo and planned another invasion on the chiefs of Hilo and Puna. On his second attempt to invade Puna, Kamehameha rallied his army and directed his men to land his war canoes at Pāpaʻi Bay in Keaʻau. On landing at Pāpaʻi, Kamehameha pursued some of the local fishermen intending to kill them, at which time his foot became lodged in a crevice. As he tried to free his foot, he was struck on the head with a paddle by one of the fishermen, which left him badly wounded. Under the old laws of the land, the harming of a chief mean certain death. However, in reflecting on his actions, Kamehameha pardoned the fishermen being that they were merely defending their village. It was on this account that the famous *Kānāwai Māmalahoa* was proclaimed. Fornander writes:

> Kamehameha's famous *mamalahoa* law was given by him after recovery from his serious situation and the capture of his assailants, when he uttered this decree to protect them and their people against the penalty, of the then law, of stoning to death. (1918-1919:468)

Keōua became Kamehameha's main rival on the Island of Hawaiʻi, and he proved difficult to defeat (Kamakau 1992). Keawemauhili would eventually give his support to Kamehameha, but Keōua never stopped resisting. Around 1790, in an effort to secure his rule, Kamehameha began building the *heiau* of Puʻukoholā in Kawaihae, which was to be dedicated to the war god Kūkaʻilimoku (Fornander 1996).

Westervelt (1916) relates a story of Keōua, Keawemauhili, and Kamehameha that begins after the battle of Mokuʻōhai, but tells of another battle in ca. 1790 when Kamehameha routed Keōua at Waimea and Hāmākua and then sent men to attack Kaʻū. As Keōua attempted to return to his home district a portion of his army was killed by an eruption from Kīlauea Volcano. Westervelt writes:

> . . . Kiwalao's half-brother Keoua escaped to his district Ka-u, on the southwestern side of the island. His uncle Keawe-mau-hili escaped to his district Hilo on the southeastern side.
>
> For some years the three factions practically let each other alone, although there was desultory fighting. Then the high chief of Hilo accepted Kamehameha as his king and sent his sons to aid Kamehameha in conquering the island Maui.
>
> Keoua was angry with his uncle Keawe-mau-hili. He attacked Hilo, killed his uncle and ravaged Kamehameha's lands along the northeastern side of the island.
>
> Kamehameha quickly returned from Maui and made an immediate attack on his enemy, who had taken possession of a fertile highland plain called Waimea. From this method of forcing unexpected battle came the Hawaiian saying, "The spear seeks Waimea like the wind."
>
> Keoua was defeated and driven through forests along the eastern side of Mauna Kea (The white mountain) to Hilo. Then Kamehameha sent warriors around the western side of the island to attack Keoua's home district. Meanwhile, after a sea fight in which he defeated the chiefs of the islands Maui and Oahu, he set his people to building a great temple chiefly for his war-god Ka-ili. This was the last noted temple built on all the islands.
>
> Keoua heard of the attack on his home, therefore he gave the fish-ponds and fertile lands of Hilo to some of his chiefs and hastened to cross the island with his army by way of a path near the volcano Kilauea. He divided his warriors into three parties, taking charge of the first in person. They passed the crater at a time of great volcanic activity. A native writer, probably Kamakau, in the native newspaper *Kuokoa*, 1867, describes the destruction of the central part of this army by an awful explosion from Kilauea. (Westervelt 1916:140-141)

The untimely eruption of Kīlauea, as Keōua's army attempted to return to Kaʻū to stop Kamehameha's warriors from ravaging their home district, cost him about 400 fighting men along with an untold number of women and children (Fornander 1996). Kamehameha's prophets said that this eruption was the favor of the gods who rejoiced at his building of Puʻukoholā Heiau. According to Westervelt, "The people said it was proof that Pele had taken Kamehameha under her special protection and would always watch over his interests and make him the chief ruler" (1916:146).

Unable to defeat Keōua in battle, Kamehameha resorted to trickery. When Puʻukoholā Heiau was completed in the summer of 1791, Kamehameha sent his two counselors, Keaweaheulu and Kamanawa, to Keōua to offer peace. Keōua was enticed to the dedication of the Puʻukoholā Heiau by this ruse, and when he arrived at Kawaihae, he and his party were sacrificed to complete the dedication (Kamakau 1992). It is widely thought that Keōua knew the likely

outcome of his visit to Puʻukoholā Heiau, but sacrificed himself anyway to spare the people of Kaʻū further bloodshed. The assassination of Keōua gave Kamehameha undisputed control of Hawaiʻi Island by 1792 (Greene 1993).

By 1796, with the aid of foreign weapons and advisors, Kamehameha conquered all of the island kingdoms except Kauaʻi. In 1810, when Kaumualiʻi of Kauai gave his allegiance to Kamehameha, the Hawaiian Islands were unified under a single leader (Kuykendall and Day 1976). Kamehameha would go on to rule the islands for another nine years. He and his high chiefs participated in foreign trade, but continued to enforce the rigid *kapu* system.

The Death of Kamehameha and Early Historical Accounts of Puna (1823-1847)

Early written accounts, such as those presented in the following pages, describe Puna as a populated country containing numerous residences situated primarily along the coast where marine resources were easily accessible, however inhabitated fertile inland tracts are also mentioned. These narratives also describe a surprisingly fertile agricultural landscape thriving among what would appear to be unsuitable fields of lava and thin soils, rife with crops such as *kalo*, sweet potatoes, sugar cane, breadfruit, bananas, and arrowroot in addition to non-native species such as coffee, grapes, strawberries, and various citrus trees. It is evident through these accounts that although Puna natives were still largely rooted in traditional subsistence practices, procurement, and trade, western influence was slowly infiltrating into native lifeways.

Following the death of Kamehameha I in 1819, the Hawaiian religious and political systems underwent a radical transformation; Kaʻahumanu proclaimed herself "*Kuhina nui*" (Prime Minister), and within six months the ancient *kapu* system was overthrown. Within a year, Protestant missionaries arrived from America (Fornander 1969; ʻĪʻī 1959; Kamakau 1992). In 1823, British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM) toured the island of Hawaiʻi seeking out communities in which to establish church centers for the growing Calvinist mission. Ellis recorded observations made during this tour in a journal (Ellis 2004). Walking southwest to northeast along the southeastern shore of the District of Puna with his missionary companions Asa Thurston and Artemas Bishop, Ellis' writings present descriptions of residences and practices:

> The population in this part of Puna, though somewhat numerous, did not appear to possess the means of subsistence in any great variety or abundance; and we have often been surprised to find desolate coasts more thickly inhabited than some of the fertile tracts in the interior; a circumstance we can only account for, by supposing that the facilities which the former afford for fishing, induce the natives to prefer them as places of abode; for they find that where the coast is low, the adjacent water is usually shallow.
>
> We saw several fowls and a few hogs here, but a tolerable number of dogs, and quantities of dried salt fish, principally albacores and bonitos. This latter article, with their *poë* [*poi*] and sweet potatoes, constitutes nearly the entire support of the inhabitants, not only in this vicinity, but on the sea coasts of the north and south parts of the island.
>
> Besides what is reserved for their own subsistence, they cure large quantities as an article of commerce, which they exchange for the vegetable productions of Hilo and Mamakua [Hāmākua], or the *mamake* and other tapas of Ora [ʻŌlaʻa] and the more fertile districts of Hawaii.
>
> When we passed through Punau [Pānau], Leapuki [Laeapuki], and Kamomoa [Kamoamoa], the country began to wear a more agreeable aspect. Groves of coca-nuts ornamented the projecting points of land, clumps of kou-trees appeared in various directions, and the habitations of the natives were also thickly scattered over the coast. (Ellis 2004:263-264)

Ellis and the ABCFM missionaries also traversed along the coast of Kauwai, Waʻawaʻa, and Nānāwale *ahupuaʻa* and then turned *mauka* toward a village in Honolulu Ahupuaʻa (Ellis 2004:294). On August 8, 1823, the Ellis and the ABCFM missionaries left Honolulu and visited a nearby village in Waiakahiula. Ellis' journal provides a brief first-hand description of the village's location relative to the coast:

> We arose early on the 8th, and Mr. Thurston held morning worship with the friendly people of the place [Honolulu]. Although I had been much indisposed through the night, we left Honoruru [sic] soon after six a.m. and, travelling slowly towards the sea-shore, reached Waiakeheula [sic] about eight, where I was obliged to stop, and lie down under the shade of a canoe-house near the shore. Messrs. Thurston and Bishop walked up to the settlement about half a mile inland, where the former preached to the people. (Ellis 2004:295)

After preaching, Bishop continued on alone toward Waiakea, while Thurston returned to fetch Ellis from the canoe shed. Upon reaching Kea'au, Ellis found that it was thickly populated and incredibly fertile and verdant (underlined emphasis added):

> After conversing some time, we walked on, in an inland direction, to Honoruru, a small village situated in the midst of a wood, where we arrived just at the setting of the sun . . .The country was populous, but the houses stood singly, or in small clusters, generally on the plantations, which were scattered over the whole country. Grass and herbage were abundant, vegetation in many places luxuriant, and the soil, though shallow, was light and fertile.
>
> Soon after 5 P.M., they reached Kaau [*sic*], the last village in the division of Puna. It was extensive and populous, abounding well with cultivated plantations of taro, sweet potatoes, and sugar-cane, and probably owes its fertility to a fine rapid stream, which, descending from the mountains, runs through it into the sea. (1825:172-174)

Sheldon Dibble was a missionary and teacher at the Lahinaluna School and was an influential instructor of esteemed Hawaiian historians Samuel Kamakau and David Malo. He is associated with the creation of one of the first books on Hawaiian History, the *History of the Sandwich Islands,* containing information methodically gathered by ten of his top scholars at Lahainaluna. Dibble was stationed at the Hilo mission beginning in 1831, where he remained until relocating to Lahaina, Maui in 1834. During his residence on Hawai'i Island, Dibble toured Puna. His narrative expresses perhaps the most systematic and straightforward of experiences:

> In making the tour of Puna, you first provide yourself with two gourd shells of good water, containing about a bucket a piece. You balance these on a short pole or stick, which you place on the shoulder of one of your attendants. You then fill two calabashes with changes of raiment and small provisions, and balance them on the shoulder of another attendant. You tie a pair of sandals of dried bull's hide on the bottom of your shoes, and take care to place several other pairs among your baggage, for you are to travel over fields of sharp-pointed lava, and a common pair of shoes would serve you but a short time. Then with a native testament and hymn-book in your pocket, and an umbrella in your hand to shield you from a tropical sun, you set out on your way. You arrive at the first village, and sit down perhaps under a grove of cocoanut trees. A shell is blown, and the people assemble. You deliver a short address of 30 minutes, perhaps under the trees, and perhaps in a school-house; make various inquiries about schools, books, and church members; and then pass on to the next village or grove of trees and preach again a short discourse. After passing six or seven villages and preaching as many sermons, it is night-fall, and you turn your attention to food and rest.
>
> Food, after the native form of cooking, you may find in abundance, but it will be a large hog baked whole in the earth, a calabash of fermented poi, or something of the kind, and will not probably please your taste. You look about for a chicken perhaps—roast it on some coals, and that, together with the sweet potatoe or the *kalo*, and some biscuit from your calabash, makes a palatable meal. Thus food is easily obtained.
>
> To find rest is rather more difficult. A mat, braided of the lauhala leaf, something like the palmetto, is the bed, a small pillow you usually carry with you, a sheet of bark cloth is the covering. Such a bed, in a warm climate and after the fatigue of a day's journey, you may enjoy as a luxury, and sleep soundly and quietly. A tour through Puna usually occupies a week or ten days, and the travelling is entirely on foot, under an oppressive sun and over many fields of rugged lava. (Dibble 1843:268-269)

One year after Ellis' tour, the ABCFM established a base church in Hilo. From that church (Hāili), the missionaries traveled to the more remote areas of the Hilo and Puna Districts. David Lyman, who came to Hawai'i in 1832, and Titus Coan, who arrived in 1835 were two of the most influential congregational missionaries in Puna and Hilo. As part of their duties they compiled census data for the areas within their missions. In 1835, 4,800 individuals were recorded as residing in the district of Puna (Schmitt 1973); the smallest total district population on the island of Hawai'i. One year after his arrival to the island, Coan traveled to Puna. He recorded his observations of the dramatic scenery:

> The district of Puna lies east and south of Hilo, and its physical features are remarkably different from those of the neighboring district.
>
> Its shore line, including its bends and flexures, is more than seventy miles in extent. For three miles inland from the sea it is almost a dead level, with a surface of pahoehoe or field lava, and *a-a* or scoriaceous lava, interspersed with more or less rich volcanic soil and tropical verdure, and sprinkled

> with sand-dunes and a few cone and pit-craters. Throughout its length it is marked with ancient lava streams, coming down from Kilauea and entering the sea at different points along the coast. These lava streams vary in width from half a mile to two or three miles. From one to three miles from the shore the land rises rapidly into the great volcanic dome of Mauna Loa (Long Mountain). The highlands are mostly covered with woods and jungle, and scarred with rents, pits, and volcanic cones. Everywhere the marks of terrible volcanic action are visible. The whole district is so cavernous, so rent with fissures, and so broken by fiery agencies, that not a single stream of water keeps above-ground to reach the sea. All the rain-fall is swallowed by the 10,000 crevices, and disappears, except the little that is held in small pools and basins, waiting for evaporation. The rains are abundant, and subterranean fountains and streams are numerous, carrying the waters down to sea level, and filling caverns, and bursting up along the shore in springs and rills, even far out under the sea. Some of these waters are very cold, some tepid, and some stand at blood heat, furnishing excellent warm baths. There are large caves near the sea where we enter by dark and crooked passages, and bathe by torchlight, far underground, in deep and limpid water.
>
> Puna has many beautiful groves of the cocoa-palm, also breadfruit, pandanus, and ohia, and where there is soil it produces under cultivation besides common vegetables, arrowroot, sugar-cane, coffee, cotton, or anges, citrons, limes, grapes, and other froots [sic]. On the highlands, grow wild strawberries, cape gooseberries, and the ohelo, a delicious berry resembling our whortleberry. (Coan 1882:39-40)

In 1841, five years after Coan's tour through Puna, he documented the population at 4,371, having dropped by 429 individuals since his earlier census assessment conducted in 1835 with Lyman. Coan noted that majority of the inhabitants lived near the coast, although there were hundreds of individuals who lived inland (Holmes 1985). That same year, the United States Exploring Expedition under the direction of Commander Charles Wilkes, toured Hawai'i Island and travelled through the Puna District. Wilkes produced a map of Puna which illustrates a coastal trail and shows a large "Pandanus Forest" covering the lands in the vicinity of the study area (Figure 10) Wilkes, travelling towards Kapoho at the eastern tip of the island, provides the following description of Puna:

> Almost all of the hills or craters of any note have some tradition connected with them; but I found that the natives were now generally unwilling to narrate these tales, calling them "foolishness."
>
> After leaving the pahoihoi [sic - *pāhoehoe*] plain, we passed along the line of cone-craters towards Point Kapoho, the Southeast part of the island.
>
> Of these cone-craters we made out altogether, large and small, fifteen, trending about east-northeast. The names of the seven last are Pupukai, Poholuaokahowele [Pu'u-hōlua-o-Kahawali], Punomakalua, Kapoho, Puukea, Puuku, and Keala. On some of these the natives pointed out where there had formerly been slides, an amusement or game somewhat similar to the sport of boys riding down hill on sleds. These they termed kolua [sic – *holua*].
>
> This game does not appear to be practiced now, and I suppose that the chiefs consider themselves above such boyish amusements. The manner in which an old native described the velocity with which they passed down these slides was, by suddenly blowing a puff; according to him, these amusements were periodical, and the slides were usually filled with dried grass.
>
> As we approached the sea-shore, the soil improved very much, and was under good cultivation, in taro, sweet-potatoes, sugar cane, and a great variety of fruit and vegetables. At about four o'clock, we arrived at the house of our guide, Kekahunanui, who was the "head man." I was amused to find that none of the natives knew him by this name, and were obliged to ask him, before they could give it to Dr. Judd… (Wilkes 1845:Vol. IV:186)
>
> During the night, one of the heaviest rains I had experienced in the island, fell; but the morning was bright and clear,—every thing seemed to be rejoicing around, particularly the singing-birds, for the variety and sweetness of whose notes Hawaii is distinguished. Previous to our departure, all the tenantry, if so I may call them, came to pay their respects, or rather to take a look at us. We had many kind wishes, and a long line of attendants, as we wended our way among the numerous taro patches of the low grounds, towards Puna; and thence along the sea-coast where the lava entered the sea, at Nanavalie [sic - Nānāwale]. The whole population of this section of the country was by the wayside, which gave me an opportunity of judging of their number; this is much larger than might be expected from the condition of the country, for with the exception of the point at Kapoho, very little ground that can be cultivated is to be seen. The country, however, is considered fruitful

> by those who are acquainted with it, notwithstanding its barren appearance on the roadsides. The inhabitants seemed to have an abundance if bread-fruit, bananas, sugar-cane, taro, and sweet-potatoes. The latter, however, are seen to be growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed, the finest on the island…
>
> In some places they have taken great pains to secure a good road or walking path; thus, there is a part of the road from Nanavalie to Hilo which is built of pieces of lava, about four feet high and three feet wide on the top; but not withstanding this, the road is exceedingly fatiguing to the stranger, as the lumps are so arranged that he is obliged to take a long and short step alternately; but this the natives do not seem to mind, and they pass over the road with great facility, even when heavy laden…(Wilkes 1845, Vol. IV:188-193)

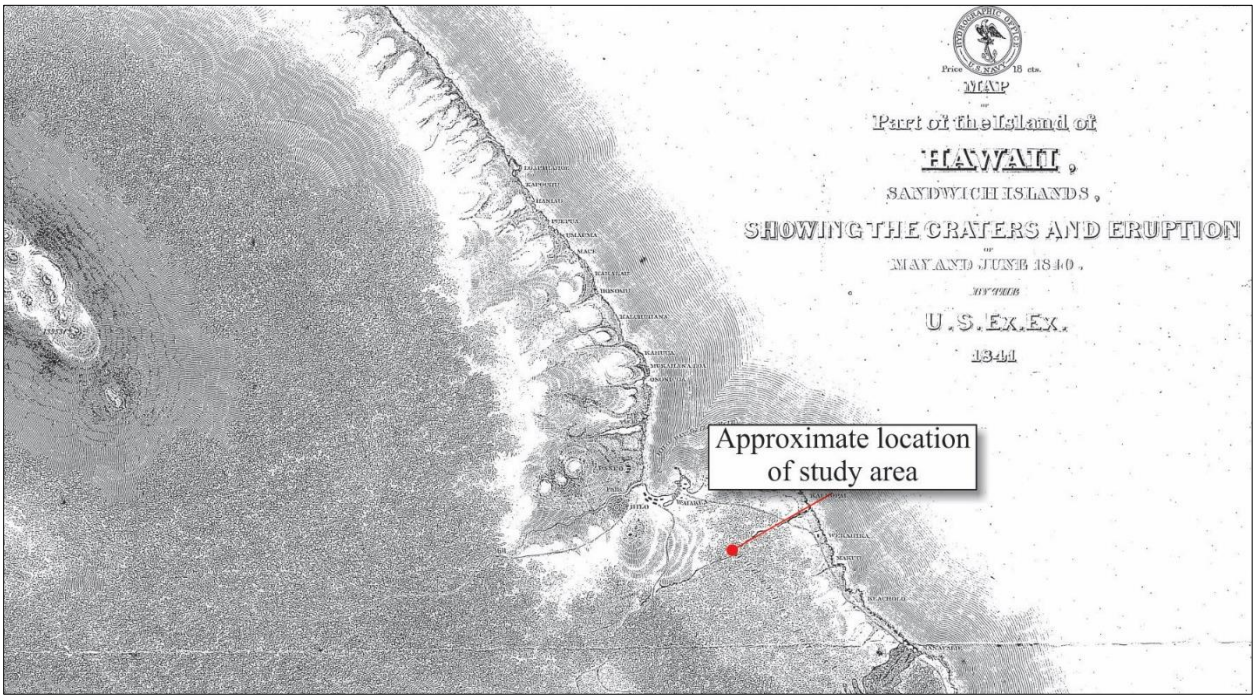


Figure 10. Portion of Hawai‘i Registered Map No. 424 prepared by Wilkes in 1841 showing approximate location of current study area.

Wilkes continued his journey from Kīlauea to Kea‘au, commenting on the bleakness of the landscape and the surprising number of inhabitants for such an atmosphere:

> We had many kind wishes, and a long line of attendants, as we wended our way among the numerous taro-patches of the low grounds, towards Puna; and thence along the sea-coast towards the place where the lava entered the sea, at Nanavalie [Nānāwale]. The whole population of this section of the country was by the wayside, which gave me an opportunity of judging of their number; this is much larger than might be supposed from the condition of the country, for with the exception of the point at Kapoho, very little ground that can be cultivated is to be seen. The country, however, is considered fruitful by those who are acquainted with it, notwithstanding its barren appearance on the roadsides. The inhabitants seemed to have abundance of bread-fruit, bananas, sugar-cane, taro, and sweet-potatoes. The latter, however, are seen to be growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed, the finest on the island.
>
> At Puna, there is a large church; but no appearance of a village, the houses being much scattered. The church, it is said, will contain two or three thousand persons. The Rev. Mr. Coan, I understood, officiates here occasionally. (1845:187-188)

In 1846, Chester S. Lyman, “a sometime professor” at Yale University visited Hilo, Hawai‘i, and stayed with Titus Coan (Maly 1998). Traveling the almost 100-mile-long stretch of the “Diocese” of Mr. Coan, Lyman reported

that the district of Puna had somewhere between 3,000-4,000 inhabitants (Maly 1998). Entering Puna from Hilo, and traveling to Keaʻau along the coast, Lyman offered the following observations of the Puna District:

> The groves of Pandanus were very beautiful, and are the principal tree of the region. There is some grass and ferns, and many shrubs; but the soil is very scanty. Potatoes are almost the only vegetable that can be raised, and these seem to flourish well amid heaps of stone where scarcely a particle of soil could be discovered. The natives pick out the stones to the depth often of from 2 to 4 feet, and in the bottom plant the potato–how it can expand in such a place is a wonder.
>
> Nearly all Puna is like this. The people are necessarily poor—a bare subsistence is all they can obtain, and scarcely that. Probably there are not $10 in money in all Puna, and it is thought that not over one in five hundred has a single cent. The sight of some of these potatoe patches would make a discontented N.E. farmer satisfied with his lot. Yet, I have nowhere seen the people apparently more contented & happy. (Lyman ms. Book III:3 in Maly 1998:35)

A retired sea captain by the name of Charles Wetherby Gelett visited the Hawaiian Islands in 1847. He recounts briefly the Puna wilderness, describing how the *pulu* wool obtained from the stalks of the endemic *hāpuʻu* tree fern was being commercially and domestically utilized, and mentions a brief stay at a halfway house, presumably in the neighboring area of ʻŌlaʻa:

> We got off our horses but once during the ride of fifteen miles. I was about used up when we reached the half-way house. The road was very rough and muddy, and we could only walk our horses. We had some woods to pass through, and a good deal of brush.
>
> The fern is very abundant in this region; it grows in some instances fifteen or twenty feet high. From it the pulu is obtained, which is used for beds, pillows, etc., and the root is used for food in seasons of scarcity.
>
> We found the half-way house neat and comfortable, but were disappointed at not finding a fire to warm and dry us. (Gelett 1917:66)

Written accounts left by early visitors to the Island of Hawaiʻi offer insight into what life may have been like for the Hawaiians of Puna. However, by the time Ellis visited Puna, less than fifty years after the arrival of the first Europeans, the population of Hawaiʻi was already beginning to decline. By 1850, the population of Hawaiʻi Island had dropped to 25,846 individuals (Schmitt 1973:8). Maly summarizes the reasons for the rapid decline of native populations thusly:

> Overall, historic records document the significant effect that western settlement practices had on Hawaiians throughout the islands. Drawing people from isolated native communities into selected village parishes and Hawaiian ports-of-call, had a dramatic, and perhaps unforeseen impact on native residency patterns, health, and social and political affairs. In single epidemics hundreds, and even thousands of Hawaiians died in short periods of time. (Maly 1998:36)

The *Māhele ʻĀina* of 1848

By the mid-nineteenth century, the ever-growing population of Westerners in the Hawaiian Islands forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership. By 1840 the first Hawaiian constitution had been drafted and the Hawaiian Kingdom shifted from an absolute monarchy into a constitutional government. Convinced that the feudal system of land tenure previously practiced was not compatible with a constitutional government, the King (Kamehameha III) and his high-ranking chiefs decided to separate and define the ownership of all lands in the Kingdom (King n.d.). This change was further promoted by missionaries and Western businessmen in the islands who were generally hesitant to enter business deals on leasehold lands that could be taken from them at any time. After much consideration, it was decided that three classes of people each had one-third vested rights to the lands of Hawaiʻi: the King, the chiefs and *konohiki*, and their tenants (the *makaʻāinana* or common people). In 1845, the legislature created the "Board of Commissioners to Quiet Land Titles" (more commonly known as the Land Commission), first to adopt guiding principles and procedures for dividing the lands and granting land titles, and then to act as a court of record to investigate and ultimately award or reject all claims brought before them. All land claims, whether by chiefs for entire *ahupuaʻa* or by tenants for their house lots and gardens, had to be filed with the Land Commission within two years of the effective date of the Act (February 14, 1846) to be considered (this deadline was extended several times for chiefs and *konohiki*, but not for commoners; Soehren 2005)

The King and some 245 chiefs (Kuykendall 1938) spent nearly two years trying unsuccessfully to divide all the lands of Hawai‘i amongst themselves before the whole matter was referred to the Privy Council on December 18, 1847 (King n.d.). Once the King and his chiefs accepted the principles of the Privy Council, the *Māhele ‘Āina* (Land Division) was completed in just forty days (on March 7, 1848), and the names of all of the *ahupua‘a* and *‘ili kūpono* (nearly independent *‘ili* land division within an *ahupua‘a*, that paid tribute to the ruling chief and not to the chief of the *ahupua‘a*) of the Hawaiian Islands and the chiefs who claimed them, were recorded in the *Māhele* Book (Soehren 2005). As this process unfolded King Kamehameha III, who received roughly one-third of the lands of Hawai‘i, realized the importance of setting aside public lands that could be sold to raise money for the government and also purchased by his subjects to live on. Accordingly, the day after the division with the last chief was recorded in the *Buke Māhele* (*Māhele* Book), King Kamehameha III commuted about two-thirds of the lands awarded to him to the government (King n.d.). Unlike the King, the chiefs and *konohiki* were required to present their claims to the Land Commission to receive their awards (LCAw.). The chiefs who participated in the *Māhele* were also required to provide to the government commutations of a portion of their lands in order to receive a Royal Patent giving them title to their remaining lands. The lands surrendered to the government by the King and chiefs became known as “Government Land,” while the lands retained by Kamehameha III became known as “Crown Land,” and the lands received by the chiefs became known as “*Konohiki* Land” (Chinen 1958:vii, 1961:13). All lands awarded during the *Māhele* were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission.

During the *Māhele*, native tenants of the lands that were divided up among the Crown, *Konohiki*, and Government could claim, and acquire title to, *kuleana* parcels that they actively lived on or farmed. The Board of Commissioners oversaw the program and administered the *kuleana* as Land Commission Awards (LCAw.). Claims for *kuleana* had to be submitted during a two-year period that expired on February 14, 1848 to be considered. All of the land claimants were required to provide proof of land use and occupation, which took the form of volumes of native registry and testimony. The claims and awards were numbered, and the LCAw. numbers, in conjunction with the volumes of documentation, remain in use today to identify the original owners and their use of the *kuleana* lands. The work of hearing, adjudicating, and surveying the claims required more than the two-year term, and the deadline was extended several times for the Land Commission to finish its work (Maly 2002). In the meantime, as the new owners of the lands on which the *kuleana* were located began selling parcels to foreigners, questions arose concerning the rights of the native tenants and their ability to access and collect the resources necessary for sustaining life. The “Enabling” or “*Kuleana* Act,” passed by the King and Privy Council on December 21, 1849, clarified the native tenants’ rights to the land and resources, and the process by which they could apply for fee-simple interest in their *kuleana*.

The work of the Land Commission was completed on March 31, 1855. A total of 13,514 *kuleana* were claimed by native tenants throughout the islands, of which 9,337 were awarded (Maly 2002). The history of the *kuleana* claim and award process is summarized in an 1856 report by the Minister of Interior:

> …During the ten months that elapsed between the constitution of the Board and the end of the year 1846, only 371 claims were received at the office; during the year 1847 only 2,460, while 8,478 came in after the first day of January 1848. To these are to be added 2,100 claims, bearing supplementary numbers, chiefly consisting of claims which had been forwarded to the Board, but lost or destroyed on the way. In the year 1851, 105 new claims were admitted, for Kuleanas in the Fort Lands of Honolulu, by order of the Legislature. The total number of claims therefore, amounts to 13,514, of which 209 belonged to foreigners and their descendants. The original papers, as they were received at the office, were numbered and copied into the Registers of the Commission, which highly necessary part of the work entailed no small amount of labor…
>
> …The whole number of Awards perfected by the Board up to its dissolution is 9,337, leaving an apparent balance of claims not awarded of say 4,200. Of these, at least 1,500 may be ranked as duplicates, and of the remaining 2,700 perhaps 1,500 have been rejected as bad, while of the balance some have not been prosecuted by the parties interested; many have been relinquished and given up to the Konohikis, even after surveys were procured by the Board, and hundreds of claimants have died, leaving no legal representatives. It is probable also that on account of the dilatoriness of some claimants in prosecuting their rights before the Commission, there are even now, after the great length of time which has been afforded, some perfectly good claims on the Registers of the Board, the owners of which have never taken the trouble to prove them. If there are any such, they deserve no commiseration, for every pains has been taken by the Commissioners and their agents, by means of oft repeated public notices and renewed visits to the different districts of the Islands, to afford all and every of the claimants an opportunity of securing their rights… (quoted in Maly 2002:7)

As a result of the *Māhele*, Keaʻau Ahupuaʻa in its entirety was awarded as *Konohiki* Land to William C. Lunalilo as *ʻāpana* (lot) 16 of LCAw. 8559B (Figure 11). The Royal Patent (no. 7223) award, which conveyed an absolute fee simple title to Keaʻau Ahupuaʻa was not issued until 1879 by King Kalākaua, some five years after Lunalilo's death (Figure 12). Keaʻau Ahupuaʻa was one of sixty-five *ahupuaʻa* maintained by Lunalilo following the *Māhele*. The sixty-five ahupuaʻa that he maintained as part of his personal land holdering were spread across six islands; Hawaiʻi (n=31 *ahupuaʻa*) of which, eight were in Puna; Maui (n=15 *ahupuaʻa*); Lānaʻi (n=1 *ahupuaʻa*); Molokaʻi (n=2 *ahupuaʻa*); Oʻahu (n=9 ahupuaʻa); Kauaʻi (n=7 *ahupuaʻa*) (Kameʻeleihiwa 1992:236-237). Next to the *mōʻī*, Kauikeaouli, Lunalilo ranked second for having the most lands as a consequence of the Māhele. Fearing that his son's drinking habit and wasteful spending would lead to a total loss in the new captilist system, in 1858, Lunalilo's father, Charles Kanaʻina petitioned the court to appoint guardians to manage his son's estate. The court concurred and subsequently appointed Kanaʻina, Armstrong, and J.W. Austin as guardians of his estate (ibid.).

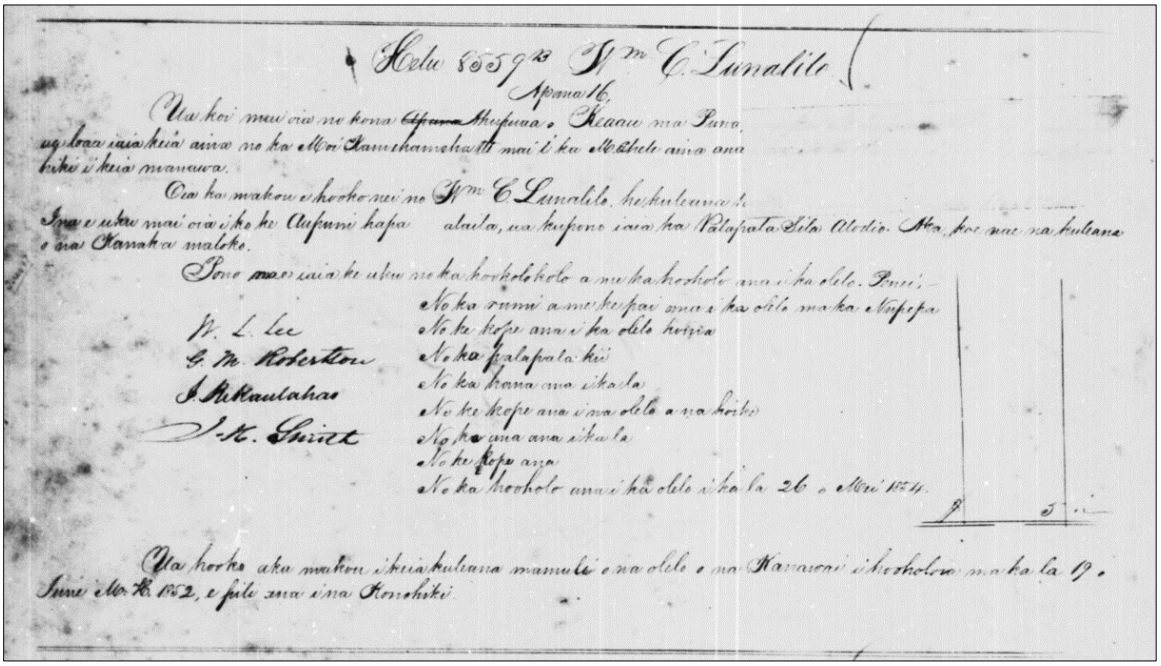
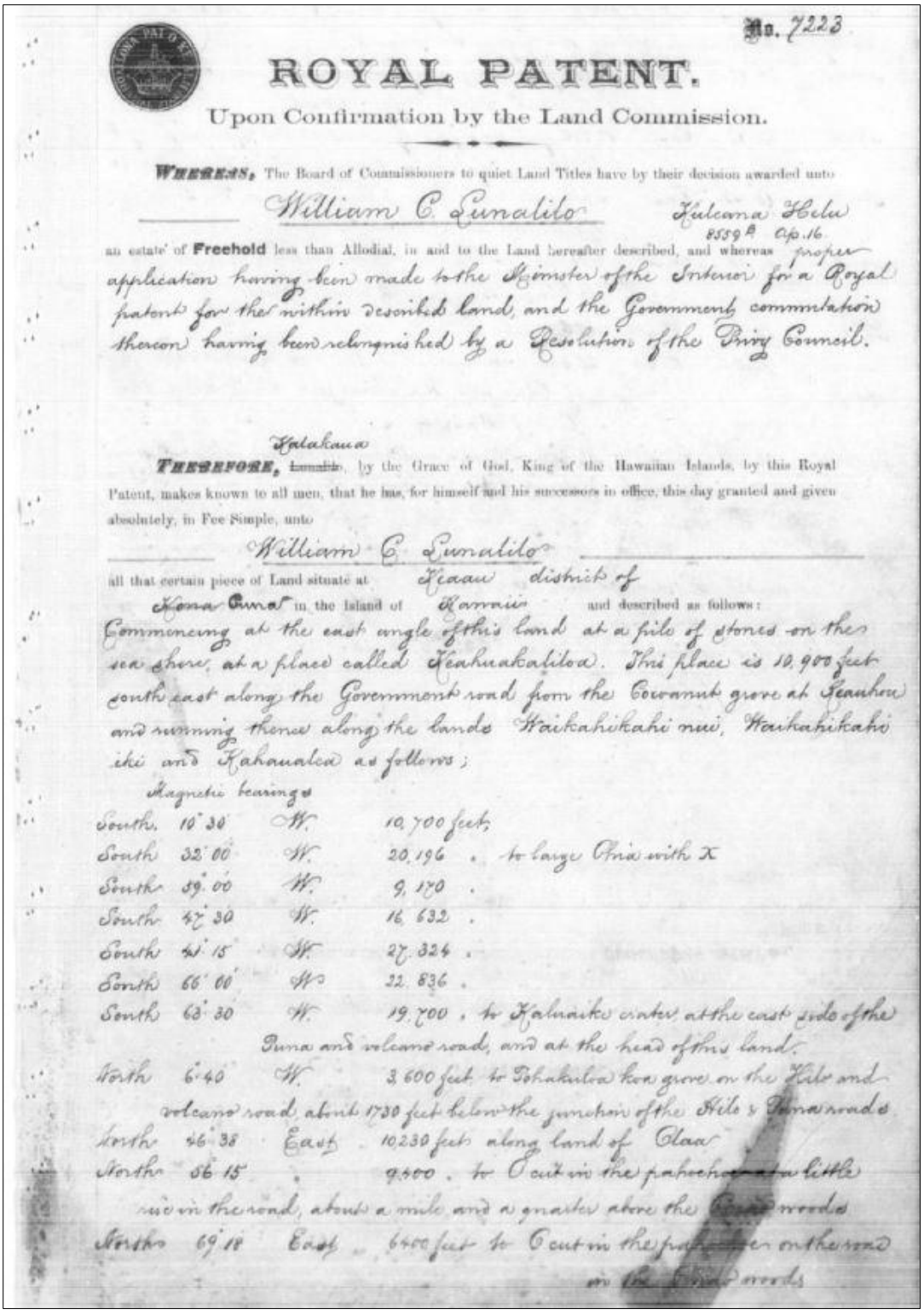


Figure 11. Land Commission Award 8559B *ʻāpana* 16 to William C. Lunalilo (kipukadatabase.com).



No. 7223

ROYAL PATENT.

Upon Confirmation by the Land Commission.

WHEREAS, The Board of Commissioners to quiet Land Titles have by their decision awarded unto

William C. Lunalilo Kuleana Helu 8559 B Ap. 16

an estate of **Freehold** less than Allodial, in and to the Land hereafter described, and whereas proper application having been made to the Minister of the Interior for a Royal patent for the within described land, and the Government commutation thereon having been relinquished by a Resolution of the Privy Council.

THEREFORE, ~~Lunalilo~~ Kalakaua, by the Grace of God, King of the Hawaiian Islands, by this Royal Patent, makes known to all men, that he has, for himself and his successors in office, this day granted and given absolutely, in Fee Simple, unto

William C. Lunalilo

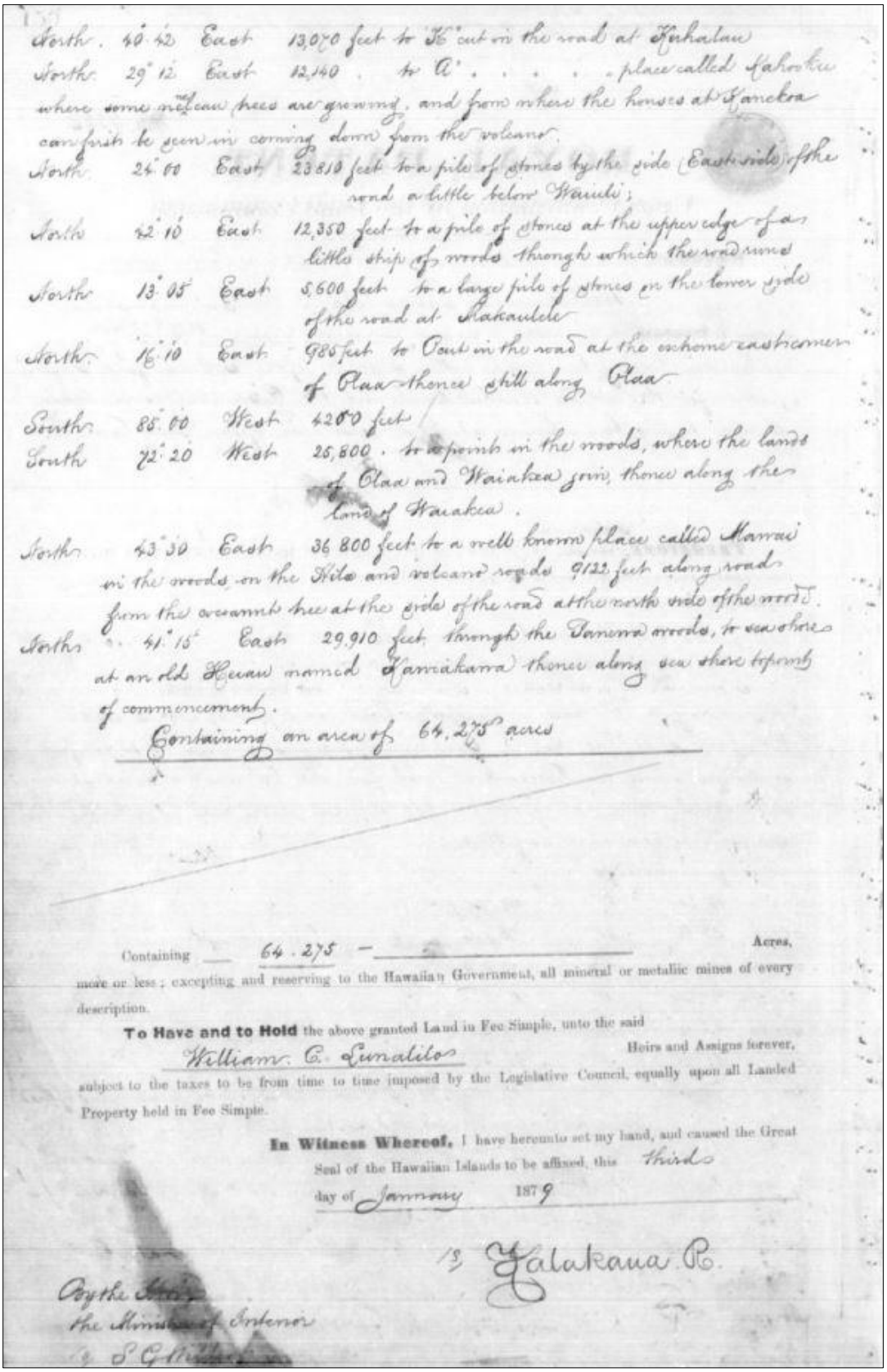
all that certain piece of Land situate at Keaau district of Kona Puna in the Island of Hawaii and described as follows:

Commencing at the east angle of this land at a pile of stones on the sea shore, at a place called Keahuakaliloa. This place is 10,900 feet south east along the Government road from the Cocoanut grove at Keauhou and running thence along the lands Waikahikahi nui, Waikahikahi iki and Kahaualea as follows;

Magnetic bearings

South 10° 30' W. 10,700 feet;
South 32° 00' W. 20,196 . to large Ohia with X
South 59° 00' W. 9,170 .
South 47° 30' W. 16,632 .
South 41° 15' W. 27,324 .
South 66° 00' W. 22,836 .
South 63° 30' W. 19,700 . to Kaluaike crater at the east side of the Puna and volcano road, and at the head of this land.
North 6° 40' W. 3,600 feet to Pohakuloa koa grove on the Hilo and volcano road, about 1730 feet below the junction of the Hilo & Puna roads
North 46° 38' East 10,230 feet along land of Olaa
North 56° 15' " 9,400 . to O cut in the pahoehoe at a little rise in the road, about a mile and a quarter above the Olaa woods
North 69° 18' East 6400 feet to O cut in the pahoehoe on the road in the Olaa woods

Figure 12. Royal Patent 7223 for Kea‘au Ahupua‘a issued to Lunalilo in 1879 by King Kalākaua.



North. 40° 42 East 13,070 feet to "K" cut in the road at Kuhalau
North 29° 12 East 12,140 . to "A" . . . . . place called Kahooku
where some nelcau trees are growing, and from where the houses at Kanekoa
can first be seen in coming down from the volcano.
North 24° 00 East 23810 feet to a pile of stones by the side (East side) of the
road a little below Waiuli;
North 42° 10 East 12,350 feet to a pile of stones at the upper edge of a
little strip of woods through which the road runs
North 13° 05 East 5,600 feet to a large pile of stones on the lower side
of the road at Makaulele
North 16° 10 East 985 feet to Pcut in the road at the extreme east corner
of Plaa thence still along Plaa
South 85° 00 West 4200 feet
South 72° 20 West 25,800 . to a point in the woods, where the lands
of Plaa and Waiakea join, thence along the
land of Waiakea.
North 43° 30 East 36 800 feet to a well known place called Mawai
in the woods on the Hilo and volcano roads 9122 feet along road
from the cocoanut tree at the side of the road at the north side of the woods.
North 41° 15 East 29,910 feet through the Tanewa woods, to sea shore
at an old Heiau named Kawiakawa thence along sea shore to point
of commencement.

Containing an area of 64,275 acres

Containing 64.275 — Acres,
more or less; excepting and reserving to the Hawaiian Government, all mineral or metallic mines of every
description.

To Have and to Hold the above granted Land in Fee Simple, unto the said
William C. Lunalilo Heirs and Assigns forever,
subject to the taxes to be from time to time imposed by the Legislative Council, equally upon all Landed
Property held in Fee Simple.

In Witness Whereof, I have hereunto set my hand, and caused the Great
Seal of the Hawaiian Islands to be affixed, this third
day of January 1879

By the Minister
the Minister of Interior
S. G. Wilder

Figure 12. continuation of Royal Patent 7223.

Shortly before his death in 1874, Lunalilo's legacy to the Hawaiian people was expressed in his will dated June 7, 1871. Cahill (1996) writes:

> There he named as his executor…the Honorable Charles. R. Bishop, the husband of Princess Bernice Pauahi. The welfare of the Hawaiian people, especially the less priviledge, had always been close to the ruler's heart. In clear, concise, and legal language, his will spelled out how the income from the many lands he had owned would be used for the construction and maintenance of what is known today as Lunalilo Home. (The Lunalilo Trust still cares for, in the comfortable and spacious Lunalilo Home, those elderly Hawaiian the king felt were most in need.) His last will and testament read "and in case I shall die without issue lawfully begotten I give and devise all of the reas estate… to three persons to be nominated and appointed by… the Supreme Court or the Court of highest jurisdiction in these Hawaiian Islands, to be held by them in Trust.. to sell and dispose of… to the best advantage at public or private sale, and incest the proceeds… in of poor, destitute and infirm people of Hawaiian (aboriginal) blood or extraction, giving preference to the older people." (Cahill 1996:126-127)

Lunalilo died in 1874, leaving the three appointed trustees in charge of managing the Lunalilo Trust. Charles Kanaʻina, however, contended "that the will offered for probate is not the Will of the deceased; that at the time of the execution thereof he was incompetent and that the Codicil thereto was not executed according to law" (Cahill 1996:163). Within a month after the court hearing, Justice Harris made his ruling and validated the will and admitted it to probate. To fund the construction of the Lunalilo Home on Oʻahu, the trustees first applied to the Supreme Court to determine whether they had the authority to lease the Keaʻau tract, rather than selling it outright. The Supreme Court ruled that the trustees did not have the power to lease the said land and forced the trustees into disposing of the Keaʻau tract in its entirety. The roughly 65,000-acre Keaʻau Ahupuaʻa was put up for sale in an 1881 public auction. Three men, Willie (William) Shipman, Captain J. Elderts, and Samuel M. Damon saw new economic and ranching possibilities for Keaʻau. With much determination, the three men formed a consortium and individually financed one-third equal share and thereby made a $20,000 offer for the parcel. On January 9, 1882 they became the owners of the entire Keaʻau Ahupuaʻa, with an agreement that gave each of the signatories first right of refusal should one of them decide to sell their portion. However, by the following year, Elderts sold his interest to Shipman and Damon. Damon followed Elderts and shortly thereafter, sold his portion to Shipman. By 1883, Willie and his wife Mary were the sole owners of the entire Keaʻau Ahupuaʻa (ibid.). Ownership of this large tract of land allowed the Shipman family to expand their early ranching operations and subsequent agricultural endeavors.

In Puna, very few claims for *kuleana* were submitted. Maly (1998:37) notes that, with the exception of the islands of Kahoʻolawe and Niʻihau, no other land division of comparable size, had fewer claims for *kuleana* from native tenants than the district of Puna. Only two *kuleana* were awarded withn Keaʻau Ahupuaʻa, none of which are in close proximity to the current study area. The first of these was a 13.64-acre parcel in the *ʻili* of Halauloa to Hewahewa as LCAw. 8081:2 containing only a single cultivated garden. The other was a 0.34-acre parcel in the *ʻili* of Kalaihina to Barenaba as LCAw. 2327:1.

Keaʻau and the Greater Puna Area After the *Māhele*

Although exposed to missionary presence since the 1820s, early pre-*Māhele* narratives portray Puna as a district still heavily rooted in tradition, being only marginally impacted by foreign influence. While earlier narratives describe the region as densely populated with settlement locales present at both coastal and inland settings, subsequent accounts reveal a sharp decline in the native population throughout the first half of the nineteenth century, with Hawaiians maintaining marginalized communities outside of the central population centers. Within a quarter of a century, Puna's population deteriorated by more than half from 4,800 in 1835 to 2,158 in 1860 (Anderson 1865), and continued decreasing to a mere 1,043 by 1878, reaching an unsurpassed low of 944 by 1884 (Thrum 1885 and 1886).

While explicit references to Keaʻau are notably limited from all later historic accounts pertaining to Puna, many exist for the greater district itself. The anecdotes discussed by post-*Māhele* visitors emulate many of the earlier sentiments expressed by former sojourners, focusing primarily on descriptions of the verdurous forests and precipitous lava landscape. Additionally, these writings demonstrate a considerable transformation from the almost exclusive traditional native subsistence strategies discussed in earlier chronicles to a new way of life.

Samuel Langhorne Clemens, known more famously as the classic American novelist Mark Twain, toured Hawaiʻi Island on horseback in 1866. During his journey, Twain took a moment to contemplate the curious Puna geology and offers some witty remarks:

> At four o'clock in the afternoon we were winding down a mountain of dreary and desolate lava to the sea, and closing our pleasant land journey. This lava is the accumulation of ages; one torrent of fire after another has rolled down here in old times, and built up the island structure higher and higher. Underneath, it is honeycombed with caves. It would be of no use to dig wells in such a place; they would not hold water—you would not find any for them to hold, for that matter. Consequently, the planters depend upon cisterns.
>
> The last lava flow occurred here so long ago that there are none now living who witnessed it. In one place it inclosed [*sic*] and burned down a grove of cocoanut trees, and the holes in the lava where the trunks stood are still visible: their sides retain the impression of the bark: the trees fell upon the burning river, and becoming partly submerged, left in it the perfect counterpart of every knot and branch and leaf, and even nut, for curiosity-seekers of a long-distant day to gaze upon and wonder at.
>
> There were doubtless plenty of Kanaka sentinels on guard hereabouts at that time, but they did not leave casts of their figures in the lava as the Roman sentinels at Herculaneum and Pompeii did. It is a pity it is so, because such things are so interesting; but so it is. They probably went away. They went away early, perhaps. However, they had their merits; the Romans exhibited the higher pluck, but the Kanakas showed the sounder judgement. (Twain 1913:243-244)

In 1868, two years after Twain visited Puna, a massive volcanic eruption emanating from Mauna Loa volcano shook Hawai'i Island, bringing with it lava flows, earthquakes and a large *tsunami* that transformed the landscape of the southern part of island forever, and further contributed to the depopulation of Puna. Coan (1882) recorded that on April 2:

> …a terrific shock rent the ground, sending consternation through all Hilo, Puna, and Kau. In some places fissures of great length, breadth, and depth were opened… Stone houses were rent and ruined, and stone walls sent flying in every direction…the sea rose twenty feet along the southern shore of the island, and in Kau 108 houses were destroyed and forty-six people drowned…Many houses were also destroyed in Puna, but no lives were lost. During this awful hour the coast of Puna and Kau, for the distance of seventy-five miles subsided seven feet on average, submerging a line of small villages all along the shore. One of my rough stone meeting houses in Puna [Kapoho-Koa'e], where we once had a congregation of 500 to 1,000 was swept away with the influx of the sea, and its walls are now under water. (Coan 1882:314-316)

Isabella Bird visited Puna in 1873, and published her first-hand experiences in *The Hawaiian Archipelago: Six Months Among the Palm Groves, Coral Reefs, & Volcanoes of the Sandwich Islands*. In the following excerpt, she provides an imaginative and lively depiction of Puna's lush forests, craggy lava fields, and a balmy natural springs, paying meticulous attention to detail. Her narrative is undoubtedly the most vivid of all foreign accounts describing the environs of Puna:

> At some distance from Hilo there is a glorious burst of tropical forest, and then the track passes into green grass dotted over with clumps of the pandanus and the beautiful eugenia. In that hot, dry district the fruit was already ripe, and we quenched our thirst with it. The "native apple," as it is called, is of such a brilliant crimson colour as to be hardly less beautiful than the flowers. The rind is very thin, and the inside is white, juicy, and very slightly acidulated. We were always near the sea, and the surf kept bursting up behind the trees in great snowy drifts, and every opening gave us a glimpse of deep blue water. The coast the whole way is composed of great blocks of very hard, black lava, more or less elevated, upon which the surges break in perpetual thunder.
>
> Suddenly the verdure ceased, and we emerged upon a hideous scene, one of the many lava flows from Kilauea, an irregular branching stream, about a mile broad. It is suggestive of fearful work on the part of nature, for here the volcano has not created but destroyed. The black, tumbled sea mocked the bright sunshine, all tossed, jagged, spiked, twirled, thrown heap on heap, broken, rifted, upheaved in great masses, burrowing in ravines of its own making, full of broken bubble caves, and torn by *a-a* streams. Close to the track, crystals of olivine lie in great profusion, and in a few of the crevices there are young plants of a fern which everywhere has the audacity to act as the herald of vegetation.
>
> Beyond this desert the country is different in its features from the rest of the island, a green, smiling land of Beulah, varied by lines of craters covered within and without vegetation. For thirty miles the track passes under the deep shade of coco palms, of which Puna is the true home; and from under

> their feathery shadow, and from amidst the dark leafage of the breadfruit, gleamed the rose-crimson apples of the euginia, and the golden balls of the guava. I have not before seen this exquisite palm to advantage, for those which fringe the coast have, as compared with these, a look of tattered somber, harassed antiquity. Here they stood in thousands, young as well as old, their fronds gigantic, their stems curving every way, and the golden light, which is peculiar to them, toned into a golden green. They were loaded with fruit in all stages, indeed it is produced in such abundance that thousands of nuts lie unheeded on the ground. Animals, including dogs and cats, revel in the meat, and in the scarcity of good water the milk is a useful substitute.
>
> Late in the afternoon we reached our destination, a comfortable frame house, on one of those fine natural lawns in which Hawaii abounds. A shower at seven each morning keeps Puna always green. Our kind host, a German, married to a native woman, served our meals in a house made of grass and bamboo; but the wife and children, as is usual in these cases, never appeared at table, and contented themselves with contemplating us at a great distance.
>
> The next afternoon we rode to one of the natural curiosities of Puna, which gave me intense pleasure. It lies at the base of a cone crowned with a *heiau* and a clump of coco palms. Passing among bread-fruit and guavas into a palm grove of exquisite beauty, we came suddenly upon a lofty wooded cliff of hard basaltic rock, with ferns growing out of every crevice in its ragged but perpendicular sides. At its feet is a cleft about 60 feet long, 16 wide, and 18 deep, full of water at a temperature of 90°. This has an absolute transparency of a singular kind, and perpetrates wonderful optical illusions. Every thing put into it is transformed. The rocks, broken timber, and old cocoa nuts which lie below it, are a frosted blue; the dusky skins of natives are changed to alabaster; and as my companion, in a light print *holoku*, swam to and fro, her feet and hands became like polished marble tinged with blue, and her dress floated through the water as if woven of blue light. Everything about this spring is far more striking and beautiful than the colour in the blue grotto of Capri. It is heaven in the water, a jeweled floor of marvels, "a sea of glass," "like unto sapphire," a type, perhaps, of that on which the blessed stand before the throne of God. Above, the feathery palms rose into the crystalliné blue, and made an amber light below, and all fair and lovely things were mirrored in the wonderful waters. The specific gravity must be much greater than that of ordinary water, for it did not seem possible to sink, or even be thoroughly immersed in it. The mercury in the air was 79°, but on coming out of the water we felt quite chilly.
>
> I like Puna. It is like nothing else, but something about it made us feel as if we were dwelling in a castle of indolence. I developed a capacity for doing nothing, which horrified me, and except when we energised [sic – energized] ourselves to go to the hot spring, my companions and I were content to dream in the verandah, and watch the lengthening shadows, and drink cocoa-nut milk, till the abrupt exit of the sun startled us, and we saw the young moon carrying the old one tenderly, and a fitful glare 60 miles away, where the solemn fires of Mauna Loa are burning at a height of nearly 14,000 feet. (1875:360-363)

In the following selection, Bird continues her dynamic portrayal of the Puna countryside and native life:

> The country is thickly sprinkled with cocoa-nuts and bread-fruit trees, which merge into the dense, dark, glorious forest, which tenderly hides out of sight hideous broken lava, on which one cannot venture six feet from the track without the risk of breaking one's limbs. All these tropical forests are absolutely impenetrable, except to axe and billhook, and after a trail has been laboriously opened, it needs to be cut once or twice a year, so rapid is the growth of vegetation. This one, through the Puna woods, only admits of one person at a time. It was really rapturously lovely. Through the trees we saw the soft steel-blue of the summer sky: not a leaf stirred, not a bird sang, a hush had fallen on insect life, the quiet was perfect, even the ring of our horses' hoofs on the lava was a discord. There was a slight coolness in the air and a fresh mossy smell. It only required some suggestion of decay, and the rustle of a fallen leaf now and then, to make it an exact reproduction of a fine day in our English October. The forest was enlivened by many natives bound for Hilo, driving horses loaded with cocoa-nuts, bread-fruit, live fowls, *poi* and *kalo*, while others with difficulty urged garlanded pigs in the same direction, all as presents for the king. We brought back some very scarce parasitic ferns. (1875:195-196)

The following passage, written by American author Charles Nordhoff and published in an 1873 edition of *Harper's Magazine,* describes the typical purlieus of Puna, and makes the first mention of commercial coffee

production in the district. Nordhoff's narrative is of particular significance in that it presents a detailed explanation of native sweet potato planting methods in lava:

> For instance, the Puna coast of Hawaii is a district where for thirty miles there is so little fresh-water to be found that travelers must bring their own supplies in bottles; and Dr. Coan told me that in former days the people, knowing that he could not drink the brackish stuff which satisfied them, used to collect freshwater for his use, when he made the missionary tour, from the drippings of dew in caves. Wells are here out of the question, for there is no soil except a little decomposed lava, and the lava lets through all the water which comes from rains. There are few or no streams to be led down from the mountains. There are no fields, according to our meaning of the word. Yet formerly the people in this district were numbered by thousands: even yet there is a considerable population, not unprosperous by any means. Churches and schools are as frequent as in the best part of New England. Yet when I asked a native to show me his sweet-potato patch he took me to the most curious and barren-looking collection of lava you can imagine, surrounded too, by a very formidable wall made of lava, and explained to me that by digging holes in the lava where it was a little decayed, carrying a handful of earth to each of these holes, and planting there in a wet season, he got a very satisfactory crop. Not only that, but being desirous of something more than a bare living, this man had planted a little coffee in the same way, and had just sold 1600 pounds, his last crop. (550)

Nordhoff expresses wonder at the notion of cultivating sweet potatoes in this manner, and further discusses agriculture and difficulties in cultivation attributed to insect infestation as well as deforestation caused by introduced species:

> It will surprise you to find people living among the lava, making potato patches in it, planting coffee and some fruit trees in it, fencing in their small holdings, even, with lava blocks. Very little soil is needed to give vegetation a chance in a rainy season, and the decomposed lava makes a rich earth. But, except the cocoa-nut, which grows on the beach, and seems to draw its sustenance from the waves, and the sweet-potato, which does very well among the lava, nothing seems really to thrive. This is true all over the islands. If you ask about oranges, you hear that, except in a very few favored localities, the orange-tree suffers from a blight. The coffee culture has almost perished, because of "the blight." The cacao is blighted. The mulberry makes a rank growth, but the black or white blight covers it. And so with almost all useful trees and plants. A lady said to me, "In truth, every thing which has been tried on our islands seems to have failed from this blight, or scale insect, except sugar-cane, and there is scarcely a plantation of sugar, even, which has not ruined the first, and in some cases the second, owners." Wheat and other cereals are not raised, but all imported. Even the forests are now perishing, partly because cattle eat the young shoots, and partly because an insect attacks the older trees. This is a serious inconvenience, because fuel is scarce, and as the woods disappear, the watercourses dry up, and the sugar-cane has of late, I am told, begun to suffer from a worm which eats out the pith, near the ground, and thus destroys the whole cane. For general agriculture the islands are worthless. A small or general farmer would not starve here, because he could always raise enough sweet-potatoes to live on; but he would never get on. (401).

Journalist Henry Martyn Whitney published the very first guide book to the islands in 1875, entitled *The Hawaiian Guide Book, For Travelers: Containing A Brief Description of the Hawaiian Islands, Their Harbors, Agricultural Resources, Plantations, Scenery, Volcanoes, Climate, Population, and Commerce*. An excerpt from his book describes his trek from Puna to Kīlauea Crater via the Kaimū-Kalapana route:

> This continues for three or four miles, and then follow groves of the pandanus, and at Kaea the ocean appears and the houses in Puna. Cocoanut trees here begin to form a prominent part of the landscape, clustered in groups of hundreds and thousands.
>
> Twenty-five miles of fair riding will carry the traveler to the comfortable ranch of Capt. Eldarts, who entertains guests for a reasonable compensation. This vicinity is noticeable for the ancient *heiau* upon a palm crowned cone; for a fresh water reservoir in an extinct crater; for a hot water cave; and for an open stone basin, below a lofty cliff which contains a pool of warm, blue water that sparkles when stirred. The temperature is so delightful that a half hour's bath is delicious. The greatest depth is not less than 18 feet, and the water is so buoyant as to make diving difficult. This section of Puna is quite fertile, whenever soil for cultivation can be found. Bread-fruit and cocoanuts are abundant. After a good rest at Eldart's the route continues over a vast tract of rough lava, on which the ohia woods are beginning to secure firm and permanent hold; the sea is skirted by successive rows of

> cocoanut trees, some so thickly planted as to hide the ground from the rays of the sun. Eighteen miles of road rough and smooth, volcanic scenery variegated by bread-fruit, guava, ohia, pandanus and cocoanut trees, and interspersed with miniature churches and grass houses, ends the journey at Kaimu, near the sea, where comfortable quarters for the night may be obtained at a native house. (Whitney 1875:79-80)

The Reverend George Leonard Chaney of Salem, Massachusetts, visited Puna on March 18, 1876. His detailed anecdote describes the distinctive lava-blanketed landscape so often marveled at by previous visitors, and mentions the presence of a native village:

> Arrived at Kaau [Kea'au], we lunch on boiled eggs and taro, bait our horses and give them a brief nooning, at at two o'clock start again for Puna. The student of lava will find every variety on this route, and an abundance of it. Beginning in a vast expanse of *pahoehoe* or satin-stone, it leads to a-a, pumice, and rotten-stone, it leads to a-a, pumice, and rotten-stone. *Lauhala* forests cover the *pahoehoe*, and now and then as we travel through them wild cattle make their appearance, and acknowledge Mr. L—'s ownership by running rapidly away. Some coco palms succeed the *lauhalas*. All the way the sound of a splendid surf attends us, and occasionally a lock of silvery spray tossed above the rocks hints the ocean beauty which we cannot see. All at once this iron barrier is removed, and we are opposite a beach where the surf rolls up magnificently. At the foot of the black lava sand-hills, beyond this beach, we stop to pick up olivine crystals scattered among the lava pebbles. Then we come to fresh green lands, with the finest specimens of coco palms which we have seen. Mr. Clemen's witty comparison of this palm to a "feather-duster struck by lightning" does not apply to these luxuriant jets of foliage. Each frond, with pinnæ of a vivid, glossy green and midrib of polished amber, was a piece of ideal vegetation. I did not wonder that Miss B—, who sojourned with us at Hilo, wished, above all things, to carry one of these palm leaves to America with her. It is the *chef-d'oeuvre of* tropical vegetation. No wonder this district was a favorite dwelling-place of the natives. A respectable settlement still remains. But the large old meeting-house, which stands among the little grass houses as an ostrich might stand with a brood of chickens about her, seems sadly in excess of the probable need of the place. Not many years ago it was filled with worshipping congregations. Dr. Coan tells me that he has preached there to an overflowing house; but there will be no crowd this year, altthough all the population around is convened. (Chaney 1880:135-136)

An account entitled *The Native Sandwich Islanders* written by Captain C. E. Dutton of the United States Ordnance Corps was published in an 1885 volume of *The Missionary Herald*. Dutton lived briefly in Puna while collecting scientific observations of volcanoes. During his time spent there, he noted the diminishing numbers of the native population, suggesting abandonment was caused at least in part by greater economic opportunities elsewhere:

> A little way off [from Puna] is a cluster of grass-houses, built in true native fashion except for the glazed windows, while among them is a white-painted board cottage and a little church, which also serves the purpose of a schoolhouse. It is hard to say whether these structures built in civilized fashion improved the prospect or not. They certainly seemed out of place in a region where everything else had the aspect of tropical barbarism. They served, however, to remind us that we were in a region where all that is horrible and hateful in barbarism has been supplanted by much that is good in civilization, by the reign of civil law, the security of life and property, and the establishment of peace.
>
> There is no portion of these islands where so much of the primitive character of the Hawaiians is retained by the people as in Puna. The district is seldom visited by white people, and I am informed that only two families of whites reside there. The native population is somewhat scanty and has undergone a great decrease within the present century, as in all other parts of the island. This decrease, however, seems to be due more to the emigration of the inhabitants to the large towns, like Honolulu and Hilo, than to the ravages of those diseases which are supposed to be the prime cause of the decay of the Hawaiian race. Many of the natives also go to other parts of the island, where they obtain employment upon the plantations and in other occupations. But those who remain retain considerable of their primitive character, spending the day in lounging, fishing, and visiting, living in grass-houses and subsisting principally upon fish and poi. On the other hand, they are amiable, hospitable, and peaceful to the last degree. They have civilized clothing, but often, as a matter of preference, go about wearing a shirt and malo. Probably in no part of the islands have the teachings of the missionary produced a deeper and more lasting impression. Their village has a church for its most conspicuous structure, and on Sunday all the natives go to church with *furore*.

> So intense is the sabbatarianism that I found considerable difficulty in avoiding arrest and prosecution for riding through one of their villages on Sunday with a pack-train.
>
> I was much pleased at the comparative neatness and order of the grass-houses in which most of the natives still live. The furniture is simple in the extreme. The floor is covered with mats woven of lauhala (pandanus) leaves, and are scrupulously neat. Tables and chairs are seldom used, except as luxuries. Food is eaten *á la turque*, the family sitting cross-legged around the dish of poi. Most households possess crockery, knives, forks, and spoons, but calabashes made from large gourds are still used, and "fingers were invented before forks." I spent an hour watching an old kanaka making a calabash, with as much delight as when, an urchin of seven, I used to watch the cobbler mending a shoe or the wandering tinker grinding knives and scissors. Not a little suggestive were long rows of letters in their envelopes, stuck cornerwise into the slats to which the bunches of grass are tied to form the wall of the house. All natives of suitable age can read and write their own language, for education is compulsory. They correspond most vigorously, and the mail facilities are remarkably good, considering the scanty population and resources of the kingdom. Every week the postboy rides through from Hilo to Kau, via Puna and Kilauea, and back again. The saddlebags are full of letters and weekly newspapers from Honolulu, printed in the Hawaiian tongue. This does not sound very barbaric, and in truth the Hawaiian is in all essentials as well civilized as the poor people of England or America. He owns his property in fee; he makes laws, executes and obeys them; he reads and writes; he has but one wife; he tills the soil and tends flocks; sometimes he accumulates wealth and sometimes he does not; he makes his will in due form, dies, and receives a Christian burial. In no land in the world is property more secure; indeed, I have yet to learn of any other where it is equally secure from burglary, rapine, and thieving, or those subtler devices by which the cunning and artful succeed in getting possession of the property of the less astute without giving an equivalent. All this is seen in Puna, which is no doubt the most primitive district in all the islands. The few relics of barbarism remaining are of the most harmless description and probably as good for the Hawaiian as any civilized customs he might adopt in place of them, and certainly not inconsistent with all the comforts and blessings of good laws cheerfully obeyed and well administered. (385-387)

An American author named Charles Warren Stoddard trekked from Hilo to Kīlauea on horseback in 1885. His account, reminiscent of Sheldon Dibble's uncomplicated and candid narrative published nearly half a century prior, recounts his stay at a halfway house in ʻŌlaʻa, Puna, giving vivid insight into a typical stay there at that time:

> It is a fact, that the thirty mile horse-back ride from Hilo to the crater of Kilauea is not as comfortable as it might be under other circumstances; that the trail is not the best in the world, nor the horses either; and that it rains at intervals on the road; but water-proofs are obtainable, one may lodge at a half-way house, and thus break the journey into two easy stages, and, as for the object of the pilgrimage, does it not well repay one for some little privation and fatigue?
>
> We stop over at the Half-way House for the sake of an experience; it is not on every day that one finds an excuse for looking into the inner life of the gentle Hawaiian, so we order supper, and secretly take notes during the preparation thereof.
>
> In turning over my journals, I find the record of a night spent under a grass roof, and I give it as the faithful picture of an episode I would not willingly forget.
>
> It is the close of day, and of a long day in a hard saddle; I am literally famishing, and my mule is already up to his ears in water cress; but I have ridden, and he has carried me—How just, O Mother Nature, are thy judgments [sic]!
>
> With the superb poses of a trained athlete, my native swings a fowl by the neck, and very shortly it is plucked and potted, together with certain vegetables of proper affinities. Then he swathes a fish in succulent leaves, and buries it in hot ashes; and then he smokes his peace-pipe. Pipe no sooner lighted, than mouths mysteriously gather—five, ten, a dozen of them, magically assemble at the smell of smoke, and take their turn at the curled shell, with a hollow stalk for a mouth-piece.
>
> Dinner at last. O, fish, fruit, and fowl on a mat, on a floor, in a grass hut evening! How excellent are these—Amen.
>
> Night; supper over; some one twanging upon a stringed instrument of rude native origin. Gossip lags, but darkness and silence and a cigarette are agreeable substitutes.

> My native rises haughtily, and lights a lamp that looks very like a diminutive coffee pot with a great flame in the nose of it; he hangs it against a beam, already blackened with smoke, to the peak of the roof. Again, the peace-pipe sweeps the home circle, and is passed out to the mouths of the neighborhood.
>
> The spirit of repose descends upon us; one by one my dusky fellows roll themselves into mummy-like bundles, and lie in a solemn row along the side of the room, sleeping. I, also, will sleep; a great bark-cloth (kapa) that rattles as if it had received seven starchings, is all mine for a covering. I lie with my eyes to the roof, and count the beams that look like an arbor. What is it I see as large as my thumb, cased in brown armor? A cockroach! A melancholy procession of cockroaches passing from one side of the hut, over the roof, with their backs downward, and descending on the other side by the beams—a hundred of them, or perhaps a thousand—"The cry is 'still they come!'" Ha! I put out the coffee pot, for these sights are horrible.
>
> Now I will sleep with my face under the kapa, and in an atmosphere of cocoa-nut oil, relieved at intervals by the sulphurous spurt of a match; I do sleep, and find it in spite of every thing highly refreshing. (1897:41-43)

An unauthored article entitled, "Curiosities of Puna" was published in an 1893 edition of the *Paradise of the Pacific*. Like previous pieces composed by Ness, Nordhoff and Whitney, this account appears to be geared primarily towards potential tourists of the era:

> If Puna possessed the crater of Kilauea the district would contain more natural objects of interest to the tourist than any other section of Hawaii Territory. It is most prolific in wild fruit. The very inhabitants differ in complexion and physique from other Hawaiians, being of lighter color and larger frame.
>
> An antiquity shown to tourists is a stone roadway three feet wide and many miles long, moss-grown with age. One section, four miles in extent, is as straight as the most skillful engineer could construct it, a monument of a lost Hawaiian art. A horseback journey through the by-ways of Puna will furnish the traveler with considerable information regarding the primitive customs and styles of the natives, for here the sons of the soil live closer to nature and are more like what the Lord made them than many of their brothers of the settlements, whose minds and bodies have been poisoned by the lusts of civilization. (11)

Throughout the late 20th century, the increased volcanic activity continued draw in more visitors to the Puna District. In the late 1880s, a new road was proposed from Hilo to Volcano, which reduced travel time for visitiors and offered a more pleasant ride. An 1893 map produced by Baldwin illustrates the new road to Kīlauea, passing east of the current study area against the old route (Figure 13). In Thrum's *Hawaiian Annual* for 1894, he describes the construction of the new road:

> In expectation of tourist travel, and to make these islands more attractive than ever, our "natural wonder" *par excellence*—the volcano of Kilauea… (ibid.:138)
>
> The new road from Hilo is still in progress, on completion of which visitors may drive the entire distance of twenty-nine miles in a carriage, on an easy grade, with as much comfort as can be had on Honolulu's macadamized streets (ibid.:139)

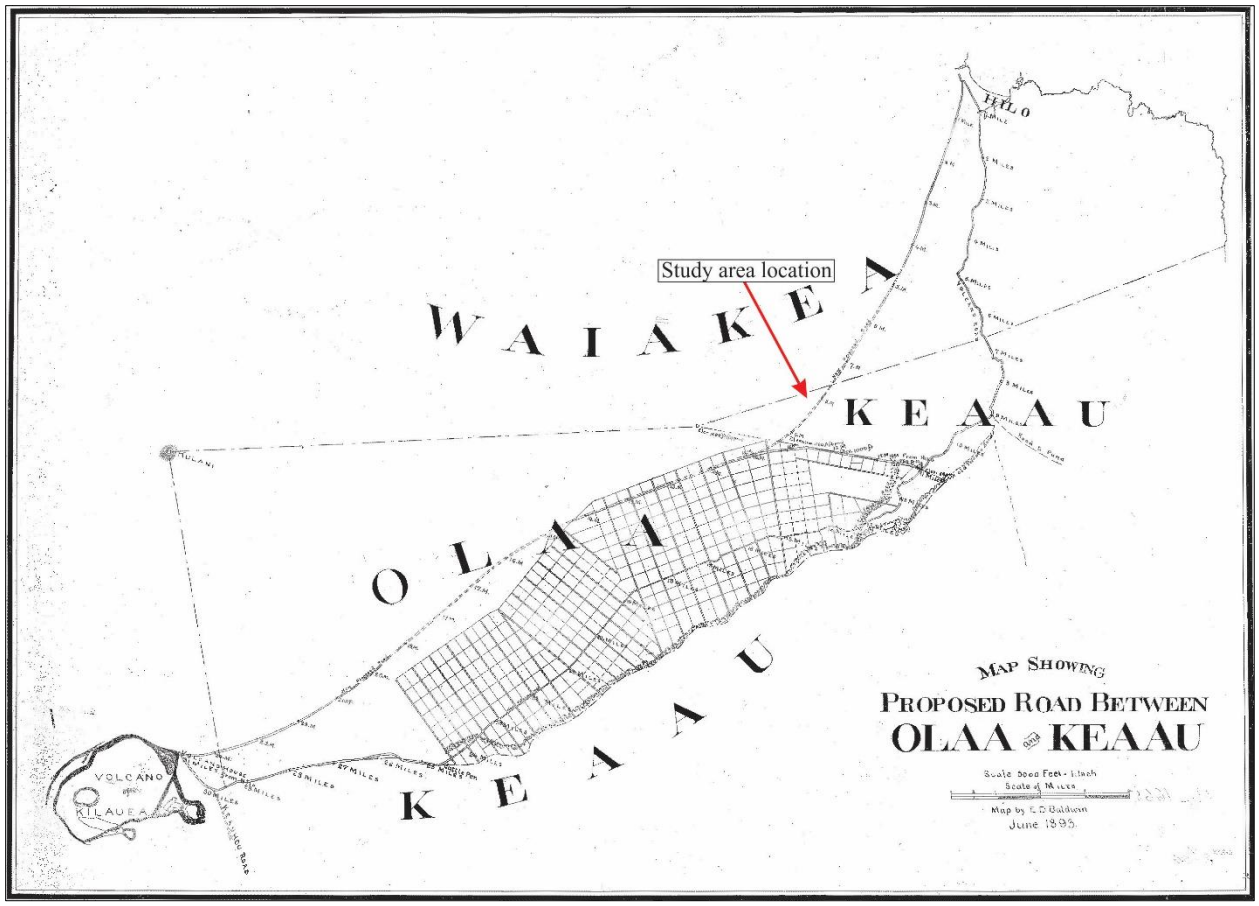


Figure 13. Hawai‘i Registered Map 1665, showing the proposed route to Volcano, by Baldwin 1893.

Whitney published yet another account of a tour through Puna in an 1895 edition of *The Tourists' Guide Through the Hawaiian Islands Descriptive of Their Scenes and Scenery*. In the following excerpt, he describes crossing through dense forests and the 1840 lava flow as he journeys from Hilo towards Maku‘u:

> Puna.—This district presents some features which are well worth the exertion which the traveler will have to make in order to see them. The general appearance from the road is sterile, especially in the southern part, where there are considerable tracts covered with lava rock supporting the scantiest of vegetation. The northern part of the district is covered with a dense *lauhala* forest and is thinly inhabited. The road is thus very monotonous. Some eighteen miles from Hilo the country begins to improve, and away from the main road, upon the slopes of the mountain, there are many acres of excellent land, suitable for coffee and fruit growing. The south-eastern part of Puna has some celebrity for its groves of coconuts, the trees being more abundant here than in any other part of the islands. The traces of volcanic action are extremely prominent in this district. The most striking flow is that of 1840, which after pursuing an underground course for many miles suddenly burst forth in the woods and rushed down to the sea, overwhelming a small village in its course. During the great earthquakes of 1868, the southern coast of Puna was lowered. Traces of this may be seen in the stumps of coconut trees which are left sticking up amid the constant surf.
>
> The tourist who plans to go through Puna, should obtain letters for either Kapoho or Pohoiki, where the first night would be spent, and for Kaimu, which should be the second stopping place. The road from Hilo, skirts along the Bay, passes over the Waiakea river and very shortly plunges into a thick belt of forest which extends as far as Keaau, nine and a quarter miles from Hilo. From thence the road goes in almost a straight line through long tracts of *lauhala* groves, with occasional glades affording glimpses of the sea. A few scattered houses are passed and at Makuu, fifteen miles from Hilo, there is quite a little settlement. Some four miles further on the flow of 1840 is crossed. The lava looks almost as fresh to-day, as when it came down fifty years ago. (Whitney 1895:91-92)

John Roy Musick, an American author, visited the Hawaiian Islands not long after Whitney. On a journey through Puna, Musick details Puna's geologic wonders:

> The Puna district which joins the district of Hilo on the south is one of the most interesting in Hawaii. The general appearance from the road is sterile, especially on the southern part, where there are considerable tracts covered with lava-rock, supporting only the scantiest vegetation. The northern part of the district is covered with dense *lauhala* forest and is thinly inhabited. About eighteen miles from Hilo the country begins to improve, and away from the main road, upon the slope of the mountain, there are many acres of excellent land suitable for coffee-growing. The southeastern part of Puna is celebrated for its groves of coconuts. In 1840 the lava-flow from the volcano, after pursuing an underground course for many miles, suddenly burst forth in the woods and rushed down to the sea, overwhelming small villages in its course. The lava-flows have left many strange figures in the forest. Trees of lava can be seen. They are supposed to have been made by the molten lava rushing down the hill with such velocity that it splashed up the sides of the trees, and congealed before the wood was burned away. These lava-trees or columns are hollow, and some are supposed to be a hundred years old. Hundreds of these monuments of ancient eruption are to be seen, some fifteen or twenty feet in height. These memorials of a perished forest are both curious and instructive. There is a warm sprint about a mile from Kapoho Ranch toward the sea, which is a charming spot. It is situated at the foot of a cliff some eighty feet high, while on the side it is approached by a somewhat abrupt slope, clothed with grass and shaded by trees, conspicuous among which are the tall coconuts with their long, slender trunks and umbrella-shaped tops. The water is warm but not hot, just comfortable for bathing—and gives the skin of the bather an alabaster whiteness.
>
> In 1868 the southern coast of Puna was lowered by the effect of a terrible earthquake. As a result of this earthquake, stumps of coconut-trees may still be found sticking up in the midst of the roaring surf. Puna is one of the great coffee-producing districts of Hawaii. The coffee grown there is not excelled anywhere in the world. Some of the plantations contain from twenty-five to sixty thousand trees. (Musick 1898:170-171)

In 1898, Burton Holmes, famed travel writer of the late nineteenth century, journeyed to Hawai'i. While writing of Puna, Holmes carefully describes his journey through the densely forested jungle and his interaction with two coffee planters as they introduce him to the 100-acre plantation upon which they work. Holmes' account offers the most specifics on commercial coffee production in Puna:

> A few years ago the Puna district was an impassable tangle of fierce, savage, lovely vegetation, a wilderness of green, hundreds of square miles in extent. It was in 1898 the newest region in Hawaii, the latest land of promise to allure both the man who seeks to invest safely a fortune already made, and the man who seeks to make a new one. My companion is of the former class, and with the true American spirit is using his wealth to turn the lovely wilderness into a paying piece of property. I need not tell you of the beauty of this ride. Even the celebrated road to the volcano must yield the palm,—and in fact, the banana and everything else—to this new-cut road that penetrates almost to the heart of the promised land of Puna. The tall trees are the Ohia, and around their trunks are twined the serpent-like tendrils of the Ieie, a very strong creeping thing that seems with its knife-like leaves to be an armed protector of the tree that it entwines from root to very tip. Both the ohia and the ieie bear at certain seasons of the year a little blossom of intense red, as if the blades of the ieie-vine had actually drawn blood.
>
> A few miles farther on we meet our hosts, two coffee-planters of the younger generation; both are Americans, one born, however, in Hawai'i and resident in the islands all his life; the other, he of the broad-brimmed hat, a self-exiled San Franciscan. Both of them wear the indispensable crude water-proof or pummel-slicker—for Puna is a place of drenching rains. We follow them along the corridor of verdure till the corridor comes to a sudden end. The road ends as abruptly as a shaft in a silver mine, bringing up against the solid wall of the apparently impenetrable jungle. And now, forsaking cart and buggy, we load our baggage on the horses, and mounting mules that have been sent from the plantation we boldly plunge into the tropic tangle. We feel as if all hope should be abandoned here; surely no human habitation can be hid in this labyrinth of rain-soaked vegetation. They must be leading us into the haunts of savage beasts or the abode of serpents,—only there are no wild beasts and no deadly reptiles in Hawaii. For a mile or more we struggle through the leafy tunnel—so green and damp as to appear unearthly, as if it were a forest at the bottom of the sea. The animals are up to their knees in rich black mud; a dozen times to every rod there is a log to clear or a swinging

> rope of the ieie-vine to avoid, but finally we come out once more into the world of men—of good, kind, cheerful, and hearty men, for the little group of fellows, who have been living here for three long years, waiting for their coffee-trees to grow, watching each budding berry as it slowly turns from green to ripened red,—are like a lot of college men on a prolonged and possibly perpetual picnic in the woods. Their home is of semi-native construction, its walls of leaves, its roof of corrugated iron. There are two rooms. In one they sleep and in the other they dine with appetites born of an outdoor life. A Japanese cook prepares for them far better meals than can be had at the hotel in Honolulu. The temperature is almost invariably of such degree that it is not noticed, and the drafts that filter through the leafy walls are not the kind that cause pneumonia. Twenty-four showers every day beat their tattoos upon the roof, and after every shower the sun comes out and smiles as if to say, "That little rainfall was nothing but a joke."
>
> The coffee-fields, of course, claim our attention. There are here about a hundred acres under cultivation in clearings of from five to ten acres each. Some of their coffee is already in its fourth year and promises a crop with a little profit for the present season. The planters estimate that a tract of seventy-five acres will in five years have paid expenses for clearing, planting, cultivating, picking, sorting, drying, and shipping, and thereafter it should yield a profit of from eight to ten thousand dollars annually.
>
> The labor is performed largely by the better class of Japanese (the offspring of whom is just as quaint and fascinating as in Japan itself), but there is no reason why white men could not find it profitable and pleasant. The most trying thing for the owners of a coffee-ranch is the four or five years' waiting while tender little trees are growing up, preparing to reward the men who cared for them in childhood. Men who love solitude and nature and are possessed of patience and a little capital may find in coffee culture an ideal existence in an ideal land. But as I ride with one of my hosts through the dense tangled forest that shuts in this little community of half a dozen white men and half a hundred Japanese, I am led to suspect that this peaceful novel life, so grateful to us who come as visitors for a brief season, is most monotonous to those who have to spend here twelve months of the year, with no diversion save an occasional ride to Hilo or a semi-annual trip to Honolulu. (1908:104-111)

Around the turn of the century, Walter Del Mar took a tour of the world, visiting Japan, Indonesia, Hong Kong, Canton, Shanghai, Macao, Singapore, Ceylon (present day Sri Lanka), California, and Nevada. Del Mar's travels also brought him to Hawai'i, where he made the journey to the volcano. He describes his experience thusly, mentioning the possible replacement of coffee with the "bamboo" variety of sugarcane:

> The road is an excellent one, built at a cost of £20,000, and in the thirty-one miles from Hilo to the Volcano House rises about 4500 feet. This being on the windward side of the island, there is ample rainfall, and the road runs through a natural fernery all the way. Great plantations of sugar-cane stretch on either side, for some miles, and the land slopes so gradually that while the road continually gains elevation the country looks flat. About five miles from Hilo the landscape begins to be wooded, and bananas, cacao, bread-fruit, wild guavas, the papaia (or papaya) palm, and many varieties of tree ferns including the pulu, which yields a short, elastic, yellow fibre, used for stuffing mattresses, packing fruit, and so on, may be seen growing by the roadside. In the neighbourhood of Olaa, which is at an elevation of about 2000 feet above the sea, are large plantations of coffee of the Guatamala variety; but now that it has been demonstrated that the "bamboo" species of sugar-cane can be grown up to an elevation of 2500 feet, the coffee-trees are to be pulled up and cane planted in their place.
>
> The Halfway House, where we halted for three-quarters of an hour to get luncheon and change horses, was reached at 12.30, and we got a bad meal, abominably served, and a fresh team, more wretched than the one we were leaving in exchange. It took four hours to do the remaining sixteen miles; but we should have been pleased if it had taken longer and if we had had more time to enjoy the varying display of luxuriant vegetation. The trees increased in size as we ascended, and some of the tree ferns near the end of the journey were fully fifty feet in height. (Del Mar 1904:382)

A detailed description of Puna was published in the *Geography of the Hawaiian Islands* in 1908 by Charles Wickliffe Baldwin. Through this description it is evident that commercial agriculture had gripped Puna. 'Ōla'a Sugar Co. is a dominant player in the industry, overtaking coffee cultivation, but other crops are thriving as well:

> Puna.—There is a tradition which says that at one time Puna was one of the most fertile districts of Hawaii, but while the chief of the district was in Hilo, Pele paid him a visit, pouring over his possessions a terrible flood of lava. However, the rainfall is so great in parts of the district that this lava has been rapidly decomposed, and the heaviest of forests are to be found, as in Olaa and the region about Pahoa.
>
> A large part of the soil of upper Olaa is ash which probably came from Kilauea; the great fertility of this soil is due to the decayed vegetable matter which has been added to it.
>
> There are no streams or springs in Puna, the only dependence for water being tanks.
>
> The Olaa section of Puna is a fine agricultural region, but, owing to the want of a market, small-truck farming does not pay. However, vanilla, tobacco, pineapples, and bananas grow well; and the rubber industry is destined to be an important one, as the climate is particularly well adapted to the growth of rubber trees. The cultivation of coffee in Olaa has been abandoned, as the trees did not thrive there.
>
> All the lower lands of Olaa are planted with the cane of the Olaa Sugar Company. This is one of the largest plantations on Hawaii, and occupies nearly all of the available cane land of the Puna district, including the Kapoho and Pahoa tracts.
>
> The Hilo Railroad winds through the Olaa cane fields, extending as far as the twenty-two mile post on the Volcano Road. This is a splendidly built, broad-gauge road. Branch roads have also been built to Kapoho and Pahoa.
>
> The chief places in Puna are Keaau (Nine Miles), Mountain View, Pahoa, Kapoho, and Kalapana. The Puna landings have all been abandoned. South Puna is but thinly settled and too rocky ever to be of much use.
>
> A long section of the Puna coast, thirty or forty miles, shows evidences of having sunk: cocoanut trees are found below the tide level, or their dead stumps stand out in the sea.
>
> At Kapoho there is a warm spring; this is a pool about sixty feet in length and thirty feet wide, with a depth of twenty-five feet, filling a cleft in the lava rock. The water is remarkably transparent and buoyant, and is of blood heat.
>
> Other interesting features of Puna are: the lava tree casts found in the forest above Kapoho; Green Lake, a pretty pond of water in a volcanic cone at Kapoho; the bowlders [sic – boulders] strewn along the coast near Pohoiki by the great 1868 tidal wave; the heiau of Wahaula in farthest Puna. (A facsimile in miniature of this heiau as it would appear if restored is to be seen in the Bishop Museum.) (1908:77-79)

An American author named Henry Walsworth Kinney visited Hawai‘i in the early part of the twentieth century and published a comprehensive historic account of his journey through Puna in his book entitled *The Island of Hawaii*. Kinney’s description of Puna in the early 1900s is undeniably the most intensive and perspicuous historic account presented in this section, providing a virtual expedition through the district describing various locations such as Hawaiian villages, Hawaiian sites, natural geologic landmarks, and places of industry:

> The district of Puna may, for the sake of clearness, be divided into two sections, the Olaa region, the north half, and Puna proper. The former consists of the great Olaa sugar plantation, and forest which has been partially cleared, while some tracts are used for cattle. The middle part of the district, with Pahoa as the center, is used for extensive lumber operations. The remainder, Puna proper, is covered by forest and old lava flows, most of them covered with vegetation. In spite of its exceptional beauty and the fine opportunity it offers for seeing the typical Hawaii, which is so rapidly disappearing in the march of progress, it is comparatively little known. Still it is possible to see the greater part of Puna in one day’s and practically all of Puna in two days’ autoing, while the Hilo R. R. Co. trains pass through the main portions. The roads are almost all excellent.
>
> The main road into Puna is a continuation of the Volcano road which runs from Hilo town, the Puna boundary being about six miles out from Hilo. Hence an excellent road passes through forest and, further south, through cane, to Nine Miles, Olaa, the largest plantation camp on the Island. Near the boundary line may be seen clearings where awa is planted. Just north of the camp a road leads makai to the Shipman ranch headquarters at the beach. It is about four miles long, good and very pretty, passing through cane and then puhala forest. Right by the ocean is a large pond with very cold water. Small craft may effect a landing here in good weather.

> From the Nine Miles village another road leads makai to the great Olaa mill and the railway depot. The main road strikes west towards the Volcano and Kau (this being the belt road proper. See Volcano) while the road into Puna proper turns south. It passes through cane and past the homes of the principal plantation officers, and continues over an ancient lava flow, covered with stunted vegetation and used for cattle.
>
> It leads to Pahoa, a village which has sprung into prominence since it became the main camp of a lumber company which has a large mill here, where ohia (a hardwood used for railroad ties, flooring, shingles, tools and many similar purposes) and koa (Hawaiian mahogany, a wood used for furniture and fine wood work) is milled in large quantities.
>
> At Pahoa the main road forks. One branch leads south, through an exceptionally beautiful and well preserved section of forest with great trees and a riotous tangle of vines and undergrowth. It passes the plantation of the Pacific Development Co., which extends down to the sea, and which has planted rubber and cane. Here is the last telephone. Next to it come the awa plantations of Captain Eldarts, a veteran settler, and several Hawaiians. A couple of miles further south a road leads to the right, extending about four miles in a westerly direction to some old homesteads. It was originally the intention to extend this road to the beach, but the plan was abandoned when the coffee boom ended. Emerging from the forest the main road passes through a comparatively recent lava flow of small width, where may be seen some structures, resembling small huts, which are, however, burying places. Such may be seen through all the arid regions. It being practically impossible to dig through the rock, the dead are placed in piles of rock, and roofs are erected over these. As the road slopes towards the beach, a very fine view is afforded. At the beach the road enters first the village of KAIMU, exclusively Hawaiian, with a large grove of cocoanut trees surrounding a fine semi-circular sand beach. Care should be excercised in bathing on account of the undertow. Less than a mile further on, westwards, lies the village of KALAPANA, one of the largest Hawaiian villages in the Islands. There are no white inhabitants, and only a couple of Chinese stores. Here is the headquarters for a couple of stages, which make irregular trips to Pahoa (Rate: 75 cents a passenger one way).
>
> KALAPANA still supports quite a large population, and is a very pretty village, having, like all the Puna coast villages, a fine growth of cocoanuts, puhala and monkeypod trees. The landing is so rough that it is used now only for canoes. Near the bluff, which rises from the sea at the landing are the niu moe (sleeping cocoanuts). These were bent, when young, by visiting chiefs, the tree bearing afterwards the name of the chief who had bent it. On this bluff, named Puu o Hakuma, is a very interesting and easily accessible cave, which was used in ancient days as a place of refuge in war times. Makai of the last house in the village, at the foot of the bluff, is a cement mausoleum, and about a hundred feet west thereof is a path to the top of the bluff. A couple of hundred yards east of the top of this trail at about the middle of the flat top of the ridge, are some stone fences, among which can be located the cave entrance, a hole with stone slab sides, through which one must crawl, down a narrow winding passage, to the main chamber. The passage was purposely made narrow, so as to make it impossible for more than one man to enter at a time, and winding to prevent the throwing of spears into the chamber. The main chamber is quite large, and partly built up with slabs. From the side opposite the entrance another passage leads several hundred feet to a wide kind of balcony in the cliff, directly above the breakers. This passage is quite large and easily traversed. It is impossible to make the trip without candles or other artificial light. At Kalapana is also the remnant of the Niukukahi heiau, in a dense undergrowth. It was a very noted temple for the god Kuahailo.
>
> At Kalapana the road proper ends, but a trail leads along the coast, through some distance from it, for about eight miles, when it strikes mauka to the Volcano. It passes through a beautiful piece of country to the KAHAUALEA village, where are located a ranch and a Hawaiian village. Here is the PUNALUU pond, a mineral water deposit in a lava crack, a famous bathing place, very picturesquely located. A bit further on, about three miles from Kalapana, is the famous WAHAULA heiau, the last place where idolatry was extensively practiced. (Kinney 1913:75-79)

This passage, written by John Ness seven years later, was published in the January 1920 edition of *The Mid-Pacific Magazine* and offers a glimpse into early twentieth century life in Puna. At this time, we see that while ʻŌlaʻa Sugar Co. is still highly visible, small-time farmers are cashing in too, taking advantage of Puna's fecund terrain:

> The district is by no means an entirely uncultivated forest and lava-clad area. Some of the most productive of the canefields of Olaa plantation and the holdings of many independent planters are found in Puna. Travelers interested in the agricultural and industrial development of the region will find here that the cultivation of cane is not all to which Hawaii's soil and climate are adapted. An interesting rubber plantation is located in this district, while more awa, the native root, is grown and dried in Puna than in any other district in the Islands.
>
> The homesteads of small farmers are scattered along the roads of the district, and vegetables and fruits, especially watermelons, are a feature of the output of Puna's fertile soil.
>
> At Pahoa is the mill of a lumber company, where the ohia and koa, two Hawaiian hardwoods taken from the virgin forests, are manufactured into various forms of lumber. . .(1920: 368)
>
> . . .The tropical forests will be the first to claim the attention of the visitor to Puna. Lining the roadway for many miles is the dense tropical growth. Great ferns and masses of undergrowth cluster in wild profusion about the base of magnificent groves of koa and ohia trees. Reaching far above the verdant and multi-colored undergrowth are the scraggly trunks of the ohia and koa with here and there palms and puhala. Thick vines have spread their long fingers in twisted and haphazard fashion over the tree trunks and a kaleidoscope profusion of color is spread through all by the many varieties of tropical flowers.
>
> As the road nears the seashore, here and there are clearings, the settlements and homesteads of natives. At the terminus of the road at the beach is Kaimu and just beyond is Kalapana, two villages whose population numbers no white men and is almost exclusively native.
>
> In this part of the district may be found the best examples of primitive Hawaiian life. Many grass huts, the primitive houses of the native, of which the visitor to the Island hears so much and sees so few, may be seen along the wayside. (1920: 369)

It is evident from these accounts, especially ones composed closer to the turn of the century and shortly thereafter, that economic interests in Puna swiftly transformed from the traditional Hawaiian land tenure system of subsistence farming and regional trading networks to the more European based cash crops including coffee, sugar, rubber, timber, vanilla, pineapples, tobacco, and emphasized cattle ranching and even bottled mineral water production. As the population declined well into the twentieth century, the native agricultural system was largely abandoned in favor of these new economic ventures (Yent and Ota 1982). As mentioned by Dutton in the last quarter of the nineteenth century, large numbers of natives left Puna to seek employment elsewhere. By 1920, it seems by and large that the traditional lifeways of Puna natives were rapidly deteriorating, overwhelmed by increasing urbanization. This sentiment is perhaps best articulated by Nordhoff in *Harper's Magazine*, who expressed:

> In fact, old things are dying out in many ways in the islands, and new things do not always take their place. Even the taro patches have in some places been turned into rice patches; and they are very well fitted for this. Taro is still an article of commerce; but the decreasing number of the native people lessens the demand for poi, and no doubt it will be found profitable to raise more rice and less taro. (1873:552)

Late Nineteenth and Early Twentieth Century Industrialization in Puna

By the beginning of the twentieth century, Puna was on the verge of major economic growth, spurred by the booming sugar and lumber industries. Increasing urbanization of Puna, and particularly Kea'au, were initially propelled by the sale of the *ahupua'a* to William Herbert (W.H.) Shipman, J. Eldarts, and Samuel Damon by the King Lunalilo Estate in 1882. Campbell and Ogburn (1992) suggest that with land leased from Shipman, a small group of investors (B.F. Dillingham, Lorrin A. Thurston, Alfred W. Carter, Samuel M. Damon) created and developed what they believed would become one of Hawai'i's largest sugar plantations, the 'Ōla'a Sugar Company.

The 'Ōla'a Sugar Company (1899-1984)

The 'Ōla'a Sugar Company was incorporated on May 3, 1899. With a $5,000,000 investment, the promoters purchased 16,000 acres in fee simple land and nearly 7,000 acres in long leasehold from W.H. Shipman. The plantation fields extended for ten miles along both sides of Volcano Road as well as in the Pāhoa and Kapoho areas of the Puna District. They also purchased 90% of the stock in the adjacent Puna Plantation, adding another 11,000 acres to their holdings. 'Ōla'a Sugar Company began as one of Hawai'i's largest sugar plantations with much of its acreage covered in trees. Prior to the commercial cultivation of sugarcane, coffee was the primary agricultural crop that was grown in the region, however, with the purchase of these lands, the coffee was uprooted and cleared for the planting of sugarcane.

On July 1, 1899, active operations began under the management of Frank B. McStocker. In his first report, he stated, "As soon as the planting of the main crop begins, which will be about the month of March [1900], arrangements will be made by which a large portion of the crop will be cared for by laborers on shares." From this early start of "share planting," the company branched out into the leasing of land to individuals to raise cane and to making contracts to purchase cane from persons who owned or leased land from the sugar company. In most cases, the company carried the financial burden for the planter until the individual was paid for their cane and then recovered the advances made. Other independent cane farmers lived in their own homes, used their own work animals and tools, and supplied their own fertilizers.

The directors of the company realized early on that the lack of mass transportation would hinder the success of their business. As a result, they organized the Hilo Railroad Company and on April 8, 1899, were granted a 50-year charter (Best 1978). The railroad's infrastructure developed quickly, with service to ʻŌlaʻa (Keaʻau) from Hilo commencing on June 18, 1900. Another sugar company, the Puna Sugar Company, located near the village of Kapoho, had been organized within the Puna District on March 2 of that same year. Puna Sugar had cane fields scattered throughout lower Puna from Kapoho to Pāhoa Town. As with ʻŌlaʻa Sugar's early Keaʻau operations, the lack of a reliable transportation system made it expensive to collect and transport the cane from the scattered fields to the mill. So, when Hilo Railroad proposed to lay 4 miles of track from Kapoho to Pāhoa, the Puna Sugar Company paid for half the cost. By March 1, 1902, the Hilo Railroad was making regular stops at the ʻŌlaʻa Sugar Mill (Figure 14), the town of Pāhoa, and extended through lower Puna and *mauka* to Mountain View. The route of the railroad across Keaʻau can be seen on a 1922 map prepared by A.S. Chaney (Figure **Error! Reference source not found.**).

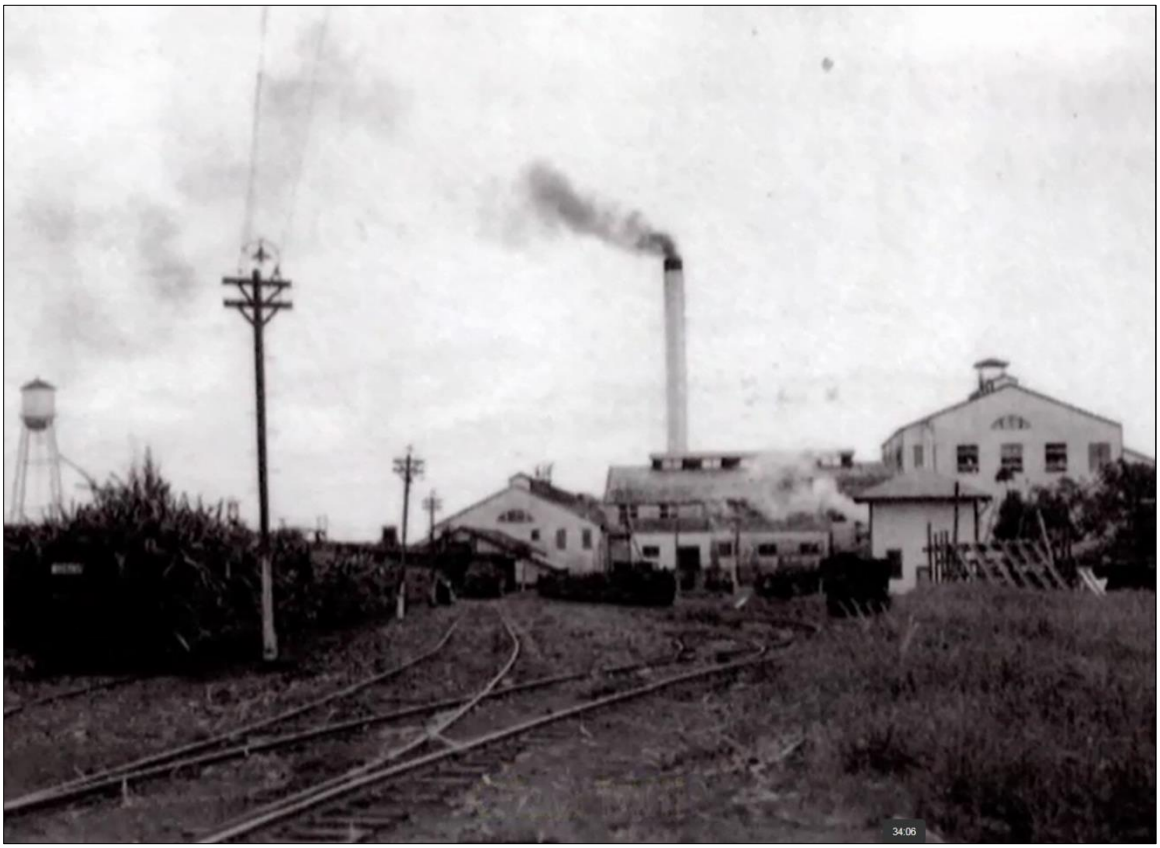


Figure 14. Hawaiʻi Consolidated Railway alignments at ʻŌlaʻa Sugar Mill.

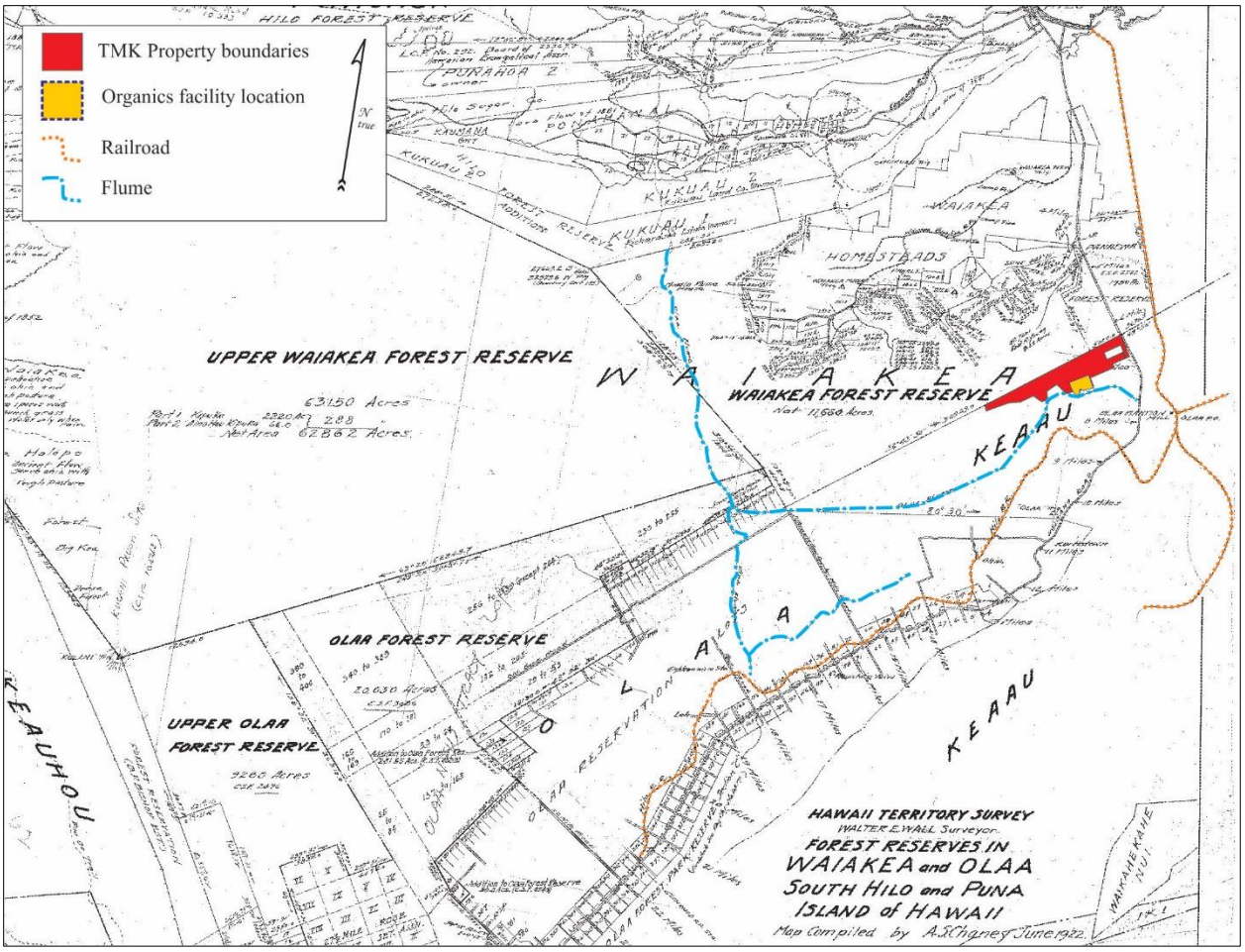


Figure 15. Plat Map 0788 prepared by A.S. Chaney, showing flume lines and railroad associated with the ʻŌlaʻa Sugar Company in 1922.

By the time 1905 rolled around, Puna Sugar Co. harvests were being ground at the ʻŌlaʻa Mill, and the company was operating as a division of the ʻŌlaʻa Sugar Co. (Dorrance and Morgan 2000). Two lears later, the Hawaiian Mahogany Lumber Company incorporated and signed a five-year contract with the Atchison, Topeka, and Santa Fe Railroads for the delivery of 90,000,000 board feet of *ʻōhiʻa* railroad ties from the vast forest reserves of Puna (Clark et al. 2001). Subsequently, in 1908 the company erected a lumber mill at Pāhoa. A network of narrow gauge railroad tracks, 3 feet wide, extended from the lumber mill to the forests above Pāhoa. On March 24, 1909, the Hawaiian Mahogany Company became the Pāhoa Lumber Mill, and James B. Castle, the former managing director of the mill, became the new owner. The company then negotiated a contract with the Santa Fe Railway Company for the delivery 2,500,000 cross ties and 2,500 sets of switch ties. In addition to railway ties, the Pāhoa Lumber Mill began producing products such as roofing shingles, flooring, paving blocks and lumber for cars, wagons, and carriages.

On the night of January 28, 1913, a raging fire broke out in the mill and it was burnt to the ground along with most of the stock of milled lumber. Fortunately for Pāhoa residents, the wind blew the flames and smoke to the north away from the village. In spite of this disaster, J. B. Castle rebuilt the mill, and by October the mill was operating again under the name of the Hawaiʻi Hardwood Company, part of the Hawaiian Development Company. The Santa Fe Railroad found, ultimately, that *ʻōhiʻa* wood did not last as long as expected in the dry climate of the American Southwest. They did not renew their contract, and, in 1916, the Hawaiian Hardwood Company, Inc. closed their doors permanently (Burtchard and Moblo 1994).

When the lumber business moved out of Pāhoa in ca. 1916, the mill was leased to ʻŌlaʻa Sugar. Standard gauge railroad track replaced the old timber railroad grade tracks, and the timber producing forests were converted to sugarcane fields. The company used four mogul type Baldwin locomotives to haul cane from the Puna fields through Pāhoa to their processing plant in Keaʻau. Passenger rail service in the Puna District also started to increase around this time. In 1916 the Hilo Railroad was reorganized as the Hawaiʻi Consolidated Railway. The railroad used Baldwin

locomotives and Hall-Scott motorcars with passenger trailers to haul freight and passengers. Then, in 1925 the Hawai‘i Consolidated Railway ordered and received three railbusses from the White Motor Company, which they used in Puna and Hilo districts, making daily stops in the town of Pāhoa. The railbusses became an especially popular form of transportation during World War II when mandatory gas rationing was in effect for all residents (Best 1978).

The ‘Ōla‘a Sugar Company had many problems throughout its operation, ranging from difficult growing conditions to financial issues. The area was in the wet belt of Hawai‘i amid forests of fern trees and ‘*ōhi‘a* with an average monthly rainfall of 18-30 inches. The wet conditions of ‘Ōla‘a made it difficult to grow sugarcane, and the company continuously experimented with finding varieties suitable for the climate. Transporting cane to their mill in what is now the town of Kea‘au was also difficult. The company initially used flumes and portable rail to bring cane from the fields to the Hilo Railroad (Figure 16). For the struggling company, however, the manpower and maintenance costs of these systems proved to be financially draining. Beginning around 1938, the plantation management experimented with other transportation options in the fields, including the use of Athey Wagons pulled by tractors (‘Ōla‘a Sugar 1939). This year also marked the beginning of a program to build gravel field roads and acquire trucks. Roads were built to service plantation-owned lands as well as fields owned by their contract planters (who were to pay the company back over time). The road-building program was curtailed during 1941 due to a shortage of labor, and then terminated upon the onset of World War II when the United States Engineers commandeered the company’s equipment (‘Ōla‘a Sugar 1942). By that time, however, sufficient roads had been built to allow almost thirty-nine percent of that year’s crop—all the cane produced in Kapoho, Malama, and Kama‘ili and large parts of the cane produced in the plantation’s Pāhoa, ‘Ōla‘a, and Mountain View Sections—to be hauled by truck. The manpower and equipment shortages caused by the war paradoxically interrupted the plantation’s conversion to truck hauling while simultaneously stimulating management’s desire to rid itself of portable tracks and flumes. In 1943, the company reported that it was able to resume its road building efforts, and that it planned to add 37.94 miles of road to its existing 512.58 miles across the entire plantation (‘Ōla‘a Sugar 1944). By the end of 1945, the plantation’s conversion to truck hauling was completed when its final cane roads were built in the Mountain View section.

By 1946, rail travel was becoming less popular and less profitable, due to improved roads and increased trucking. In March of that year, stockholders of Hawai‘i Consolidated Railway voted to abandon all railroad operations. This decision was further reinforced on April 1, 1946 when a devastating *tsunami* destroyed Hilo Bay, including all the rail lines, a drawbridge in the bay, and part of the Waiākea freight yards. On November 20, 1946, the company shut down its remaining lines, including all Puna railroad operations, and began auctioning off all its assets. The ‘Ōla‘a railroad line remained in operating condition and continued to be used for hauling sugar until December of 1948. In that year, the sugar industry began phasing out its operations in Puna and closed the tracks permanently.

During the second half of the twentieth century, ‘Ōla‘a Sugar continued to accumulate debt despite attempts to cut operating costs that included the introduction of mechanized harvesting in 1947. The boom in real estate following statehood prompted the company to sell some of its fee simple lands and offered employees the opportunity to purchase their own houses. On March 28, 1960, the company’s shareholders decided that the name “‘Ōla‘a Sugar Company” was jinxed, and rechristened the company the Puna Sugar Company. Despite making what appeared to be a slight financial upturn after the name change, by the 1980s the company again fell onto hard times. Tax breaks and government subsidies disappeared, and competition from cheap artificial sweeteners such as high fructose corn syrup made continued operations unsustainable, and on January 7, 1982, it was announced that Puna Sugar Company would close its doors (Dorrance and Morgan 2000). The company disposed of equipment, sold its lease lands and laid off employee with severance packages that included five acres of land for each employee. By December 1, 1984, the plant was officially closed, and in 1988 the entire sugar mill was sold to Fiji Sugar Corporation, Ltd. and Hawaiian Electric Light Company took over the power plant.

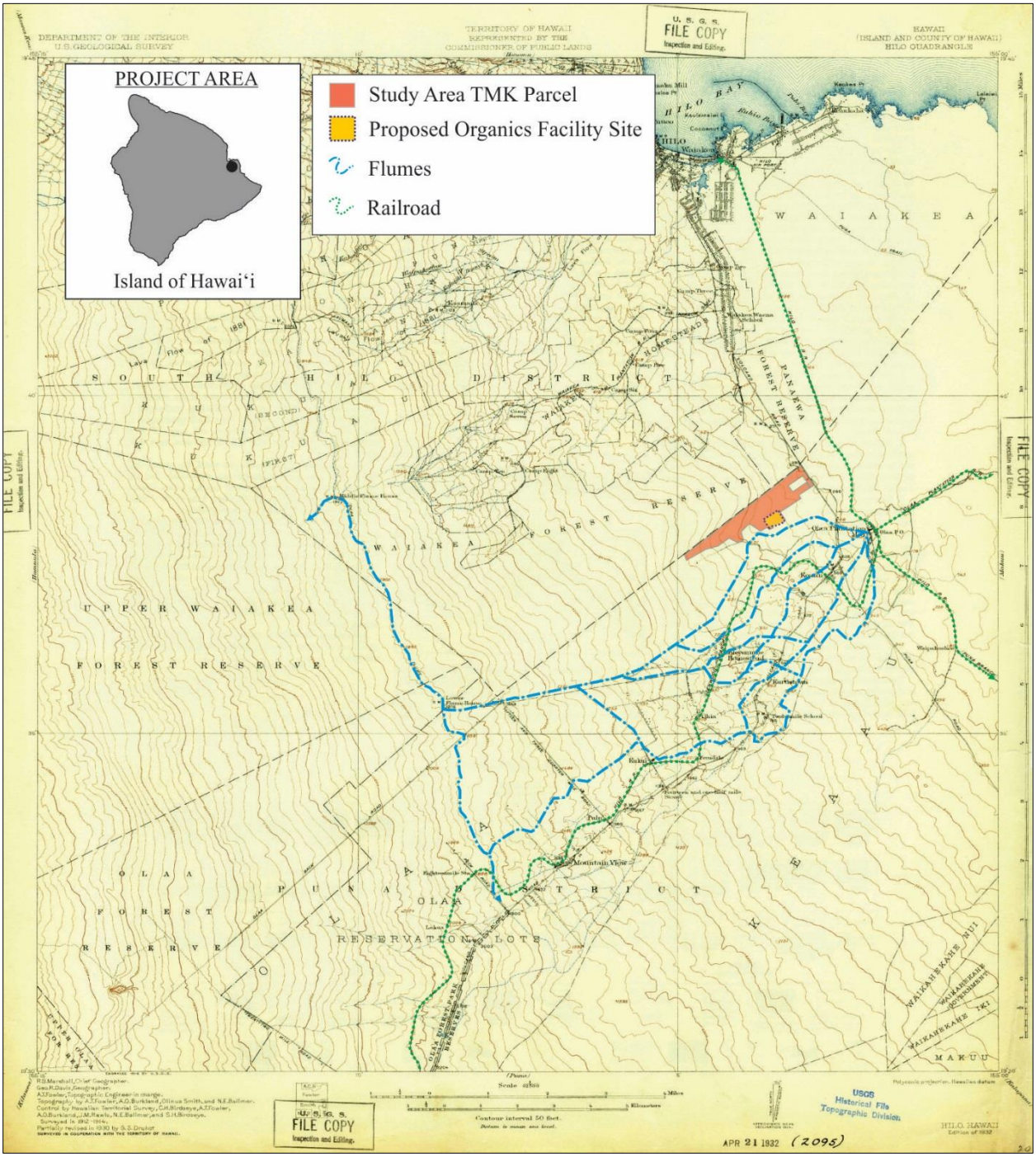


Figure 16. USGS, Hilo HI, Quadrangle, 1932 showing flumes and plantation related infrastructure near study area.

Study Area During the Twentieth Century

Although cane fields dominated the Kea‘au landscape well throughout this period of industrial growth and decline in Puna, the proposed project location remained largely untouched by the commercial sugar industry. In 1930, W.H. Shipman, Ltd. submitted Land Court Application 1053 to fix the boundaries of Kea‘au more precisely than had been done by the Boundary Commission. The second iteration of this map created by surveyor J.N. Smith in 1936 depicts locations and routes of various infrastructure pertaining to sugar cultivation including a complex network of interlacing flumes, ditches, cane roads, and Hawai‘i Consolidated Railway routes in addition to sections and limits of areas planted in cane (Figure 17). Examination of the 1936 map shows that the study area parcel remained untouched by the commercial sugar industry.

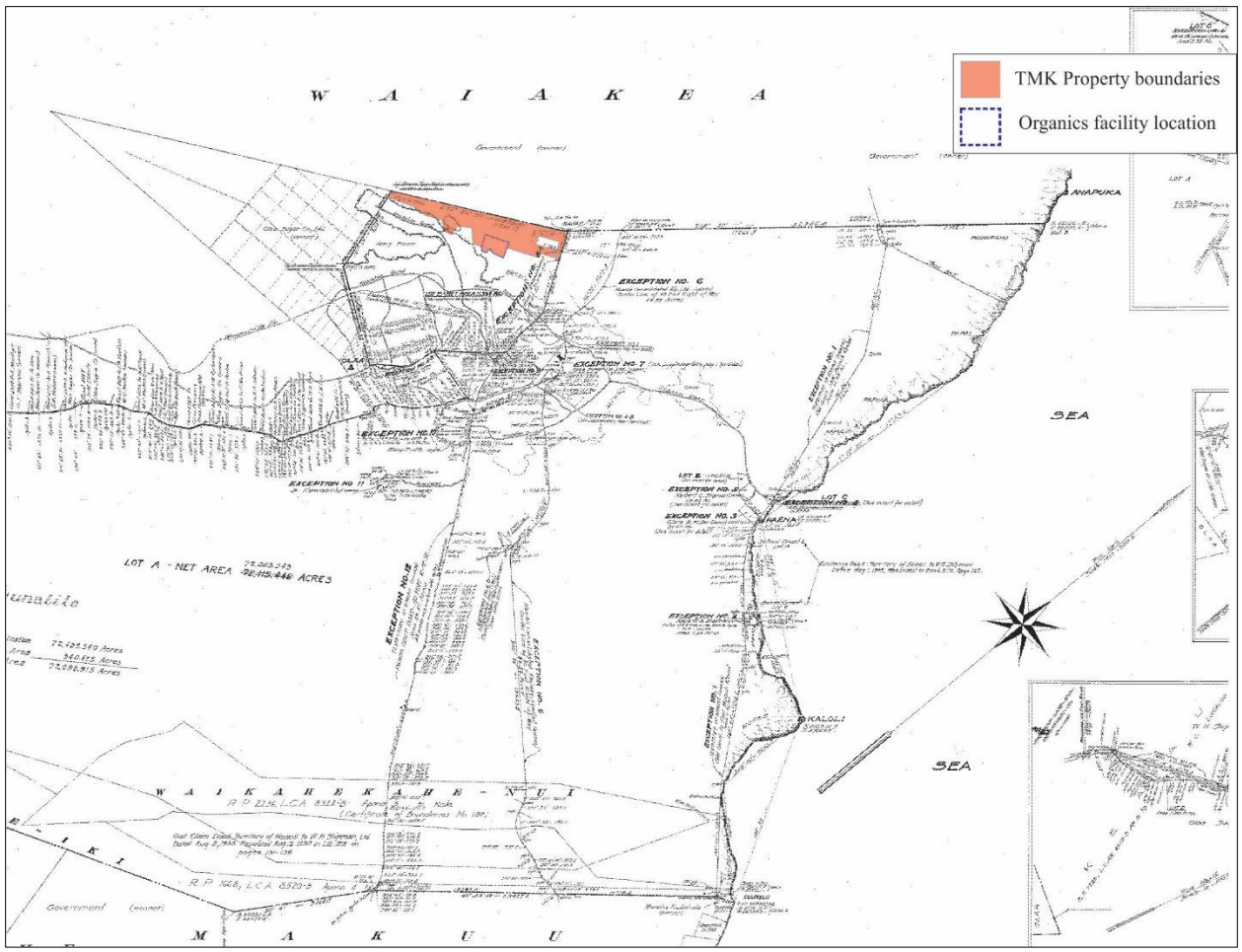


Figure 17. Portion of Land Court Application 1053 Map 1 from 1936 showing study area parcel.

In 1937, a University of Hawai‘i at Mānoa sociology student named Charles Taniguchi prepared an ecological study of Kea‘au Village (also referred to as ‘Ōla‘a Village). As part of his project, Taniguchi produced seven unscaled maps of the village and its immediate surroundings and indicated the locations of segregated camps, railroad alignments, places of business and entertainment, and the plantation manager’s home on the parcel immediately southeast of the current study area (Figures 18-24. Legend for Figure. Although not to scale, an examination of relationships between landmarks in the immediate vicinity of the current study area (e.g. Kea‘au-Pāhoa road, sugarcane roads, railroad alignment, and plantation manager’s house) depicted on Taniguchi’s maps correlate directly with those present in other maps from the same period and allow for an approximation of the present study parcel boundaries. With respect to the current study area, Taniguchi illustrates that a “dense forest” existed at least within the southeast portion of the study area parcel as indicated by Figure 21. Another map prepared by Taniguchi provides a specific breakdown of ethnic distributions within Kea‘au Village (see Figure 23 and 24. Legend for Figure).

United States Geological Survey (USGS) aerial images from 1954 (Figure 25) and 1965 (Figure 26) indicate that the study area parcel was still forested and the sugar fields did not extend into the current study area parcel. However,

five years later between 1959 and 1968, sections of native forest within the Waiākea Forest Reserve located to the north of the study area was bulldozed to make way for a timber planting initiative. This initiative was intended to provide consistent wood and forest resources that would be used to stimulate Hawai‘i’s forest product industry. A year later, various species of hardwood including *Eucalyptus saligna* and *E. grandis*, Queensland maple (*Flindersia brayleyana*), and Australian toon (*Toona ciliata*) (Figure **Error! Reference source not found.**) replaced the native forest that once thrived in this area (Department of Land and Natural Resources 2016). Shortly after the timber planting initiative, a quarry was established to the southeast of the current study area in the current location of the W.H. Shipman Business Park, which appears on a 1977 USGS map (Figure 28). A field map produced by the Puna Sugar Company around this same time reveals that the western portion of the study area parcel was under cultivation (Figure 29). Throughout the 1970s-80s as the Puna Sugar Company ceased their operations, the leased lands were returned to W.H. Shipman Limited, at which time, Roy Shipman Blackshear (William Shipman’s grandson) took over management of the family enterprise. Roy oversaw the transition of the former sugar lands to more diversified agriculture and business operations (Shipman 2012). In 1988, roughly 485 acres were set aside to make way for the W.H. Shipman Business Park, which was established to meet the growing demand for fee simple industrial lands in East Hawai‘i (ibid.). As the third largest industrial park in the State of Hawai‘i, it is now home to many locally owned businesses and international corporations.

Today, the western portion of the subject parcel is still under cultivation which is accessed via a gravel road located at the proposed East Hawai‘i Organics Facility roadway entrance (see Figure 30 and **33**). The eastern section remains largely undeveloped with the exception of a few scattered papaya fields (Figure 30 and 31). Several businesses including a self storage and a food distribution company are located along the eastern boundary of the proposed organics facility location. South of the study area at the corner of Kipimana and Mikahala Street is a grassy lot (Figure 32). The area to the west of the proposed organics facility site is currently cultivated with papaya,

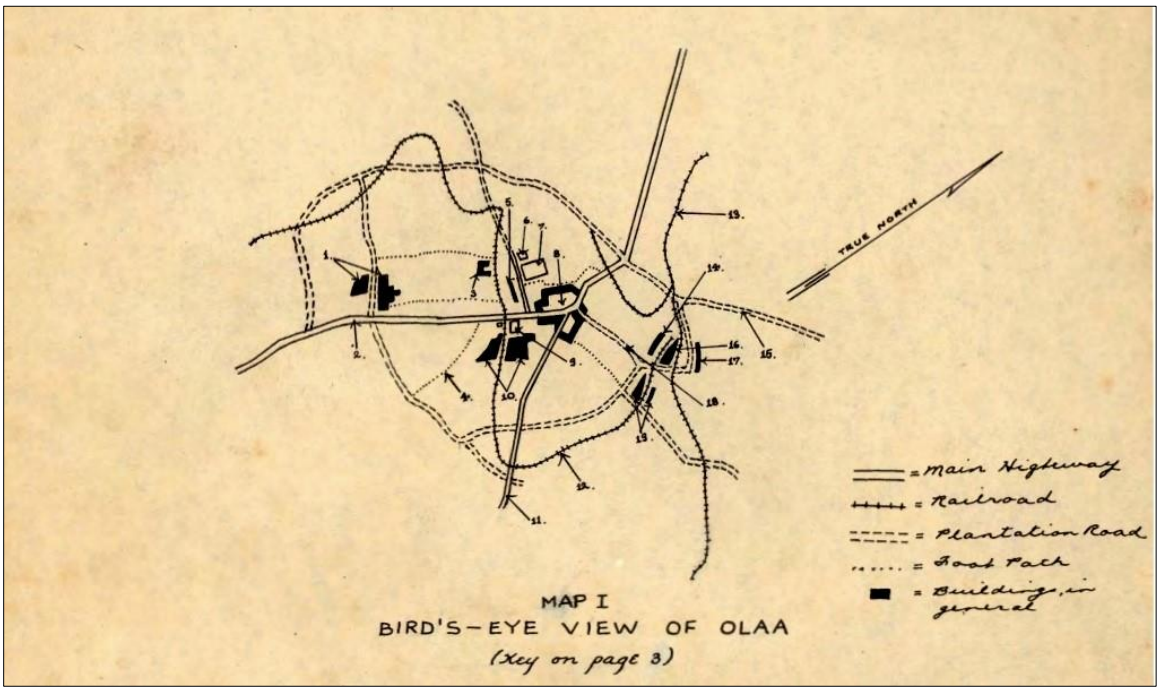


Figure 18. Taniguchi’s general map of Kea‘au/‘Ōla‘a Village.

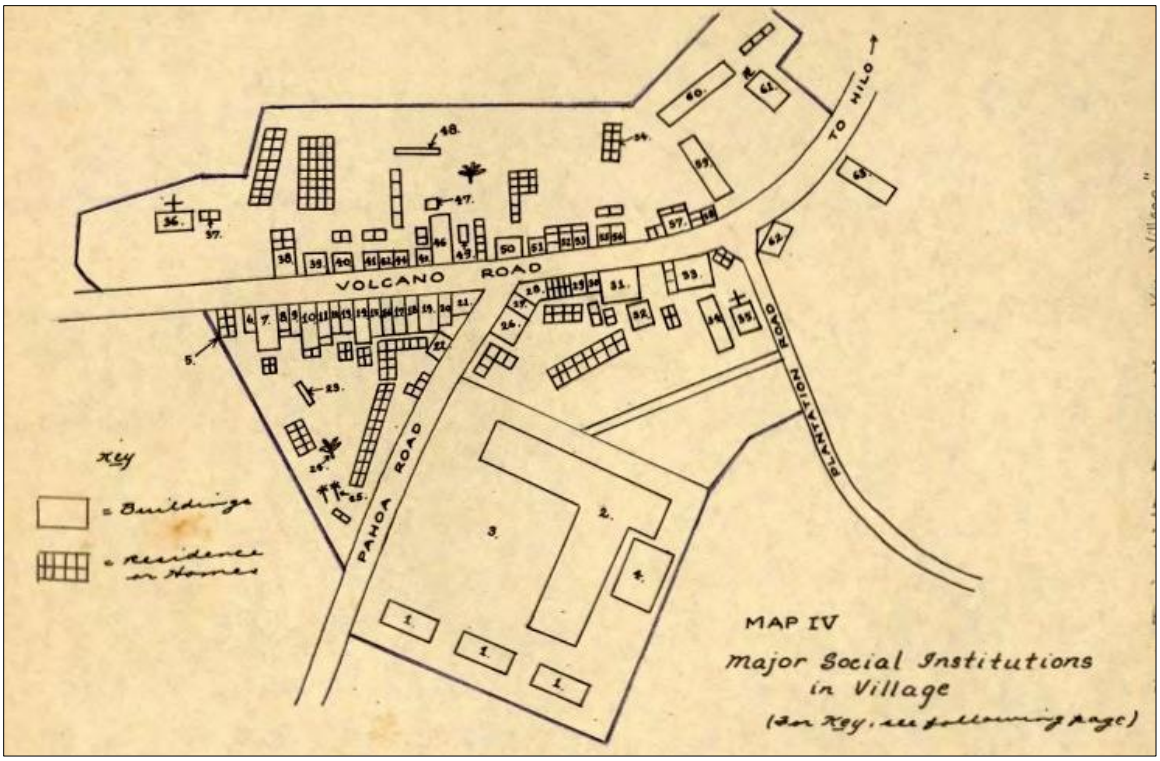


Figure 19. Taniguchi's map showing the major social institutions of Kea'au/'Ōla'a Village.

Key
Map IV

1. Teachers' Cottage
2. Olaa School Building
3. Olaa School Playground
4. School Garden Plot
5. Hawaiian Residence
6. Bicycle Shop
7. Olaa Bakery
8. Tailor Shop
9. Laundry Shop
10. Auto-Repair Shop
11. Filipino Grocery Store
12. Barber Shop
13. Restaurant
14. Gen. Merchandise Store
15. Barber Shop
16. Pool-Room
17. Shoe-Maker's Shop
18. Metal Craftman's Shop
19. Barber Shop
20. Tailor Shop
21. Store
22. Garage
23. Pig-Pens
24. Papaia Trees
25. Coconut Trees
26. Doctor's Office
27. Vegetable Store
28. Candy Shop
29. Garage
30. Dressmaker's Shop
31. Gasoline Station
32. Cultivated Garden
33. Gasoline Station
34. Catholic Gymnasium
35. Catholic Church
36. Japanese Christian Church
37. Minister's Residence
38. Meat Market
39. Store
40. Store
41. Barber Shop
42. Magazine Store
43. Vegetable Store
44. Store
45. Ice Cream Parlour
46. Olaa Theater
47. "Tofu" Plant
48. Pig-Pens
49. Olaa Court House and Prison
50. Service Station
51. Store
52. Bishop Bank (Branch)
53. Library (Branch-open once a week)
54. Filipino Houses
55. Photographer's Shop
56. Dressmaker's Shop
57. Hotel and Restaurant
58. Store
59. Y. M. B. A. Hall
60. Olaa Japanese School
61. Olaa Buddhist Church
62. Gasoline Station
63. Olaa Community Hall

= Residences in General
= Important Buildings.

Figure 20. Legend for Figure 19.

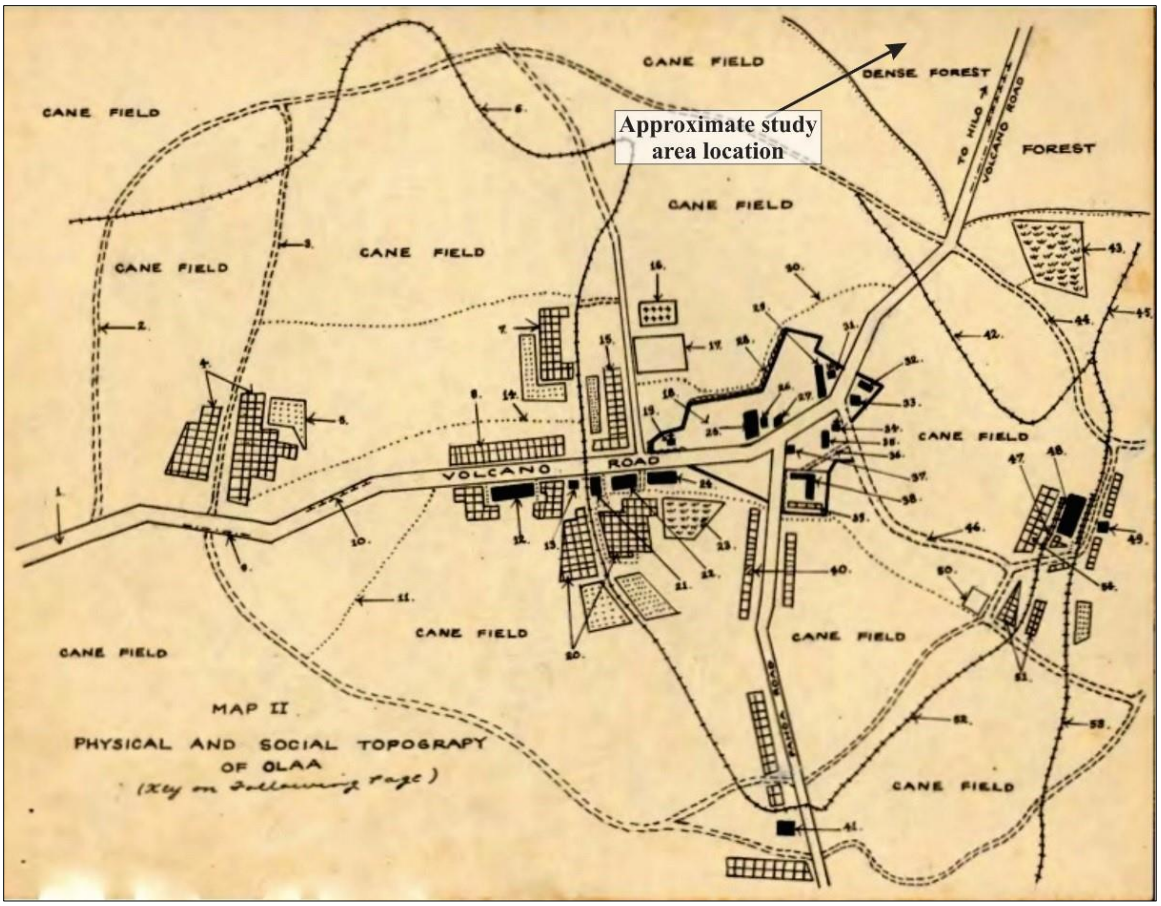


Figure 21. Taniguchi's map showing the physical and social topography of Kea'au Village.

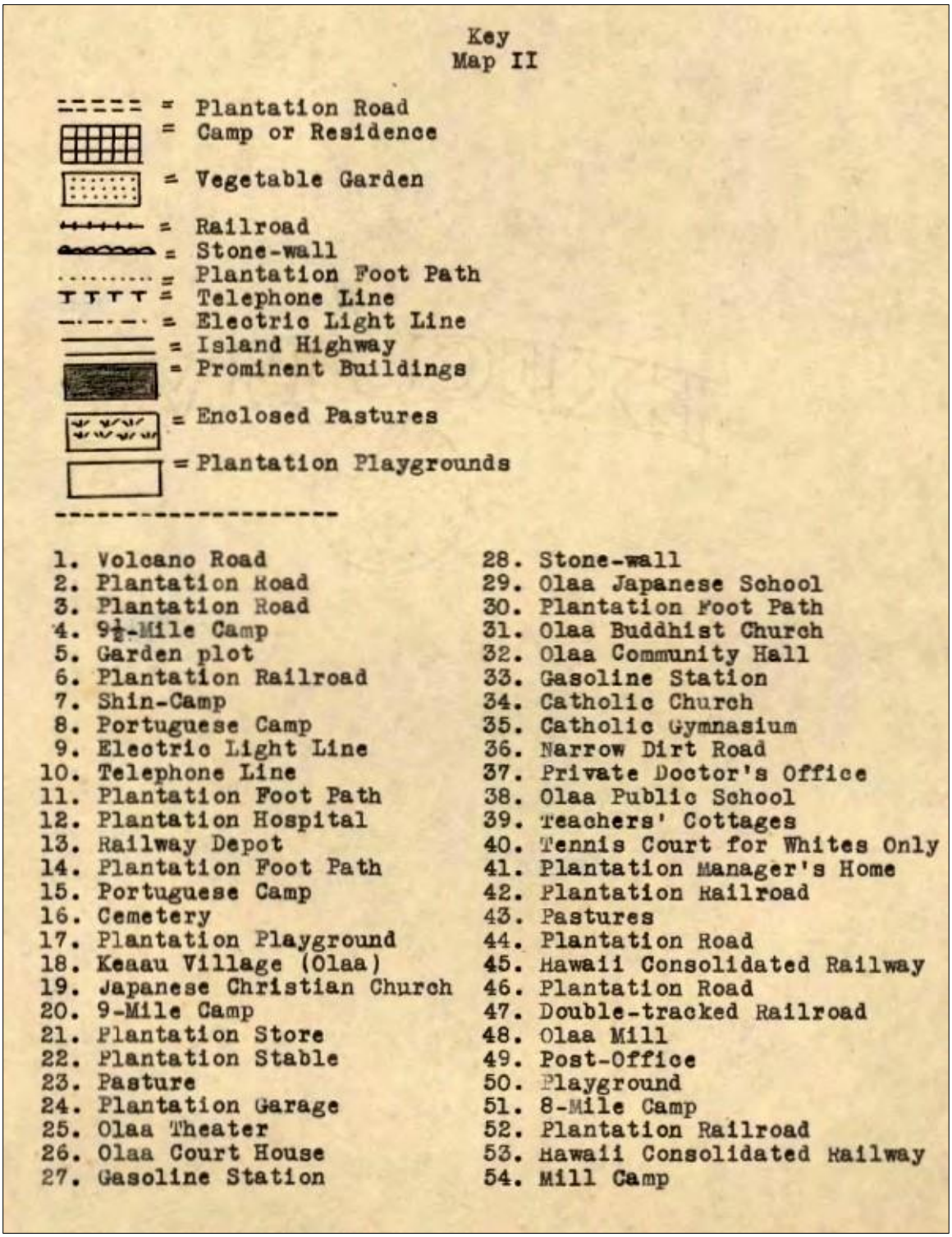


Figure 22. Legend for Figure 21.

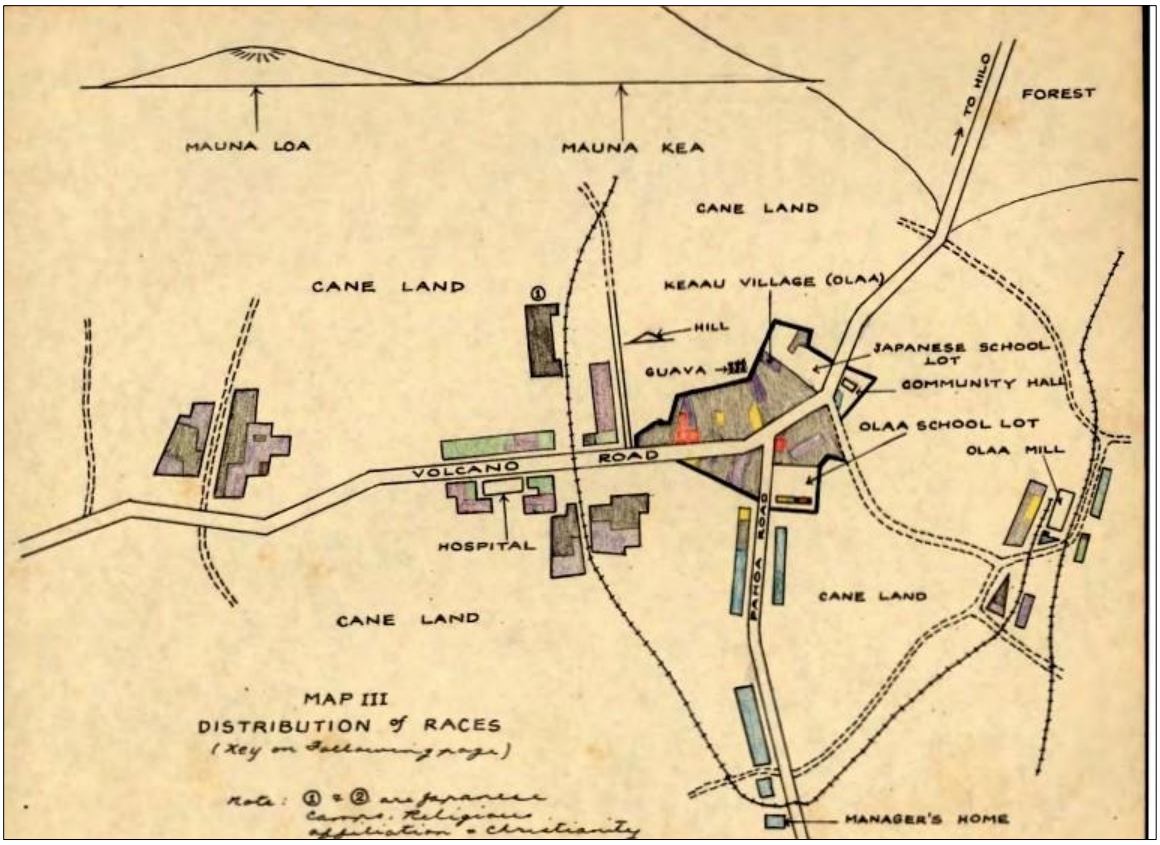


Figure 23. Taniguchi's map showing the ethnic distribution present within Kea'au Village.

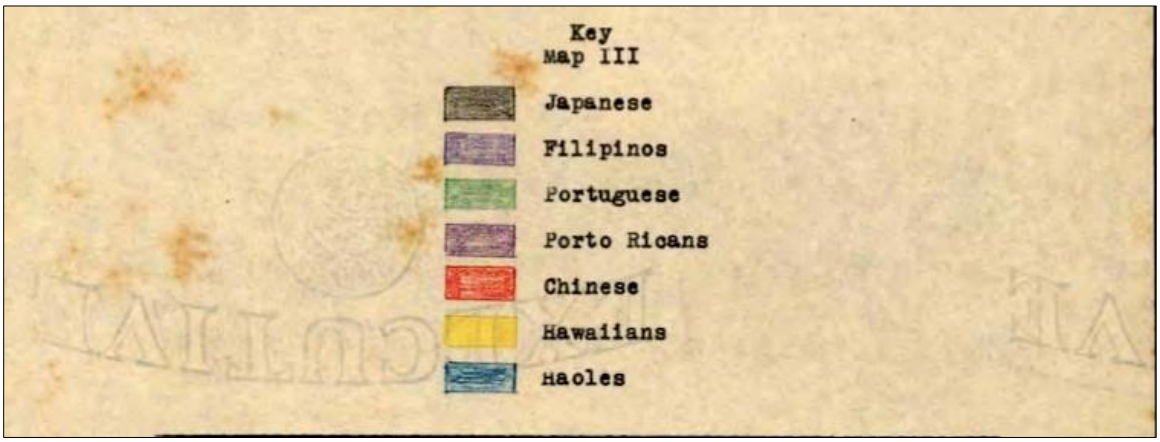


Figure 24. Legend for Figure 23.

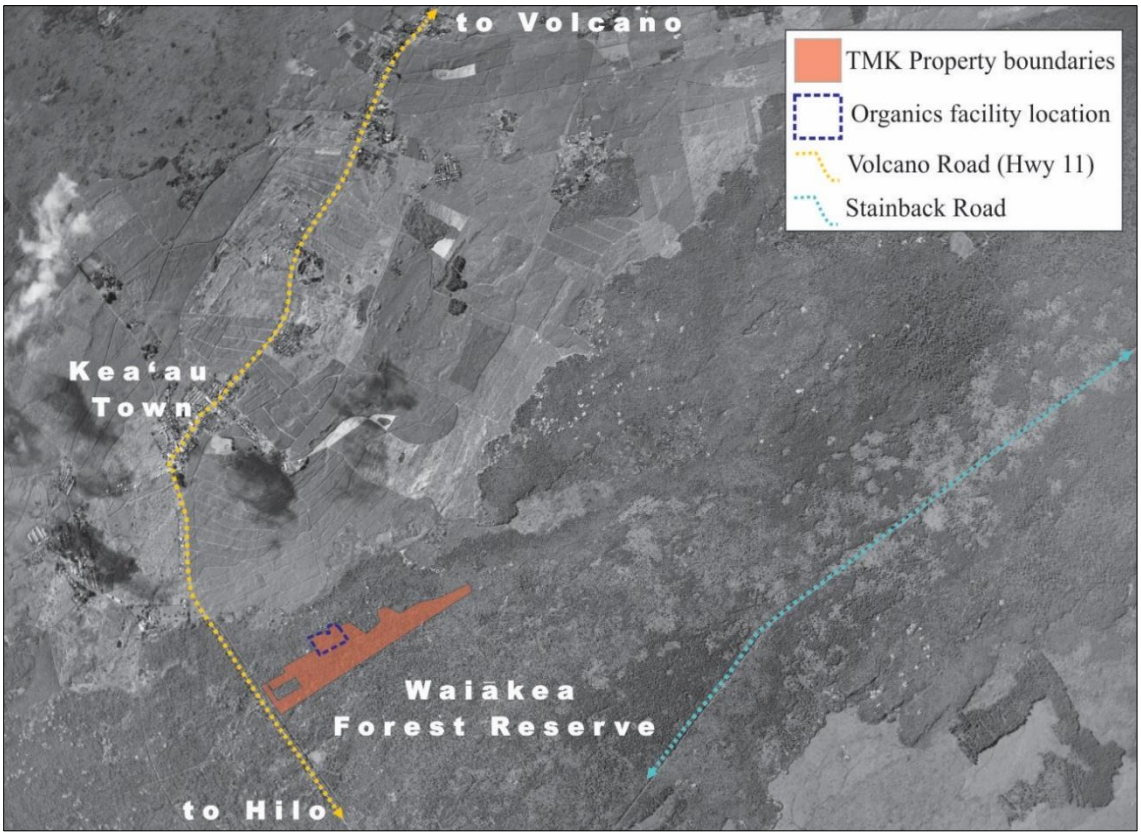


Figure 25. Detail of a 1954 USGS aerial photograph showing location of the current study area.

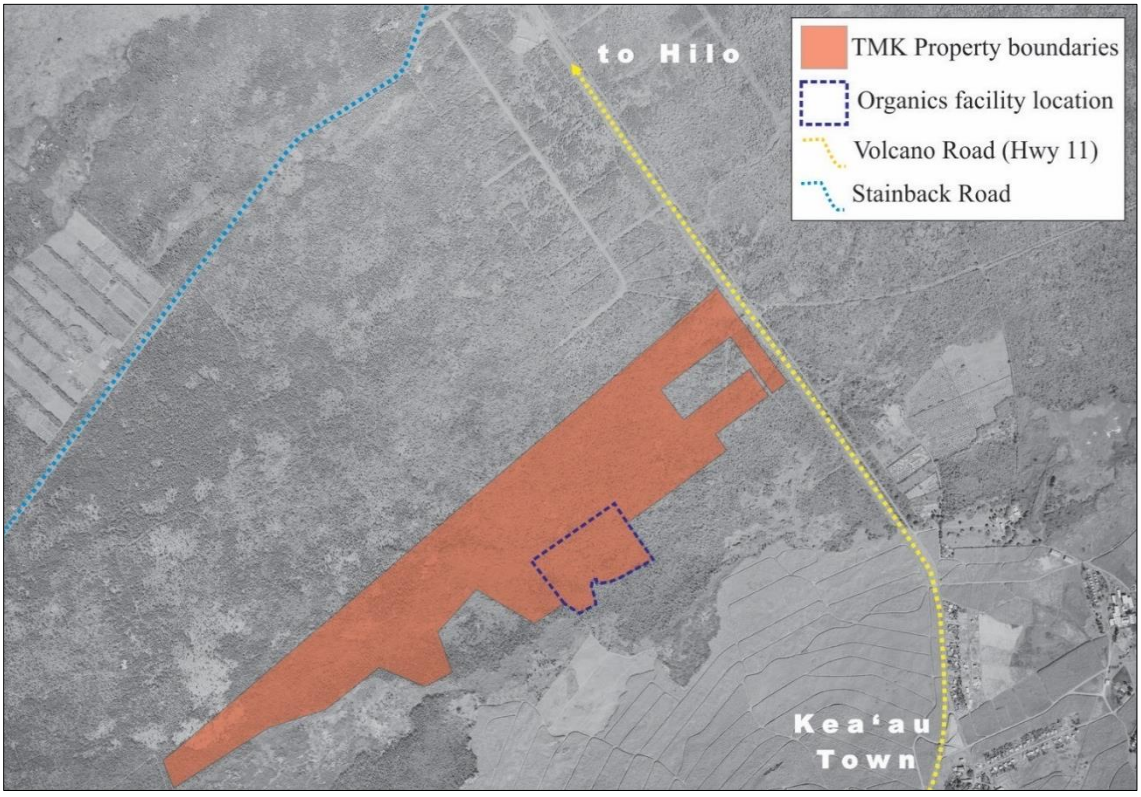


Figure 26. Detail of a 1965 USGS aerial photograph showing location of the current study area.

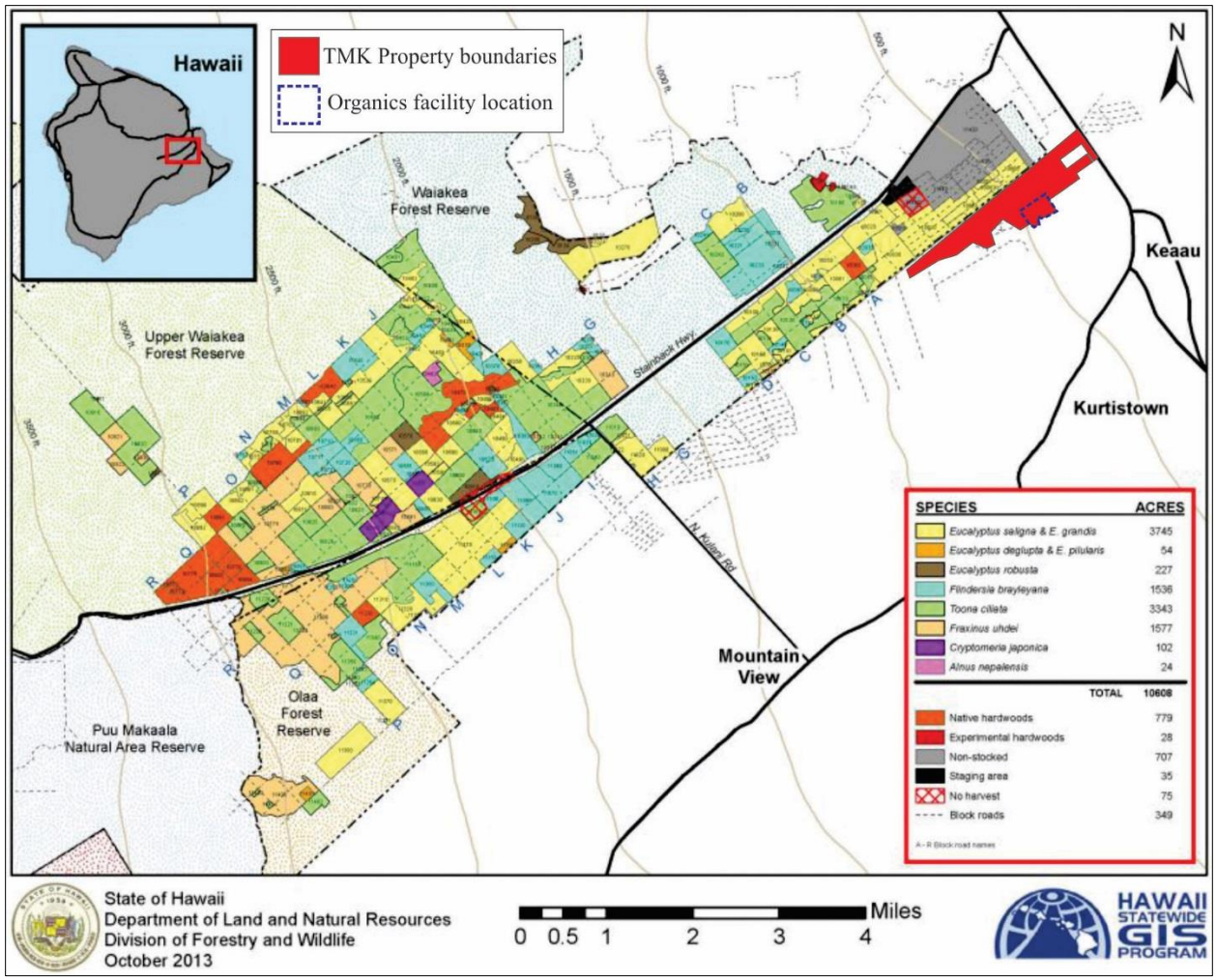


Figure 27. Hardwood species planted within the lower section of the Waiākea Forest Reserve adjacent to the study area (Department of Land and Natural Resources 2016:11).



Figure 28. Study area location plotted on a USGS, Hilo HI, Quadrangle, 1977 showing the timber plantings in the Waiākea Forest Reserve and the quarry site.

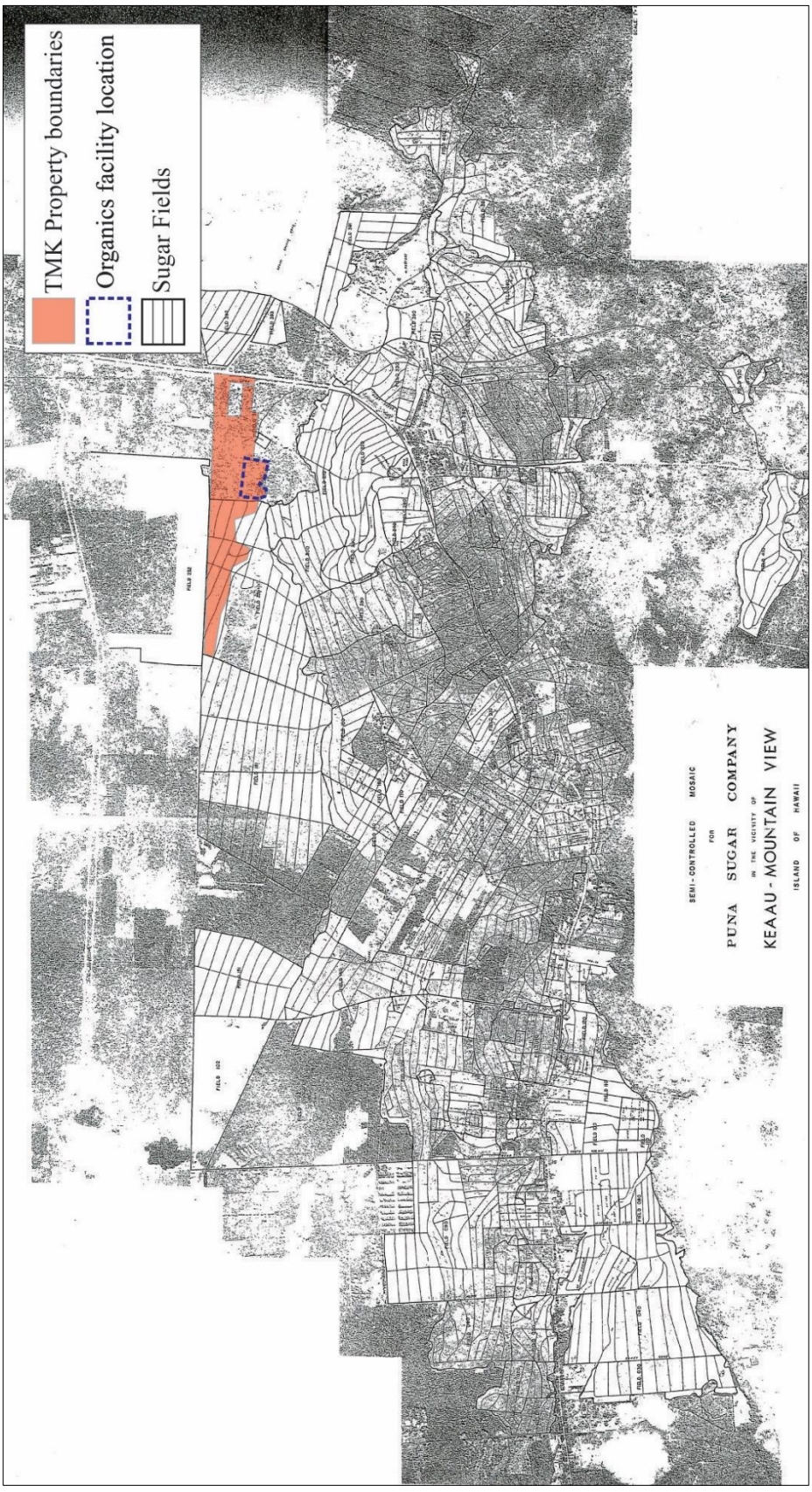


Figure 29. Puna Sugar Company field map, showing the study are parcel partially cultivated in cane, ca. 1970s.



Figure 30. View of proposed Organics Facility site, with Albizia trees dominating the upper canopy, view to the northwest.



Figure 31. View of proposed Organics Facility site, view to the northwest.



Figure 32. Grassy lot located to the south of study area at the corner of Kipimana and Mikahala Street, view to the southeast.



Figure 33. Gravel paved access road to papaya farms, view to the west.

PREVIOUS STUDIES

There have been numerous studies conducted within Keaʻau in both the general and immediate vicinity of the current study area (Table 1 and Figure 34). The intensive and extensive modification of the more *mauka* portions of Keaʻau during the Historic Period for commercial agricultural and transportation purposes has obliterated much of the Precontact landscape due to clearing and plowing. The development of lands in and around the study area was rapidly accelerated during the late nineteenth century as the commercial sugar industry expanded its operations. As such, evidence of many Precontact sites such as ancient foot trails, habitation sites, or traditional agricultural features is highly limited, particularly near the study area. Although various studies conducted nearby (see Figure 34) have resulted in negative findings with respect to archaeological resources (Desilets and Rechtman 2004; Escott 2014; Haun and Henry 2004; Masterson and Hammatt 1998; Rosendahl 1982; Rosendahl and Walker 1992; Wilkinson et al. 2008), likely a direct result of the rigorous modification associated with the sugar industry, numerous others have identified limited site types, consisting primarily of remnant Historic-era sugar infrastructure and remnants of the Hilo Railroad Company/Hawaiʻi Consolidated Railway. Despite the intensive development associated with the industry and rail transportation, Precontact site types relating to habitation, agriculture, burial, and/or ceremony have been preserved in the more coastal portions of Keaʻau or in rare instances, in/on pockets of land near Keaʻau Town left undisturbed during the sugar industry boom.

In addition to the aforementioned archaeological studies, two cultural-based studies (Farias et al. 2009 and Spencer et al. 2007) have been conducted as well. Collectively, these studies sought to identify potential impacts to culturally significant places, practices, and resources through a combination of community consultation, examination of background research, and/or field visits. A summary of the most proximate and relevant cultural and archaeological studies that have identified resources and/or potential impacts are presented below.

Table 1. Previous archaeological studies.

Year	*Author*	*Type*
1978	Hammatt	Reconnaissance Survey
1982	Rosendahl	Reconnaissance Survey
1987	Komori	Cultural and Biological Resources Survey
1992	Rosendahl and Walker	Reconnaissance Survey
1993	Hunt	Reconnaissance Survey
1994	Hurst	Archaeological Survey
1997	Walker et al	Field Inspection and Historical/Archaeological Research
1998	Masterson and Hammatt	Archaeological Inventory Survey
2000	McGerty and Spear	Archaeological Inventory Survey
2004	Desilets and Rechtman	Archaeological Inventory Survey
2004	Haun and Henry	Archaeological Inventory Survey
2008	Haun and Henry	Archaeological Inventory Survey
2009	Farias et al.	Cultural Impact Assessment
2010	Wilkinson et al.	Archaeological Inventory Survey
2013	Escott	Archaeological Inventory Survey
2014	Escott	Field inspection
2015	Wheeler et al.	Archaeological Literature Review and Field Inspection
2017	Escott	Archaeological Inventory Survey
2017	Spencer et al.	Cultural Impact Assessment
2018	Rechtman and Tam Sing	Archaeological Inventory Survey

Archaeological Research Center, Hawaiʻi, Inc. (Hammatt 1978) conducted an archaeological reconnaissance survey of the proposed King's Landing Subdivision located to the southeast of the current study area in TMK: (3) 1-6-001 (see Figure 34). As a result of the study, 27 archaeological sites were documented, all of which were situated in the more coastal portions of Keaʻau Ahupuaʻa. Site types identified during the study were both Historic and Precontact in nature, and classified as being "1) pre-Contact stone structures, 2) habitation sites, and 3) post-Contact places" (Hurst 1994:6).

As part of a cultural and biological resources study conducted by the Bernice Pauahi Bishop Museum (B.P.B.M.) in 1987, Komori (1987) conducted a pedestrian survey of a proposed Pohoiki-Keaau transmission line corridor located to the southeast of the current study area (see Figure 34). As a result of the study, Komori and Peterson (1987) recorded five agricultural site complexes, habitation and burial platforms, burial and refuge caves, and petroglyphs, all of which were located on or adjacent to *ʻaʻā* lava flows or ash deposits that were in excess of 1,500 years in age. Feature types observed at these agricultural complexes included walls, terraces, clearings, ditches, and modified outcrops. The other sites recorded during the study were located on *pāhoehoe* lava flows that originated from Kīlauea Volcano between 300 and 500 years ago. Komori (1987) suggests that the construction and utilization of the sites identified during their study likely dates to between A.D. 1450 and the present, and that the development of inland agricultural complexes most likely followed the establishment of permanent settlements at the coast sometime after A.D. 1450.

In 1993, Hunt (1993) conducted an archaeological reconnaissance survey of 600 acres of Shipman Lands in TMKs: (3) 1-6-003:003, 007, 008, 011, 012, 027, 029, 058, 073, 075, 084, 086, and 090, including land in which the current study area is situated (see Figure 34). The majority of the Hunt (1993) study area was found to have been heavily impacted by the intensive cultivation of sugarcane, however, 50 archaeological sites were identified in portions of the study area which had been only minimally impacted. The site types identified during the study included clearing mounds, walls, enclosures, alignments, and platforms, and it was concluded by Hunt (1993) that although some of these sites may have originally been constructed during the Precontact Period, they appeared to be primarily associated with the sugar industry.

Also in 1993, Ogden Environmental and Energy Services Co., Inc. (Hurst 1994) conducted an archaeological inventory survey of the proposed Keaʻau Bypass corridor to the southeast and northeast of the current study area (see Figure 34). Within the Hurst study area corridor, five specific areas suspected of containing cultural remains identified by historical background research were intensively examined during the survey. As a result of the fieldwork, it was concluded that the study area had been profoundly impacted by commercial sugar and macadamia nut tree cultivation that occurred in the latter part of the nineteenth century and the first half of the twentieth century, as well as by modern residential development. The repercussions of these disturbances resulted in the destruction of most surficial remains except for a section of a dilapidated wooden fenceline located in the vicinity of 8½ mile camp in Area B of the survey area (see Figure 34).

In 1996, Paul H. Rosendahl, Ph.D., Inc. (Walker et al. 1997) conducted a field inspection of a roughly 75-acre area comprising portions of TMK: (3) 1-6-003:003, 015, and 084 to the east of the current study area, directly between the Keaʻau-Pāhoa Road and Keaʻau Bypass corridor (see Figure 34). Fieldwork was complemented by a thorough Historical and archaeological review of the Keaʻau and greater Puna area. Although the Walker et al. study area was found to have been heavily modified during Historic times for sugarcane cultivation, a barely discernable 537-meter long section of the old Hilo Railroad Company/Hawaiʻi Consolidated Railway ROW associated with the Glenwood Division of the line was identified and assigned as SIHP Site 50-10-44-21191. Walker et al. noted that although the HCR alignment fell into disuse in the end of 1948, it appeared that subsequent agricultural modification to the landscape in the years following further impacted the visual integrity of the remnant railroad grade, leaving only two small recognizeable sections. As the extant sections of the HCR grade were thoroughly documented during the study, Walker et al. concluded that it no longer significant and therefore recommended no further work.

In 2000, Scientific Consultant Services, Inc. (McGerty and Spear 2000) conducted an archaeological inventory survey of nearly 300 acres for the proposed location of the Kamehameha Schools Bishop Estate (KSBE) campus situated to the south of the current study area in TMK: (3) 1-6-003:012 (por.) (see Figure 34). As a result of the study, seven plantation-era sugarcane field clearing mounds were identified.

In 2008, Haun and Associates (Haun and Henry 2008) conducted an archaeological inventory survey of 8 acres of land in TMKs: (3) 1-6-004:011, 047-053, 055, 056, and (3) 1-6-064:266-269, 283-286, located to the southeast of the current study area (see Figure 34). As a result of the survey, a single Historic era site bridge (Site 50-10-44-26874) extending over Waipāhoehoe Stream was identified. The bridge, likely constructed ca. 1930 out of formed concrete and mortared stone, once served as "a component of the primary transportation route between the towns of Keaau and Pahoa" (Haun and Henry 2008). It was assessed as significant under Criterion d, and was recommended for no further work.

A Cultural Impact Assessment (CIA) was conducted by Cultural Surveys Hawaiʻi, Inc. in 2009 (Farias et al. 2009) in support of an Environmental Assessment (EA) for the proposed Keaʻau-Pāhoa Road Widening Project (see Figure 34). As a result of the cultural study, two general areas where traditional cultural practices were ongoing were identified: the site of the Makuʻu Market Association and ʻAha Pūnana Leo and Ke Kula ʻO Nāwahīokalaniʻōpuʻu Public Charter School site. Through consultation, Farias et al. (2009) determined that the ongoing cultural practices

occurring at the Makuʻu Market site included the planting, cultivation, and gathering of traditional cultural resources and the preservation and perpetuation of the Hawaiian language and cultural practices. Although it was concluded that the proposed project would not affect any of the ongoing cultural activities at the Makuʻu Market location, Farias et al. (2009) opined that the area may potentially be significant as a Traditional Cultural Property under Chapter 6E. With respect to ʻAha Pūnana Leo and Ke Kula ʻO Nāwahīokalaniʻōpuʻu, Farias et al. (2009) concluded that while not directly in the Area of Potential Effect (APE), access to ʻAha Pūnana Leo and Ke Kula ʻO Nāwahīokalaniʻōpuʻu through the ʻŌpūkahaʻia intersection may be potentially impacted and/or restricted by development activities. Aside from the aforementioned, no other impacts to traditional cultural practices associated with the proposed project were identified.

Subsequent to the cultural impact assessment conducted the year prior, Cultural Surveys Hawaiʻi, Inc. (Wilkinson et al. 2010) conducted an archaeological inventory survey of an approximately 9.5-mile long and 61-meter wide section of the existing Keaʻau-Pāhoa Road for its proposed widening (see Figure 34). Their survey area encompassed five potential build out areas and extended from the junction of the Keaʻau-Pāhoa Road and the Keaʻau-Pāhoa Bypass Road just to the southeast of the current study area and terminating at the Pāhoa-Kapoho intersection, crossing eight *ahupuaʻa* in Puna: Keaʻau, Waikahekahe Nui, Waikahekahe Iki, Makuʻu, Hālona, Keonepoko Nui, Keonepoko Iki, and Waiakahiula. As a result of the survey, Wilkinson et al. identified a single Historic site (Site 50-10-35-26874) within their study area; an abandoned concrete bridge and associated paved asphalt roadway constructed ca. 1930 that extended along the southwestern edge of the Keaʻau-Pāhoa Road. It was concluded by Wilkinson et al. that Site 26874 was representative of the former alignment of the current Keaʻau-Pāhoa Road. Although no further work was the suggested treatment for the site, it was recommended that supplementary documentation of the site be undertaken by the Historic American Building Survey and Historic American Engineering Record (HABS/HAER) in the event of any future alteration or demolition.

Scientific Consultant Services, Inc. (Escott 2013) conducted an archaeological inventory survey of 3 acres of land (TMKs: (3) 1-6-002:004, 006, and 007) located to the southeast of the current study area (see Figure 34). As a result of the suryvey, three Historic-era sites were identified: Site 50-10-35-29890 (a stone wall extending along the eastern study area boundary), Site 29891 (a brick walkway remnant located in the northern portion of the study area), and Site 29899 (two remnant sections of a concrete sidewalk extending along the southern study area boundary). All the sites were determined to have been constructed in the early to mid-twentieth century and associated with non-extant residential and commercial structures. Escott (2013) concluded that all three sites had been adequately documented and as such, no further work was the recommended treatment.

In 2015, Cultural Surveys Hawaiʻi, Inc. (Wheeler et al. 2015) conducted an archaeological field inspection and literature review for the proposed demolition of four buildings at Keaʻau Middle School to the southeast of the current study area (see Figure 34). As a result of the study, a segment of an *ʻauwai* was documented in the northwestern portion of the Wheeler et al. (2015) study area. Furthermore, it was determined that one of the buildings slated for demolition was more than 50 years old, and as such, consultation with the SHPD Architecture Branch was recommended.

In 2017, Scientific Consultant Services, Inc. (Escott 2017) conducted an archaeological inventory survey of 7.8437 acres of land within TMKs: (3) 1-6-002:019, 020, 021, 022, 099, 101, 102, and 103, located to the southeast of the current study area (see Figure 34). As a result, a single archaeological site (Site 50-10-35-30613), consisting of a linear, 3-meter wide trench excavated into bedrock, was identified during the study. At one time, Site 30613 supported a wooden flume that carried water across the northern portion of the Escott (2017) study area, which was part of the sugar plantation infrastructure. No further work was the recommended treatment for Site 30613.

That same year a cultural impact assessment was conducted by Cultural Surveys Hawaiʻi, Inc. (Spencer et al. 2017) for the proposed Keaʻau Zero Waste Facility within TMKs: (3) 1-6-151:002, 003 (por.), 006 (por.), and 999 (por.) situated adjacent to the southern boundary of the current study area (see Figure 34). The Spencer et al. (2017) study concentrated on identifying cultural sites, past and ongoing traditional and cultural Hawaiian activities, and traditional gathering practices that occurred within the study area. These tasks were conducted by an examination of both cultural and historical resources in addition to limited community consultation. As a result of the Spencer et al. (2017) study, it was concluded that although no known burials were known to exist within the study area, the potential to encounter them was possible, particularly within caves. As such, it was recommended that if they were encountered, that proper steps be taken to collaborate with lineal and cultural descendants in order to develop the appropriate mitigation plan(s) for their treatment.

In 2018, ASM Affiliates (Rechtman and Tam Sing 2018) conducted an archaeological inventory survey of a roughly 6.7-acre parcel (TMK: (3) 1-6-003:103) located to the southeast of the current study area (see Figure 34). As

a result of the study, a barely discernable curvilinear alignment of depressed grade, interpreted to be a section of the former alignment of the Hilo Railroad Company/Hawai‘i Consolidated Railway right of way (Site 50-10-44-21191), was identified bisecting the central portion of the current study area. Site 21191 was originally identified and assigned an SIHP designation by Walker et al. (1997) who conducted an archaeological survey of lands situated directly east of the Rechtman and Tam Sing (2018) study area, on the *makai* side of the Kea‘au-Pāhoa Road. Also identified were remnants of a Historic core-filled rock wall (Site 50-10-44-30766) that once surrounded the Puna Sugar Company manager’s houselot which is situated on the adjacent parcel to the south of the Rechtman and Tam Sing (2018) study area. Given the lack of integrity for both sites coupled with the previous SHPD-approved Walker et al. (1997) significance evaluation and treatment of Site 21191, no further work was recommended for both sites.

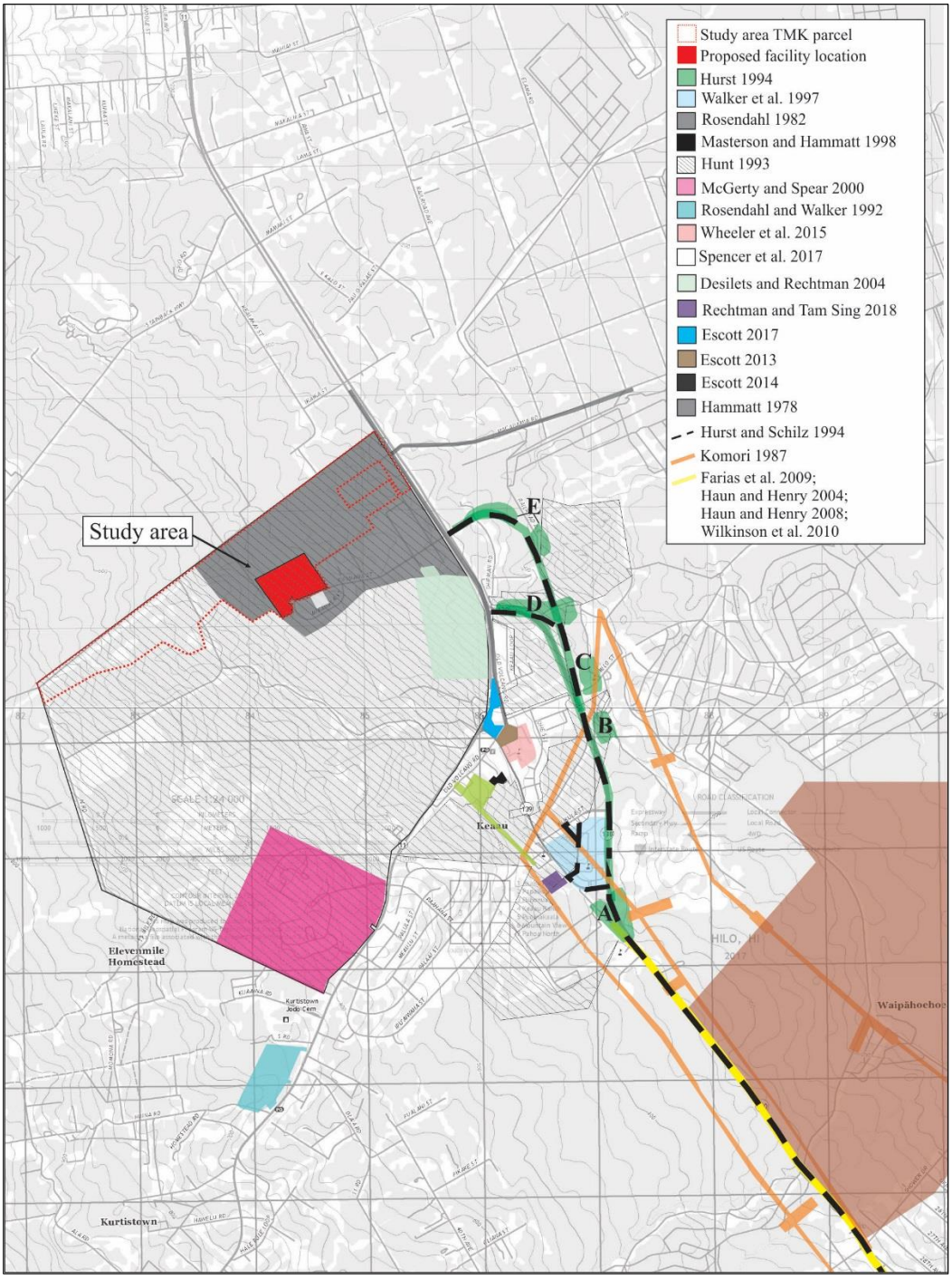


Figure 34. Locations of previous studies.

3. CONSULTATION

Gathering input from community members with genealogical ties and long-standing residency or relationships to the study area is vital to the process of assessing potential cultural impacts to resources, practices, and beliefs. It is precisely these individuals that ascribe meaning and value to traditional resources and practices. Community members often possess traditional knowledge and in-depth understanding that are unavailable elsewhere in the historical or cultural record of a place. As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify potential cultural resources, practices, and beliefs associated with the affected project area. It is the present authors' further contention that the oral interviews should also be used to augment the process of assessing the significance of any identified traditional cultural properties. Thus, it is the researcher's responsibility to use the gathered information to identify and describe potential cultural impacts and propose appropriate mitigation as necessary.

In an effort to identify individuals knowledgeable about traditional cultural practices and/or uses associated with the current subject property, a public notice was submitted to the Office of Hawaiian Affairs (OHA) for publication in their newspaper, *Ka Wai Ola* (Appendix A). Although the notice was submitted via email on April 9th with the intent that it would appear in that month's issue, the notice was not published until the May 2018 issue. As of the date of the current report, no responses have been received from the public notice.

Although no responses were received as a result of the *Ka Wai Ola* publication, eight individuals were contacted via email and/or phone: Jay Hatayama from the Department of Land and Natural Resources, William Walter, Thomas English, and Emily Taaroa from W.H. Shipman Limited, Kuʻulei Kanahele from Hawaiʻi Community College, Kainana Francisco from the U.S. Forest Service, and J.B. Friday and Corie Yanger from the University of Hawaiʻi CTAHR Research and Extension Center. Because the study area parcel has been privately owned with controlled access by W.H. Shipman Limited since the late 19th century, the authors reached out to the individuals listed above who all of whom were identified as possessing knowledge related to either the study area vicinity or other aspects related to the proposed organics facility. Of the eight individuals contacted, four individuals accepted the interview request.

As part of the interview process and with the consent of the interviewees, the interviews were audio recorded for note taking purposes only (audio files not available). Upon completion of the interview, Lokelani Brandt prepared an interview summary, which was emailed to the interviewees for review. Aside from the phone interview with Mr. Hatayama, the remaining three interviewees were asked to review the draft summary and make any necessary edits. With the approval of the interviewees, the finalized version of the summaries has been presented below.

JAY HATAYAMA

On April 11, 2018, Lokelani Brandt conducted a phone interview with Jay Hatayama, DNLR's Foresty Program Manager regarding the proposed project. When asked if he was aware of any on-going cultural practices or historic sites near the study area, Mr. Hatayama clarified that he is familiar with the Waiākea Forest Reserve, which is located to the north of the study area. He stated that he was not aware of any on-going gathering or traditional practices occurring in the immediate study area vicinity, especially since most of the vegetation within the lower portion of the Waiākea Forest Reserve is predominately Eucalyptus, which was planted some fifty years ago. He explained that hunting is allowed within the upper section of the forest but is prohibited in the lower section near the Hawaiʻi Belt Road. He explained that foliage gathering is more common along sections of Stainback Highway.

DR. J.B. FRIDAY

Given the proximity of the study area to the Waiākea Forest Reserve, (which houses many native species including *ʻōhiʻa*) and nature of the proposed East Hawaiʻi Organics Facility, concerns regarding the potential impacts of the fungus *Ceratocystis fimbriata*, more commonly known as Rapid ʻŌhiʻa Death (ROD) were explored. As a disease new to Hawaiʻi and science, ROD has devastated tens of thousands of acres of *ʻōhiʻa lehua* (*Metrosideros polymorpha*) on Hawaiʻi Island. *ʻŌhiʻa* is one of the most bioculturally significant plants found in Hawaiian forests. Confirmed cases of ROD were first recorded in Puna District around 2013, and this district is now considered the epicenter for the fungus (College of Tropical Agriculture and Human Resources n.d.).

On April 24, 2018, an in-person interview was conducted with Dr. J.B. Friday (Hawaiʻi Island Extension Forester) who is one of the leading researchers on ROD. The interview was carried out at the Cooperative Extension Service in Hilo, Hawaiʻi. When asked about what measures the County can take to mitigate the spread of ROD from the proposed facility, Dr. Friday specified that not allowing the public to dispose of any *ʻōhiʻa* cuttings is the first step. He explained

that at the current composting facility, the County has installed signs and that the workers actively discourage people from dropping off *ʻōhiʻa* cuttings. Dr. Friday detailed that although the public is prohibited from diposing *ʻōhiʻa* at the County green waste facility, not everyone follows these protocols. He clarified that to prevent the spread of ROD, all *ʻōhiʻa* cuttings it must be composted and to kill the fungus, the compost must reach a minimum of 130° F. Dr. Friday stated that the current measures implemented by the County have reduced the spread of ROD. Since *ʻōhiʻa* is a dominant plant found throughout east Hawaiʻi, the County must continue to implement and adjust their disposal protocols at the composting facilities to help reduce the spread of this disease.

Dr. Friday reported that ROD has been confirmed within the Panaʻewa Forest, (located to the northeast of the study area) and the lower section of the Waiākea Forest Reserve along Stainback Road. He expressed that since ROD has been confirmed in this area, he feels a little more comfortable with placing the facility in the proposed location. However, if ROD was absent from the area, he would advise against placing this type of facility near an uncontaminated forest. Dr. Friday clarified that the distribution of the disease is patchy and that this is something he and other researchers are trying to understand.

Dr. Friday expressed that one of the challenges that the County is facing is what do people do once they have cut down a diseased tree? He explained that people are looking for a place where they can properly dispose their infected *ʻōhiʻa*. Although several alternatives have been proposed, all of these alternatives would promote the transportation of diseased trees, which could result in the continued spread of ROD. Based on what is currently understood about ROD, he advises the County to continue encouraging people to store cut diseased trees on their property.

When asked about his interactions with the community and understanding the cultural importance of *ʻōhiʻa* , Dr. Friday revealed that he has been a part of many community talks. From these talks, he has been able to interact with various community members who have expressed their sentiments about the significance of *ʻōhiʻa*. He explained that while many in our community are upset about the situation, Native Hawaiians are particularly troubled by this because they cherish the *ʻōhiʻa* tree. He explained that Native Hawaiians have a deep attachment to this tree because it is an important part of their cultural practices and is associated with deities like Laka. Additionally, *ʻōhiʻa* is recognized for its ecological importance, such a providing a habitat for various native plants and animals, and its role in protecting our watershed. Dr. Friday described that consultation with Kekuhi Kanahele has led to discussions about giving ROD a Hawaiian name. As a result of these discussions, two names were selected, one for each species of the fungus, *Ceratocystis lukuohia* and *Ceratocystis huliohia*.

In discussing potential reforesting efforts, Dr. Friday pointed out that there has been a lot of positive community participation with the seed banking effort, which has led to the collection of *ʻōhiʻa* seeds on every island except Lānaʻi. He also advocates for continued planting of *ʻōhiʻa* as well as other native species to mimic the plant communities found in the nearby native forest. Since the current study area parcel has been previously disturbed, this has resulted in the introduction of invasive species such as strawberry guava (*Psidium cattleyanum*) and *clidemia*, with an albezia (*Falcataria moluccana*) overstory. He specified that all of these plants are known to have an adverse effect on the area's ecology.

KUʻULEI KANAHELE

An in-person interview was conducted by Lokelani Brandt on April 30, 2018, with Kuʻulei Kanahele. Mrs. Kanahele lives in the Hawaiian Homestead of Panaʻewa and is an Instructor in the Hawaiʻi Life Styles Program at Hawaiʻi Community College and a Cultural Researcher for the Edith Kanakaʻole Foundation. She has spent over twenty years researching Hawaiian chants and literature associated with the Pele traditions. When asked about her thoughts on the proposed project, Mrs. Kanahele expressed her support and explained that she is pleased to know that this facility will be constructed in Keaʻau and away from residential communities. She recalled that the County initially proposed placing the facility near her home in Panaʻewa and that her family and many others from the Panaʻewa community spoke out against the proposed facility location.

In discussing the significance of the study area vicinity, specifically Panaʻewa, Mrs. Kanahele emphasized that this area is well described in the historical text concerning the Pele family. She pointed out that in the story of Pele and Hiʻiaka the Panaʻewa forest is the home of a fierce *moʻo* also known by the same name. She noted that the phrase *"ʻōhiʻa kupu hāoʻeoʻe,"* which translates as the scraggly growing *ʻōhiʻa* is often used to describe the physical characteristics of both the *moʻo* Panaʻewa and the forest itself. Mrs. Kanahele stated that in looking at other traditional literature concerning *moʻo*, they often serve as guardians of freshwater and that when they are physically present, they transform the place by changing the color of the water and the surrounding vegetation. She specified that yellow is the color most associated with their presence and that *moʻo* can also be a metaphor for a place that is in a torpid state or condition. She added that in traditional lore, Hiʻiaka is considered a healer and that one of her responsibilities as a

deity is to incite growth and new vegetation. In reflecting on the Pele and Hi‘iaka story, Mrs. Kanahele stated that when Hi‘iaka slays Pana‘ewa, she frees the forest from the stagnant condition brought on by Pana‘ewa.

Mrs. Kanahele also stated that the Pana‘ewa Forest is said to have been created by Pele after finding a suitable home at Kīlauea. She shared that in Nathaniel B. Emerson’s version of Pele and Hi‘iaka, he writes in a footnote that Pele planted her *pāoa* (divine rod used by Pele to excavate her volcanic craters) staff in Pana‘ewa, which became a living tree that multiplied itself until it became a full-fledged forest.

Given the proximity of the proposed facility to the Pana‘ewa forest, Mrs. Kanahele described some of her concerns, specifically the spread of invasive species and diseases. She pointed out that traditionally, people didn’t typically travel beyond their *ahupua‘a* to gather resources, which would have limited the spread of invasive disease and pests. However, today, this is no longer the case. Mrs. Kanahele therefore, encourages the County to explore and implement protocols that will help to reduce the spread of Rapid ‘Ōhi‘a Death (ROD) and other invasive species such as Fire Ants. In discussing ROD, Mrs. Kanahele suggested that perhaps what we identify today as Rapid ‘Ōhi‘a Death (ROD) is a phenomenon associated with the traditional concept of *mo‘o* being both have similar characteristics and are known to have a destructive effect on the *‘ōhi‘a* forest.

In discussing the pertinence of the proposed facility, Mrs. Kanahele also shared that the concept of cooking vegetation via thermal heating is also found in the Pele literature. She specified that in one of the genealogical chants for Pele it describes her mother, Haumea, who is personified as the earth and her father, Kū-waha-‘ilo. She explained that this male deity, whose name has been defined in some historical text as maggot-mouth or worm-mouth (*waha-‘ilo)* is sometimes associated with human sacrificing. However, Mrs. Kanahele posited that the Haumea and Kū-waha-‘ilo genealogical chant informs us of the existence of a relationship between our island’s volcanic nature and worms and other insects that feed on decomposing matter.

Although Mrs. Kanahele expressed her support for the proposed organics facility, she recommends that genuine efforts be made to prevent and mitigate any potential spread of ROD or other invasive pests. She also suggests that native plants including *‘ōhi‘a* be planted around the facility to help promote the spread of healthy *‘ōhi‘a* seeds to the nearby forest. She also hopes that the County will consider giving the facility a meaningful Hawaiian name.

KAINANA FRANCISCO

On May 1, 2018, Lokelani Brandt was contacted by Kainana Francisco via email who shared her thoughts on the proposed East Hawai‘i Organics Facility. Ms. Francisco is a long-time Hilo and Puna resident. Ms. Francisco utilizes the current green waste facility located at the Hilo Landfill. She noted that at the existing green waste facility, the County had posted flyers informing people about Rapid ‘Ōhi‘a Death (ROD). However, she pointed out that some people continue to dispose of their *‘ōhi‘a* clippings at the facility. Although it would be preferable for people to abide by these protocols, she opined that since some people won’t exercise these precautionary measures, the County’s approach is not preventing potentially ROD infected material from being spread. There are additional precautionary protocols that could be considered if the goal were to prevent the spread of ROD. Basically, in a situation where you want to avoid spreading ROD, sanitizing machinery that comes in direct contact with *‘ōhi‘a* could be used to sterilize any *‘ōhi‘a* material, in addition to testing and sterilizing the material before it is distributed.

4. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS

The OEQC guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources, associated with cultural practices and beliefs that are subject to assessment. Essentially these are natural features of the landscape and historic sites, including traditional cultural properties. In the Hawai‘i Revised Statutes–Chapter 6E a definition of traditional cultural property is provided.

> "Traditional cultural property" means any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community's history and contribute to maintaining the ethnic community's cultural identity. Traditional associations are those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

The origin of the concept of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service. "Traditional" as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. "Cultural" refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term "Property" defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however with the definition of "Property" wherein there lies an inherent contradiction, and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties, because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often cosmologically tied to the rest of the landscape as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However offensive the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties. As the OEQC guidelines do not contain criteria for assessing the significance for traditional cultural properties, this study will adopt the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant the potential historic property or traditional cultural property must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

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; represent the work of a master; or possess 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.

While it is the practice of the DLNR-SHPD to consider most historic properties significant under Criterion d at a minimum, it is clear that traditional cultural properties by definition would also be significant under Criterion e. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Pa‘akai O Ka ‘Āina* v Land Use Commission court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights

will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

An analysis of the culture-historical background reveals that Keaʻau Ahupuaʻa and the Puna District as a whole is described in many traditional accounts. Some legendary accounts describe Puna as a fertile and rich land that was beloved by the deity Kāne. Although most of Puna has been altered by years of ongoing volcanic activity, isolated *kīpuka* (vegetated oasis surrounded by lava) containing deep soils and lush vegetation can still be found. These naturally occurring features are also observed along the coast between Keaʻau and Waiākea Ahupuaʻa, where pockets of white sand remain. Such examples include Hāʻena Beach, which is one of the few remaining white sand beaches in the district. These traditional accounts, especially those concerning the Pele clan also track important environmental changes. While stories of the Pele clan in Puna abound, traditional lore informs us that they are a migratory family whose origins are set in Kahiki. Upon their arrival in Hawaiʻi, the leading clan member, Pelehonuamea sets out in search of a suitable home. After digging many craters on the various islands, Pele finds Kīlauea as the most suitable place. As the goddess of lava, Pele, known for her hot temper engages in many dreadful fights that drastically transform the district into one of cinders and fields of hardened black lava. As desolate as these new lava beds appear, they provide the foundation for new vegetation such as the *ʻōhiʻa* found primarily in the uplands and the coastal plant, *hala*, both of which are found in abundance throughout the district.

Historical accounts describe densely populated settlements scattered along the Puna coastline, some of which utilized the *hala* groves for the cultivation of staple food crops, including *kalo*. Depressions found in the undulating terrain, as well as the treetops, were also planted with crops. While the harsh terrain of Puna may not appear to be the ideal conditions for agriculture, it was not a limiting factor for the native inhabitants. These early Historical accounts also shed light on Puna's political history, describing it a having an insignificant role in shaping the island's politics. Following the arrival of Captain James Cook, foreign interest in the Puna District grew significantly. Many of these early visitors were drawn to this rural district to witness the fires of Pele at Kīlauea or to spread Christianity. By the mid 19th century, the native population in Puna as elsewhere in the islands continued to decline, and the ever-growing population of foreigners propelled major changes, especially the system of land ownership. The shift to a Euro-American style of land tenure resulted in the *Māhele ʻĀina*, which began in 1848 and lasted until the early 1850s. As a result of this sweeping change, William Charles Lunalilo became the first to own the Keaʻau Ahupuaʻa in fee simple. Legal issues surrounding the chief's will lead to the auctioning of the roughly 65,000-acre *ahupuaʻa*, which was sold at an 1881 public auction to William H. Shipman, Captain J. Elderts, and Samuel M. Damon. By the turn of the 20th century, William. H. Shipman and his wife Mary (W.H. Shipman Limited) were the sole owners of the entire Keaʻau Ahupuaʻa. This *ahupuaʻa*, as elsewhere throughout the islands were experiencing a surge of economic changes that coincided with the booming sugar, lumber, and agricultural industries. Between 1899 and 1984, the ʻŌlaʻa Sugar Company later renamed as Puna Sugar Company had a firm hold in the Keaʻau area; altering the landscape and adding to the cultural fabric of the district. Although sugarcane fields were widespread throughout Keaʻau, sugar maps

Throughout the 20th century, the sugar industry experienced a massive decline, and within the Keaʻau area, much of the formerly leased lands were returned to W.H. Shipman Limited, who began diversifying their operations. By the 1980s, roughly 485 acres were set aside to create the W.H. Shipman Business Park, which has evolved over the years and now services many locally owned industries and international corporations.

A review of the previous studies conducted within and adjacent to the study area indicate that the western portion of the study area parcel in addition to the nearby land has been subjected to intensive modifications. These modifications, most of which are associated with commercial agriculture and the development of transportation routes during the Historic Period has obliterated much of the Precontact landscape. Although portions of the study area have been impacted by the sugar industry, the 40-acre parcel delineated as the proposed site for the East Hawaiʻi Organics Facility lay beyond the limits of the cultivated areas and has therefore not been subjected to the intensive ground disturbing methods often used to clear and plow the fields. The Archaeological Literature Review conducted as part of the New Compost Facility Siting Study (AECOM 2018: Appendix B) further supports these view as it was concluded that complete prior archaeological coverage by Rosendahl (1982) and Hunt (1993) of the entire study area yielded no archaeological features and that this site has been completely disturbed in modern times. Because of the lack of archaeological features and the extensive ground disturbance, this site (described as Site 2 in the AECOM 2018 study) was the preferred location for the proposed facility. Based on these findings, we anticipate no archaeological sites to be present within the study area.

As a result of the consultation process, no specific traditional cultural practices were identified to exist or have taken place within the current study area. Although no specific cultural practices were described as occurring within the study area, the greater Keaʻau Ahupuaʻa is well documented in traditional and Historic-era accounts. The adjacent

Panaʻewa Forest is known through legendary accounts specifically the story of Pele and Hiʻiaka to be associated with the *moʻo* Panaʻewa as well as the site where Pele planted her *pāoa*, from which the Panaʻewa forest grew.

Through the consultation process, the concern over the spread of invasive pests, like Fire Ants and diseases, specifically Rapid ʻŌhiʻa Death (ROD) into and from the facility was a serious concern. Although Mr. J.B. Friday indicated that ROD had been confirmed in the study area vicinity, he as well as Mrs. Kanahele, and Ms. Francisco were adamant about implementing strict disposal protocols that prohibit any *ʻōhiʻa* cuttings from being disposed of at the proposed facility. Based on their shared concern, we recommend that the County install bold signage that educates the public of the reasons why *ʻōhiʻa* will not be accepted at the facility. The authors of this study believe that taking an educational approach is an opportunity to make people aware of the devastating impacts this disease has already caused. We recommend that the signage highlights both the ecological and cultural importance of this endemic plant and provide ideas on how the public can help to mitigate the spread of this minimally understood disease. Additionally, providing educational training classes to all future facility employees about ROD should also be implemented. In this way, employees can help to reinforce the proposed *ʻōhiʻa* disposal protocols.

While prohibiting any *ʻōhiʻa* from entering the facility would be ideal, it is also imperative that the County develop precautionary measures that will prevent the spread of ROD. Ms. Francisco and the authors of this study strongly recommend that the County implement sanitizing protocols for any machinery that does come into contact with *ʻōhiʻa*. Sanitizing protocols are currently utilized by many forestry programs throughout Hawaiʻi Island.

Additionally, it is imperative that these preventative protocols be adapted as new research concerning ROD emerges. To ensure the County is operating with the latest research findings, we further recommend that the County continue to develop partnerships with the various research agencies whose focus is on ROD, which include but is not limited to the University of Hawaiʻi at Mānoa College of Tropical Agriculture and Human Resources, Department of Land and Natural Resources, Division of Forestry and Wildlife, Big Island Invasive Species Committee, and the USDA Forest Service Institute of Pacific Islands Forestry.

Given ROD has been confirmed near the study area vicinity, creating a *kīpuka* that will help with reforesting efforts is another step that should be implemented. Mr. Friday and the authors of this study recommend that the County includes different types of *ʻōhiʻa* and other native species that mimic the plant communities found in the nearby native forest into any landscaping plans. The planting of *ʻōhiʻa* and other natives species on the proposed property is an opportunity to create a small scale *kīpuka* that can serve as a seed, which can help replenish the nearby forest that has been hard hit by ROD.

As expressed by the consulted parties, another preventative measure that should be implemented is the need to test and sterilize all compost material before it is distributed to the public. Mr. Friday stated that one way to kill off any bacteria and pest is to ensure the compost piles reach the proper temperatue. Mr. Friday stated that the compost piles should reach a minimum of 130° Farenheight to kill of ROD. Additional research would be required to identify various pests and diseases and to determine the proper temperature that will kill the identified pest and diseases.

Additionally, given the location of the proposed facility and its relevance to areas mentioned in many traditional accounts, Mrs. Kanahele and the authors of this study also recommended that the County explore giving the facility as well as its components names that reflect the area's cultural history. This would require additional consultation with knowledgeable individuals or organizations.

In summary, given the absence of archaeological features and the lack of any ongoing traditional practices associated with the study area, we anticipate this project to have no significant cultural impact. However, the proximity of the proposed facility to the native *ʻōhiʻa* forest warrants significant precautionary measures. For Native Hawaiians, cultural and natural resources are often viewed as one in the same. We therefore, contend that if this facility facilitates the spread of ROD in any way, the resulting effect would indeed be a significant cultural impact. The recommendations provided above are protective measures that we believe will inhibit the spread of ROD, and thus function to mitigate any potential cultural impact.

REFERENCES CITED

AECOM
2018 New Compost Facility Siting Study. Prepared for the County of Hawai‘i, Department of Environmental Management, Solid Waste Division.

Anderson, R.
1865 *The Hawaiian Islands: Their Progress and Condition Under Missionary Labors*. Third Edition. Gould and Lincoln, New York.

Athens, J. S., T. Rieth, and T. Dye
2014 A Paleoenvironmental and Archaeological Model-Based Age Estimate for the Colonization of Hawai’i. *American Antiquity* 79(1): 144–155.

Baldwin, C.
1908 *Geography of the Hawaiian Islands*. American Book Company, New York.

Barrera, W., Jr.
1971 Anaehoomalu: A Hawaiian Oasis. Preliminary Report of Salvage Research in South Kohala, Hawaii. *Pacific Anthropological Records* No. 15. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Barrère, D.
1959 Political History of Puna. In *Natural and Cultural History Report on the Kalapana Extension of the Hawai‘i Volcanoes National Park*: Vol. I, pp. 15-65. Compiled by Emory, K.P., W.J. Bonk, Y.H. Sinoto, D.B. Barrere, Department of Anthropology, B.P. Bishop Museum, Honolulu.

Beaglehole, J.
1967 *The Journals of Captain James Cook on His Voyages of Discovery*. The Hakluyt Society, London (edited from the original manuscripts by J. Beaglehole).

Beamer, K.
2014 *No Mākou Ka Mana Liberating the Nation.* Kamehameha Publishing, Honolulu.

Beckwith, M.
1970 *Hawaiian Mythology*. University of Hawaii Press, Honolulu.

Best, G.
1978 *Railroads of Hawai‘i.* Golden West Books: San Marino, California.

Bird, I.
1875 T*he Hawaiian Archipelago:Six Months Among the Palm Groves, Coral Reefs, & Volcanoes of the Sandwich Islands.* John Murray, London.

Brigham, W., and J. Stokes
1906 Memoirs of the Bernice Pauahi Bishop Museum, Volume II, Number I. Bishop Museum Press, Honolulu.

Burtchard, G., and P. Moblo
1994 Archaeology in the Kīlauea East Rift Zone, Part 1: Land-Use Model and Research Design, Kapoho, Kamā‘ili and Kīlauea Geothermal Subzones, Puna District, Hawai‘i. Prepared for U.S. Department of Energy, Oak Ridge Operations Office, Tennessee.

Campbell, S., and P. Ogburn
1992 Hawaiian Sugar Planter's Association Plantation Archives, Register of the Olaa Sugar Company Olaa, Hawai'i, 1897-1991.

Chaney, G.
1880 *Alo'ha! A Hawaiian Salutation*. Roberts Brothers, Boston.

Chinen, J.
1958 *The Great Mahele: Hawaii's Land Division of 1848.* Honolulu, Hawai'i: University of Hawaii Press.

1961 *Original Land Titles in Hawaii.* Honolulu, Hawai'i: privately published.

Clark, M., R. Rudolph, and R. Rechtman
2001 An Archaeological Inventory Survey of TMK: 3-1-5-02:24, Waiakahiula Ahupua'a, Puna District, Island of Hawai'i. *Rechtman Consulting Report RC-0066.* Prepared for Mr. Scott Gouker, Power Electric, Pāhoa, Hawai'i.

Coan, T.
1882 *Life in Hawaii An Autobiographic Sketch of Mission Life and Labors (1835-1881).* Anson D.F. Randolph & Company, New York.

College of Atropical Agriculture and Human Resources
n.d. Rapid 'Ōhi'a Death. Internet source: https://cms.ctahr.hawaii.edu/rod/HOME.aspx. Accessed April 25, 2018.

Cordy, R.
1994 A Regional Synthesis of Hamakua District, Hawai'i Island. Historic Preservation Division, DLNR, State of Hawai'i.

Del Mar, W.
1904 *Around the World Through Japan*. Adam and Charles Black, London.

Department of Land and Natural Resources
2016 Environmental Assessment Waiākea Timber Management Area Sustainable Commercial Harvest of Timber. Prepared for the Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu.

Desilets, M., and R. Rechtman
2004 Archaeological Assessment of a 112 Acre Property (TMK: 3-1-6-03: por. 07 and 3-1-6-146:17, Kea'au Ahupua'a, Puna District, Island of Hawai'i. Rechtman Consulting, LLC Project Number RC-0260). Prepared for Dean Hirabayashi, Honolulu.

Dibble, S.
1843 *History of the Sandwich Islands*. Lahainaluna Press of the Mission Seminary, Lahaina.

Dorrance, W. and F. Morgan
2000 *Sugar Islands: The 165-year Story of Sugar in Hawai'i.* Mutual Publishing, Honolulu.

Elkin, W.
1904 Hero Tales from Hawaiian History, Chapter III. *Oregon Teachers Monthly* 8(5):26-27.

Ellis, W.
1825 *A Journal of a Tour Around Hawaii, the Largest of the Sandwich Islands*. Crocker & Brewster, No. 50, Cornhill.

2004 *Journal of William Ellis a Narrative of an 1823 Tour Through Hawaii*. Mutual Publishing, Australia

Emerson, N.
1915 Pele and Hiiaka: A Myth From Hawai‘i. Honolulu Star-Bulletin Limited. Honolulu.

Escott, G.
2013 An Archaeological Inventory Survey Report for the Kea‘au HMSA Site in Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, Hawai‘i [TMK: (3) 1-6-002:004, 006, and 007]. Scientific Consultant Services, Inc. (SCS) Project Number 1472-2. Prepared for Hawai‘i Medical Service Association, Honolulu.

2017 An Archaeological Inventory Survey Report for the Kea‘au Shipman Office Property in Kea‘au Town, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, Hawai‘i [TMK: (3) 1-6-002:019-022, 099, 101-103]. Scientific Consultant Services, Inc. (SCS) Project Number 1833-2. Prepared for KZ Companies, LLC, San Diego.

Ewart, N., and M. Luscomb
1974 Archaeological Reconnaissance of Proposed Kapoho–Keaukaha Highway, District of Puna, Island of Hawaii. Department of Anthropology, Bernice P. Bishop Museum, Honolulu, Hawaii. Prepared for Sam O. Hirota, Inc. and Department of Public Works, County of Hawaii.

Farias, M., A. Mitchell, and H. Hammatt
2009 Cultural Impact Assessment for the Kea‘au-Pāhoa Road Widening Project, Kea‘au Ahupua‘a to Waiakahiula Ahupua‘a, Puna District, Hawai‘i Island, TMK: [3] 1-5 (various plats and parcels); 1-6 (various plats and parcels). Cultural Surveys Hawai‘i Job Code: KEAAU3. Prepared for SSFM International, Inc.

Fornander, A.
1918-1919 *Hawaiian Antiquities and Folklore (Vol. 5) Memoirs of the Bernice Pauahi Bishop Museum.* Bishop Museum Press, Honolulu.

1969 *An Account of the Polynesian Race: Its Origin and Migrations*. Tokyo: Charles E. Tuttle Co., Inc.

1996 *Ancient History of the Hawaiian People*. Mutual Publishing, Australia.

Gelett, C.
1917 A Life on the Ocean: Autobiography of Captain Charles Wetherby Gelett, A Retired Sea Captain Whose Life Trail Crossed and Recrossed Hawaii Repeatedly. The Advertiser Historical Series No. 3. Hawaiian Gazette Co., Ltd., Honolulu.

Giambellucca, T., Q. Chen, A. Frazier, J. Price, Y. Chen, P. Chu, J. Eischeid, and D. Departe
2013 Online Rainfall Atlas of Hawai‘i. *Bull. Amer. Meteor. Soc.* 94, 313-316, doi: 10.1175/BAMS-D-11-00228.

Giambelluca, T., X. Shuai, M. Barnes, R. Alliss, R. Longman, T. Miura, Q. Chen, A. Frazier, R. Mudd, L. Cuo, and A. Businger
2014 Evapotransporation of Hawai‘i. Final report submitted to the U.S. Army Corps of Engineers, Honolulu District, and the Commission on Water Resource Management, State of Hawai‘i.

Greene, L.
1993 A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai‘i Island. United States Department of the Interior, National Park Service, Denver Service Center.

Hammatt, H.
1978 Archaeological Reconnaissance of the Proposed Kings Landing Subdivision, Kea‘au, Puna, Island of Hawai‘i. Archaeological Research Center, Hawai‘i, Inc. Lawa‘i.

Handy, E.S.C.
1940 The Hawaiian Planter Volume 1, His Plants, Methods and Areas of Cultivation. *B.P. Bishop Museum Bulletin 161*. Honolulu.

1993 *The Polynesian Family System in Ka-‘u, Hawai‘i*. Charles E. Tuttle Company, Inc., Rutland.

Handy, E.S.C., E.G. Handy (with M. Pukui)
1991 *Native Planters in Old Hawaii: Their Life, Lore and Environment. B.P. Bishop Museum Bulletin* 223. Honolulu: Department of Anthropology, Bishop Museum Press. (Revised Edition).

Harper’s Magazine
1875 “Hawaii Nei II.—”. Volume XLVII, June to November 1873:552.

Haun, A., and D. Henry
2004 Archaeological Assessment Survey Keaau-Pahoa Road Shoulder Lane Conversion, Land of Keaau, Puna District, Island of Hawai‘i. Haun & Associates, Kea‘au.

2008 Archaeological Inventory Survey Portions of TMK (3) 1-6-04:11, 47-53, 55, 56 and 1-6-64:266-269, 283-286 Land of Kea‘au, Puna District, Island of Hawai‘i. Haun & Associates, Kea‘au, Hawai‘i.

Holmes, B.
1908 *Burton Holmes Travelogues*. Volume Five. The McClure Company, New York.

Holmes, T.
1985 A Preliminary Report on the Early History and Archaeology of the Puna Forest Reserve/Wao Kele o Puna Natural Area Reserve. Prepared for True/Mid Pacific Geothermal, Inc.

Hommon, R.
1986 Social Evolution in Ancient Hawai‘i. IN Kirch, P.V. (ed.), *Island Societies: Archaeological Approaches to Evolution and Transformation*: 55-88, University Press, Cambridge.

Ho‘oulumāhiehie
2006 *Ka Mo‘olelo o Hiiakaikapoliopele*. Trans. By P. Nogelmeier. Awaiaulu, Honolulu.

Hunt, T.
1993 Assessment of Shipman Lands in Kea‘au, Puna, Island of Hawai‘i. University of Hawai‘i, Honolulu.

Hurst, G.
1994 Archaeological Survey of the Kea‘au Pahoa Road, Keaau Town Section. Ogden Environmental and Energy Services Co., Inc., Honolulu.

‘Ī‘ī, J.
1959 *Fragments of Hawaiian History*. Bishop Museum Press, Honolulu.

Jarves, J.J.
1847 *History of the Hawaiian Islands: Embracing Their Antiquities, Mythology, Legends, Discovery by Europeans in the Sixteenth Century, Re-Discovery by Cook, With Their Civil, Religious and Political History, From the Earliest Traditionary Period to the Present Time*. Charles Edwin Hitchcock, Honolulu.

Kalākaua, D.
1972 *The Legends and Myths of Hawaii. The Fables and Folk-Lore of a Strange People*. Rutland, Vermont and Tokyo, Japan: Charles E. Tuttle Co., Inc. R. Dagget, editor. (Original Publication 1888 [First Tuttle edition]).

Kamakau, S.
1976 The Works of the People of Old, Na hana a ka Poʻe Kahiko. *B.P. Bishop Museum Special Publication 61*. Bishop Museum Press, Honolulu, Hawaiʻi.

1992 *Ruling Chiefs of Hawaii*. The Kamehameha Schools Press, Honolulu (Revised Edition).

Kanahele P.
2011 *Ka Honua Ola ʻEliʻeli Kau Mai*. Kamehameha Publishing, Honolulu.

Kanahele, P. and D. Wise
1989 *Ka Honua Ola (The Living Earth): An Introduction to Pele and Hiʻiaka with Annotated Bibliography*. The Center for Hawaiian Studies at the University of Hawaiʻi at Mānoa.

Ka Nūpepa Kūʻokoʻa
1865 "Ka Hoomana Kahiko, Helu 5." 2 February 1865.

Kaui, S.M.
1865-1866 "He Kaʻao no Pikoiakaalala, Ke Keiki Akamai i ka Pana". *Ka Nūpepa Kūʻokoʻa.* December 6, 1865 through March 3, 1866.

Kent, N.
1983 *Hawaii: Islands Under the Influence*. University of Hawaiʻi Press, Honolulu.

King,
n.d. Hawaiian Land Titles. Department of Accounting and General Services, Hawaiʻi State Archives. Internet source: https://ags.hawaii.gov/wp-content/uploads/2012/09/Hawn-Land-Titles-by-Robert-King.pdf. Accessed April 11, 2018.

Kinney, H.
1913 *The Island of Hawaii*. Hilo Board of Trade, Hilo.

Kirch, P.
1984 *The Evolution of the Polynesian Chiefdoms*. Cambridge University Press, New York.

1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. University of Hawaii Press, Honolulu.

2011 When did the Polynesians Settle Hawaiʻi? A Review of 150 Years of Scholarly Inquiry and a Tentative Answer. *Hawaiian Archaeology* Vol. 12:3-26.

Komori, E.
1987 Cultural and Biological Resources Survey of the Pohoiki to Puna Substation 69KV Transmission Corridor, Kapoho to Keaʻau, Puna, Hawaiʻi Island. Bernice Pauahi Bishop Museum, Honolulu.

Kuykendall, R., and A. Day
1976 *Hawaii: A History From Polynesian Kingdom to American Statehood*. Prentice-Hall, Inc., Englewood Cliffs.

Maly, K.
1998 *"PUNA, KA 'ĀINA I KA HIKINA A KA LĀ."* A Cultural Assessment Study–Archival and Historical Documentary Research and Oral History Interviews for the Ahupua'a of 'Ahalanui, Laepāo'o, and Oneloa (with Pohoiki), District of Puna, Island of Hawai'i (TMK:1-4-02, por.07,13,73,74,75). Prepared for David Matsuura, A & O International Corporation; Oneloa Development, Hilo, Hawai'i.

2002 The Māhele 'Āina (The Land Division) An Overview of Documentation Found in the Claims and Awards of the Māhele. Kumu Pono Associates.

Masterson, I. and H. Hammatt
1998 Archaeological Inventory Survey for the Proposed Kea'au Elderly Housing Project, Kea'au, Puna District, Hawai'i Island (TMK: 1-6-143: por. Of 18 and 39). Cultural Surveys Hawai'i, Inc., Kailua.

McEldowney, H.
1979 Archaeological and Historical Literature Search and Research Design: Lava Flow Control Study, Hilo, Hawai'i. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for U.S. Army Engineer Division, Pacific Ocean.

McGerty, L., and R. Spear
2000 An Archaeological Inventory Survey of the Proposed K.S.B.E. East Hawai'i Campus, Kea'au Ahupua'a, Puna District, Island of Hawai'i [TMK: 1-6-03: por.12]. Scientific Consultant Services, Inc., Honolulu.

Musick, J.
1898 *Hawaii…Our New Possessions, An Account of Travels and Adventure, With Sketches of the Scenery, Customs and Manners, Mythology and History of Hawaii to the Present, and An Appendix Containing the Treaty of Annexation to the United States*. Funk & Wagnalls Company, New York.

Nimmo,H.
1990 The Cult of Pele in Traditional Hawai'i. Bishop Museum Occasional Papers. Bishop Museum. Volume 30. June 1990.

'Ōla'a Sugar
1939 *Fortieth Annual Report of the Olaa Sugar Company Limited for the Year Ending December 31, 1938.* Adverti ser Publishing Co. Ltd., Honolulu.

1942 *Forty-third Annual Report of the Olaa Sugar Company Limited for the Year Ending December 31, 1941*. Advertiser Publishing Co. Ltd., Honolulu.

1944 *Forty-fifth Annual Report of the Olaa Sugar Company Limited for the Year Ending December 31, 1943*. Advertiser Publishing Co. Ltd., Honolulu.

Paradise of the Pacific
1893 "Curiosities of Puna". Volumes 6-15, April 1893:11.

Pogue, J.
1978 *Mooleo Hawaii.* Hale Paipalapala Aupuni, Honolulu (Revised Edition).

Pukui, M.K.
1983 *'Ōlelo Noeau*, Hawaiian Proverbs & Poetical Sayings. *B.P. Bishop Museum Special Publication 71*. Bishop Museum Press, Honolulu.

Pukui, M. and L. Green
1995 *Folktales of Hawai'i, He Mau Ka'ao Hawai'i.* Bishop Museum Press, Honolulu.

Pukui, M. and S. Elbert
1986 *Hawaiian Dictionary, Hawaiian-English, English-Hawaiian*. University of Hawaii Press, Honolulu.

Rechtman, R., and K. Maly
2003 Cultural Impact Assessment for the Propsed Development of TMK:3-7-3-9:22, 'O'oma 2nd Ahupua'a, North Kona District, Island of Hawai'i, Volume I and II. Rechtman Consulting Report RC-0154. Prepared for Helber Hastert & Fee, Honolulu.

Rechtman, R., and L. Tam Sing
2018 An Archaeological Inventory Survey of TMK: (3) 1-6-003:103, Kea'au Ahupua'a, Puna District, Island of Hawai'i. ASM Affiliates Report Number 29040.00. Prepared for Lili'uokalani Trust, Honolulu.

Rosendahl, M.
1982 Archaeological Reconnaissance Survey, Proposed W.H. Shipman Industrial Park, TMK: 3-1-6-03: Por. 12. Paul H. Rosendahl, Ph.D., Inc. Report Number Ms. 75-112282. Prepared for Dennis Shigeoka, Hilo.

Rosendahl P.
1972 Archaeological Salvage of the Hapuna-Anaehoomalu Section of the Kailua-Kawaihae Road (Queen Kaahumanu Highway), Island of Hawaii. *Departmental Report Series* 72-5. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Rosendahl, P., and A. Walker
1992 Archaeological Field Inspection of TMK 3-1-7-17:3, Land of Ola'a, Puna District, Hawai'i. Paul H. Rosendahl, Ph.D., Inc., Hilo.

Royal Hawaiian Agricultural Society
1853 Proceedings of the Royal Agricultural Society, Third Annual Meeting, Honolulu, June 7, 1853. In *The Transactions of the Royal Hawaiian Agricultural Society* Vol. 1. No. 4. Honolulu, H.I., Governement Press. pp. 3-18.

Schmitt, R.
1973 The Missionary Census of Hawaii. *Pacific Anthropological Records No. 20*, Department of Anthropology B.P. Bishop Museum, Honolulu.

Schilt, R., and A. Sinoto
1980 Limited Phase I Archaeological Survey of Mahukona Properties, North Kohala, Island of Hawai'i. B.P. Bishop Museum, Honolulu. Prepared for Belt, Collins and Associates.

Sherrod, D. R., J. M. Sinton, S. E. Watkins, and K. M. Brunt
2007 Geologic Map of the State of Hawai'i. *Open-File Report 2007-1089*. U.S. Department of the Interior, U.S. Geological Survey. http://pubs.usgs.gov/of/2007/1089/.

Shipman, W.H.
2012 W.H. Shipman Business Park at Kea'au, Hawai'i. http://www.whshipman.com/business-parks/kea%CA%BBau/. Accessed at W.H. Shipman Limited website, April 23, 2017.

Sinoto, Y., and M. Kelly
1975 Archaeological and Historical Survey of Pakini-Nui and Pakini-Iki Coastal Sites, Waiahukini, Kailikii, and Hawea, Kaʻu, Hawaii. *Departmental Report Series* 75-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. (final report 1970).

Soil Survey Staff
2017 Web Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture. Accessed on April 24, 2018 at the USDA Web Soil Survey website, https://websoilsurvey.sc.egov.usda.gov/App/Help/Citation.htm.

Spencer, C., N. Ishihara, and H. Hammatt
2017 [Draft] Cultural Impact Assessment for the Keaʻau Zero Waste Facility, Keaʻau Ahupuaʻa, Puna District, Hawaiʻi Island, TMKs: [3] 1-6-151:002 and portions of 003, 006, and 999. Cultural Surveys Hawaiʻi, Inc. Job Code KEAAU 12). Prepared for the Limtiaco Consulting Group.

Stoddard, C.
1897 *A Trip to Hawai'i With Descriptive Introduction.* Passenger Department, Oceanic Steamship Co., San Francisco.

Summers, C.
1999 *Material Culture, The J.S. Emerson Collection of Hawaiian Artifacts*. Bishop Museum Press, Honolulu.

The Mid-Pacific Magazine
1920 "Motoring on the Island of Hawaii". Volume XIX, January 1920:369.

The Missionary Herald
1885 "The Native Sandwich Islanders". Volume 81:385-387.

Tatar, E.
1982 Nineteenth Century Hawaiian Chant. *Pacific Anthropological Records 33.* Department of Anthropology, B.P. Bishop Museum, Honolulu.

Thrum, T.
1885 *Hawaiian Almanac and Annual for 1885, A Hand Book of Information On Matters Relating to the Hawaiian Islands, Original and Selected, of Value to Merchants, Planters, Tourists and Others*. Thos. G. Thrum, Honolulu.

1886 *Hawaiian Almanac and Annual for 1887, A Hand Book of Information on Matters Relating to the Hawaiian Islands, Original and Selected, of Value to Merchants, Planters, Tourists and Others.* Press Publishing Company, Honolulu.

1920 *Hawaiian Almanac and Annual for 1921, The Reference Book of Information and Statistics Relating to the Territory of Hawaii, of Value to Merchants, Tourists, and Others.* Thos. G. Thrum, Honolulu.

Twain, M.
1913 *Roughing It*. Vol. II. Harper & Brothers Publishers, New York.

Walker, A., K. Maly, and P. Rosendahl
1997 Archaeological and Historical Research of the Proposed Keaʻau High School Site, Puna District, Island of Hawaiʻi. Paul H. Rosendahl, Ph.D., Inc, Hilo.

Westervelt, W.D.
1915 Keaunini. *Legends of Gods and Ghosts (Hawaiian Mythology) Collected and Translated from the Hawaiian*. William Drake Westervelt, Honolulu.

1916 *Hawaiian Legends of Volcanoes (Mythology) Collected and Translated from the Hawaiian*. William Drake Westervelt, Honolulu.

Wheeler, M., S. Wilkinson, and H. Hammatt
2015 Archaeological Literature Review and Field Inspection for Buildings B, D, E and G Demolition Project at Keaʻau Middle School, Keaʻau Ahupuaʻa, Puna District, Island of Hawaiʻi, TMK: (3) 1-6-002:001 and 1-6-003:059. Cultural Surveys Hawaiʻi, Inc., Kailua.

Whitney, H.M.
1875 *Hawaiian Guide Book, Containing A Brief Description of the Hawaiian Islands, Their Harbors, Agricultural Resources, Plantations, Scenery, Volcanoes, Climate, Population, and Commerce*. First Edition. White & Bauer, San Francisco.

1895 *The Tourists' Guide Through the Hawaiian Islands Descriptive of Their Scenes and Scenery*, Henry M. Whitney, Honolulu.

Wilkes, C.
1845 *Narrative of the United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842.* Vol. IV. Lea & Blanchard, Philadelphia.

Wilkinson, S., A. Mitchell, and H. Hammatt
2010 [Draft] Archaeological Inventory Survey Report for the Keaʻau-Pahoa Road Widening Project, Keaʻau Ahupuaʻa to Waiakahiula Ahupuaʻa, Puna District, Hawaiʻi Island, TMK: [3] 1-5 (various plats and parcels); 1-6 (various plats and parcels). Cultural Surveys Hawaiʻi, Inc. Job Code Keaau 2. Prepared for SSFM International, Inc.

Wolfe, E., and J. Morris
1996 Geologic Map of the Island of Hawaiʻi. Geologic Investigations Series Map 1-2524-A. U.S. Department of the Interior, U.S. Geological Survey.

Yent, M. and J. Ota
1982 Archaeological Reconnaissance Survey, Nanawale Forest Reserve, Halepuaʻa Section, Puna, Hawaii Island. On file, State Historic Preservation Office, Department of Land and Natural Resources.

APPENDIXA
PUBLIC NOTICE PUBLISHED IN *KA WAI OLA* NEWSPAPER

HO'OLAHA LEHULEHU
mei2018 21

PUBLIC NOTICE

ASM Affiliates is preparing a Cultural Impact Assessment (CIA) for the proposed East Hawai'i Organics Facility located in Kea'au Ahupua'a, Island of Hawai'i (TMK: (3) 1-6-003:090 por.). We are seeking consultation with any community members that might have knowledge of traditional cultural uses of the proposed project area; or who are involved in any ongoing cultural practices that may be occurring on or in the general vicinity of the subject property, which may be impacted by the proposed project. If you have and can share any such information please contact Bob Rechtman brechtman@asmaffiliates.com, or Lokelani Brandt lbrandt@asmaffiliates.com, phone (808) 969-6066, mailing address ASM Affiliates 507A E. Lanikāula Street, Hilo, HI 96720. ■

Appendix F

Archaeological Literature Review and Field Investigation

This page intentionally blank.

Draft
Archaeological Literature Review and Field Inspection Report for the Compost Facility Project, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island TMK: [3] 1-6-003:090 por.

Prepared for
SSFM International

Prepared by
Olivier M. Bautista, B.A.,
McKenzie Wildey, B.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: KEAAU 15)

June 2018

O‘ahu Office
P.O. Box 1114
Kailua, Hawai‘i 96734
Ph.: (808) 262-9972
Fax: (808) 262-4950

www.culturalsurveys.com

Hawai‘i Office
399 Hualani St. Ste. 124
Hilo, Hawai‘i 96720
Ph.: (808) 965-6478
Fax: (808) 965-6582

Management Summary

Reference	Archaeological Literature Review and Field Inspection Report for the Compost Facility Project, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, TMKs: [3] 1-6-001:090 por. (Bautista et al. 2018)
Date	June 2018
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: KEAAU 15
Investigation Permit Number	CSH completed the fieldwork component of this study under archaeological fieldwork permit number 18-15, issued by the Hawai‘i State Historic Preservation Division (SHPD) per Hawai‘i Administrative Rules (HAR) §13-282.
Agencies	County of Hawai‘i (CoH); SHPD
Land Jurisdiction	Private
Project Proponent	COH
Project Location	The project area is located along Kipimana Street and Mikahala Street in W.H. Shipman Business Park, near the town of Kea‘au in Puna District on Hawai‘i Island, TMK: [3] 1-6-003:090 por. The project area is depicted on a portion of the 1995 Hilo and 1994 Mountain View (1996) U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.
Project Description	The purpose of this project is to construct an organic-materials composting facility to divert organic waste from CoH landfills. This will extend the life of landfills and generate compost and mulch for local subsistence and commercial agriculture. The facility will include the following primary features: • Approximately 3 acres of graded, paved, or graveled surface encompassing the primary site operations • A multi-bay enclosed receiving building (approximately 50 by 100 feet [ft]) for use as a tipping floor and for waste handling • A biofilter for treatment of air exhaust from the enclosed receiving building • A concrete surface (approximately 160 by 230 ft) for placement of compost windrows under a series of membrane covers • A stockpile area for finished compost • An access road, which may include pavement, curbs, and drainage • Utilities such as water and electricity • An on-site septic system for the office building • Leachate collection systems for containerization of runoff from waste handling areas • An area for grinding green waste and untreated wood pallets • A truck scale for weighing

	• An office building and onsite parking
Project Acreage	Approximately 40 acres (16.2 hectares)
Document Purpose	Archaeological historic and cultural background research and a field inspection of the project area determined that no historic properties are present. 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.
Fieldwork Effort	CSH archaeologists Olivier M. Bautista, B.A., and McKenzie Wildey, B.A., under the general supervision of Principal Investigator Hallett H. Hammatt, Ph.D., accomplished fieldwork on 29 March 2018. The fieldwork required 2 person-days to complete.
Results Summary	Background research indicated the project area lands were generally used during the pre-Contact period primarily for scattered swidden agriculture and associated temporary habitation. In the historic era, the project area and surrounds were heavily disturbed by cattle grazing and sugarcane cultivation. Additional mechanical alterations of grubbing and bulldozing related to modern agricultural use in the 1980's changed the landscape again in the project area. Given this history of known land use, little in the way of archaeological findings was anticipated. No archaeological features were observed during the field inspection. The project area has been completely disturbed in the modern era, and approximately half of the project area is presently planted in commercial papaya.
Recommendations	Based on the findings of this LRFI, the proposed Compost Facility project is not expected to affect any historic properties. Any pre-Contact and/or historic era subsurface deposits that may have once been present are likely to have been obliterated by bulldozing and plowing for agricultural plantings in the modern era. Undetected lava tubes may be present and can contain cultural materials and modifications including human burials. However, no lava tube openings were found in the project area and no lava tubes have been documented in the near vicinity. SHPD should be consulted for determination of project historic preservation requirements.

Table of Contents

Management Summary ..... **i**

Section 1 Introduction **1**

1.1 Project Background 1
1.2 Document Purpose 7
1.3 Environmental Setting 7
1.3.1 Natural Environment 7
1.3.2 Built Environment 9

Section 2 Methods **10**

2.1 Field Methods 10
2.1.1 Pedestrian Survey 10
2.2 Research Methods 10

Section 3 Background Research **11**

3.1 Traditional and Historical Background 11
3.1.1 Mythological and Traditional Accounts 11
3.1.2 Early Historic Period 11
3.1.3 The Māhele and the Kuleana Act 13
3.1.4 Mid- to Late 1800s 13
3.1.5 1900s 14
3.1.6 Contemporary Land Use 22
3.2 Previous Archaeological Research 23
3.3 Background Summary and Predictive Model 28

Section 4 Results of Fieldwork **29**

4.1 Pedestrian Inspection Results 29

Section 5 Summary and Recommendations **34**

5.1 Summary 34
5.2 Recommendations 34

Section 6 References Cited **35**

List of Figures

Figure 1. Portion of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangle showing the location of the project area within the larger tax map parcel 2
Figure 2. Tax Map Key (TMK) [3] 1-6-003 showing the project area (Hawai‘i TMK Service 2014) 3
Figure 3. Aerial photograph showing the location of the project area (Google Earth 2013) within the larger tax map parcel 4
Figure 4. Conceptual layout illustrating proposed location within overall TMK: [3] 1-6-003:090 of compost facility area (current project area) and area of compost facility operations (in gray shading) (courtesy of client) within the larger tax map parcel 5
Figure 5. Conceptual compost facility layout (courtesy of client).....6
Figure 6. Overlay of Soil Survey of the State of Hawaii (Foote et al. 1972), indicating soil types within and surrounding the project area (USDA SSURGO 2001) 8
Figure 7. Portion of the 1901 map of Hilo Railroad, Olaa Division by C.H. Kluegel, showing the project area in relation to the Olaa Mill, the railroad, and other features in and around Kea‘au Village 15
Figure 8. Portions of the 1914 Waiakea and Mountain View USGS 7.5-minute topographic quadrangles showing the location of the project area in relation to Olaa Mill, the railroad, and other features in and around Kea‘au Village.....16
Figure 9. Portion of the 1928 map of Hawai‘i Island by Walter E. Wall, showing the project area in relation to Olaa Mill, the railroad, and other features in and around Kea‘au Village ...17
Figure 10. Portions of the 1963 Hilo and Mountain View USGS 7.5-minute topographic quadrangles showing the location of the project area in relation to the sugar mill, plantation camps in and around Kea‘au Village, and the network of jeep roads accessing the cane fields 18
Figure 11. 1977 USGS Orthophoto, showing the location of the project area in relation to features discussed in the text.....19
Figure 12. 1928 map of Hawai‘i Island by Walter E. Wall, overlain with the route of the Hawai‘i Consolidated Railway ca. 1945, illustrating the various railway spurs in Puna district (figure from Treiber 2005).....20
Figure 13. Portion of the 1944 map of Hawai‘i Island by H.T. Stearns showing the location of the project area in relation to the railroad system 21
Figure 14. Portions of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangles showing the current project area in relation to previous archaeological studies in the vicinity 24
Figure 15. Photo of papaya fields in the project area; view to northeast.....30
Figure 16. Photo of papaya fields and a jeep road in the project area; view to north.....30
Figure 17. Photo showing the interface of fallow fields (foreground) and planted papaya fields (background) along the western border of the project area; view to north 31
Figure 18. Photo of a push pile between agricultural plots within the project area; view to southeast.....31
Figure 19. Photo of a large push pile (visible across center) located within a heavily vegetated portion of the project area; view to southeast 32

Figure 20. Photo showing a stand of albizia trees located along the southern boundary of the project area; view to west 32
Figure 21. Photo showing a thicket of bingabing and gunpowder trees near the eastern boundary of the project area; view to east 33
Figure 22. Photo showing a portion of a jeep road within the project area; view to east 33

List of Tables

Table 1. Previous archaeological studies in the vicinity of the project area 25

Section 1 Introduction

1.1 Project Background

At the request of SSFM International, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this literature review and field inspection report (LRFI) for the Compost Facility project, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, TMK: [3] 1-6-003:090 por. The project area is located along Kipimana Street and Mikahala Street in the W.H. Shipman Business Park. The project area is depicted on a portion of the 1995 Hilo and 1994 Mountain View U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1), a tax map plat (Figure 2), and a 2013 aerial photograph (Figure 3).

The proposed project involves the construction of an organics composting facility. The purpose of the project is to divert organics (e.g., green waste, food, paper, and compostable plastics) from disposal in the County of Hawaii (CoH) landfills to extend the life of the landfills and generate compost and mulch to support local subsistence and commercial agriculture. The facility will comprise a small area within an approximately 40-acre portion of the overall 424.303-acre parcel (Figure 4). The facility will be designed, constructed, and operated by a private contractor, Hawaii Earth Recycling (HER), under contract to the CoH. The facility will include a covered organic-material receiving building. that will accept organic materials such as food, paper, and green waste. Composting will occur within a United States (U.S.) Environmental Protection Agency (EPA)-approved GORE ™ Cover System that utilizes forced aeration of the compostable material under a semi-permeable membrane cover. This in-vessel composting method will minimize the environmental impacts of odor, pests, and dust and will decrease the composting time required.

According to the contract between the CoH and HER, the facility will be capable of processing up to 35,000 tons per year (tpy) of organic material, including up to 17,500 tpy of food waste once the facility is fully operational. The facility would include the following primary features (Figure 5):

- Approximately 3 acres of graded, paved, or graveled surface encompassing the primary site operations
- A multi-bay enclosed receiving building (approximately 50 by 100 feet [ft]) for use as a tipping floor and for waste handling
- A biofilter for treatment of air exhaust from the enclosed receiving building
- A concrete surface (approximately 160 by 230 ft) for placement of compost windrows under a series of membrane covers
- A stockpile area for finished compost
- An access road, which may include pavement, curbs, and drainage
- Utilities such as water and electricity
- An on-site septic system for the office building
- Leachate collection systems for containerization of runoff from waste handling areas
- An area for grinding green waste and untreated wood pallets
- A truck scale for weighing
- An office building and onsite parking

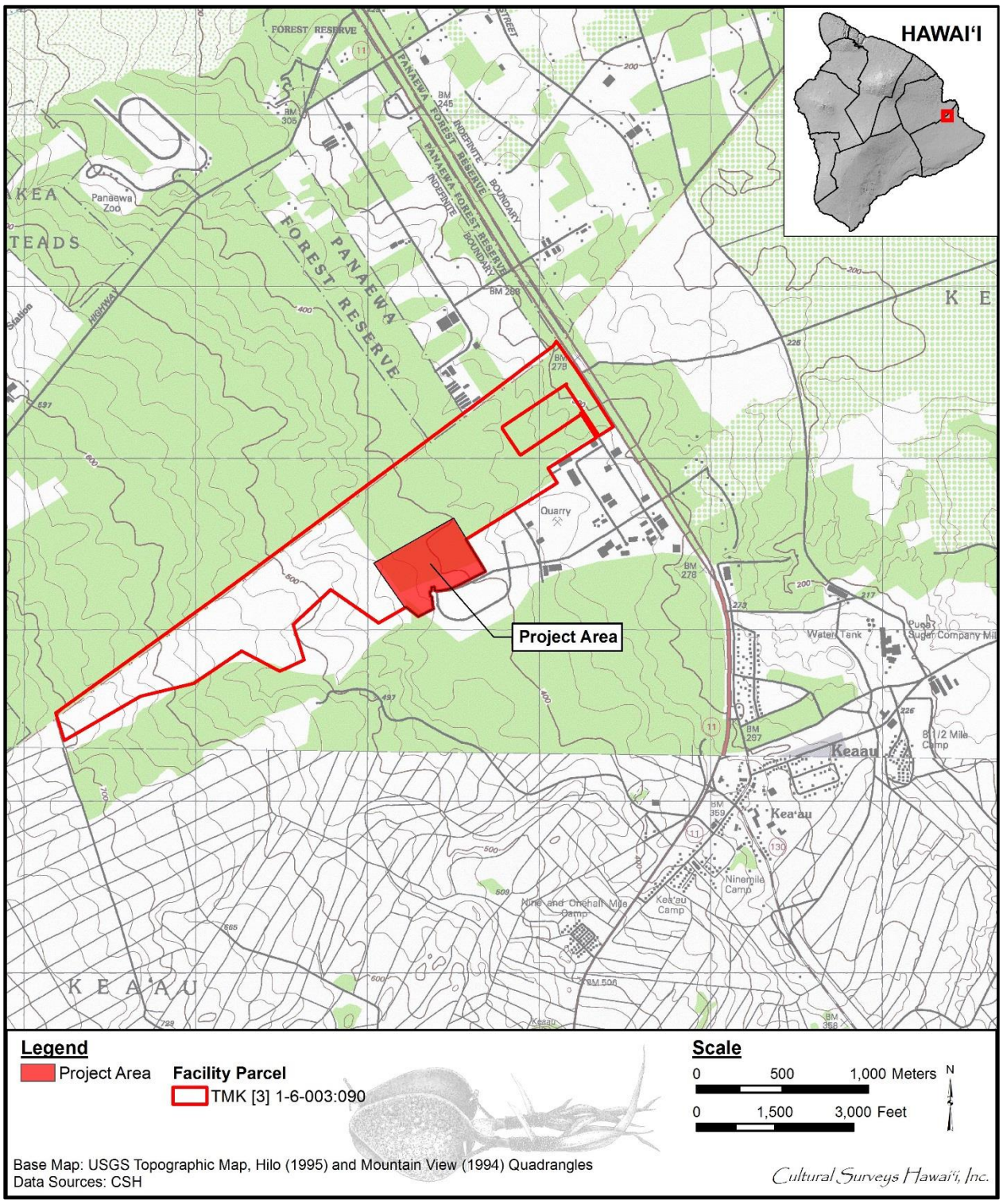


Figure 1. Portion of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangle showing the location of the project area within the larger tax map parcel

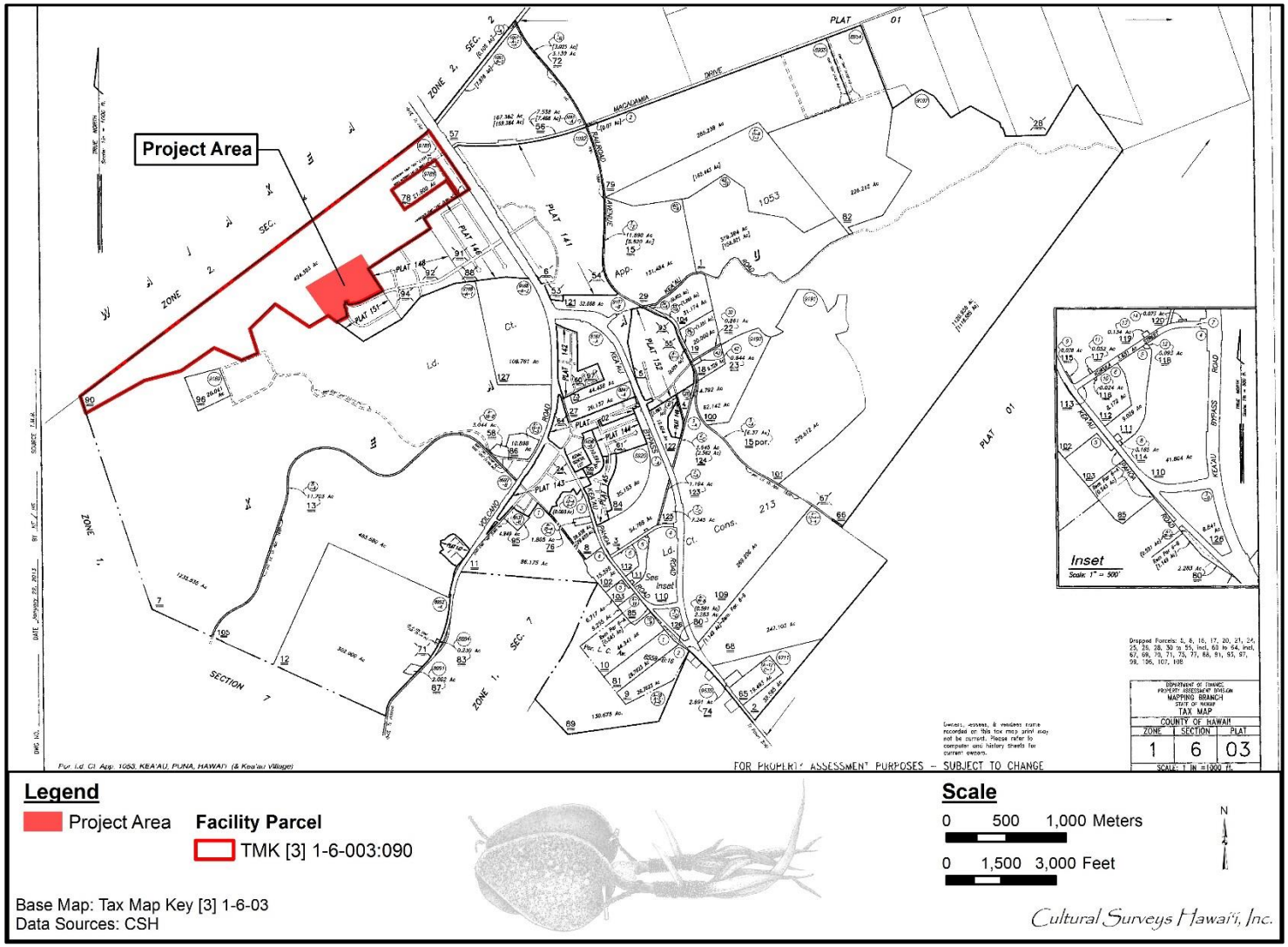


Figure 2. Tax Map Key (TMK) [3] 1-6-003 showing the project area (Hawai‘i TMK Service 2014)

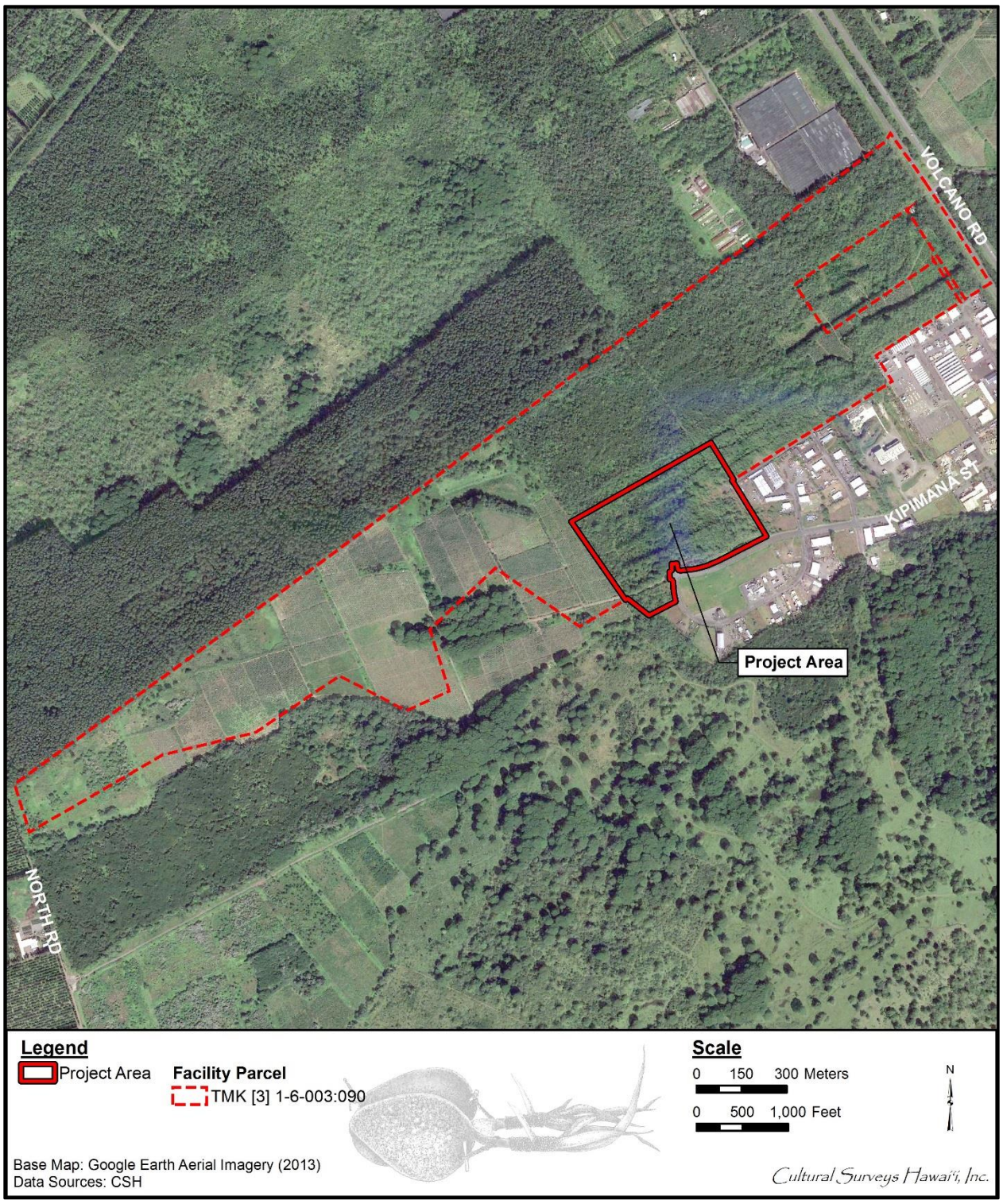


Figure 3. Aerial photograph showing the location of the project area (Google Earth 2013) within the larger tax map parcel

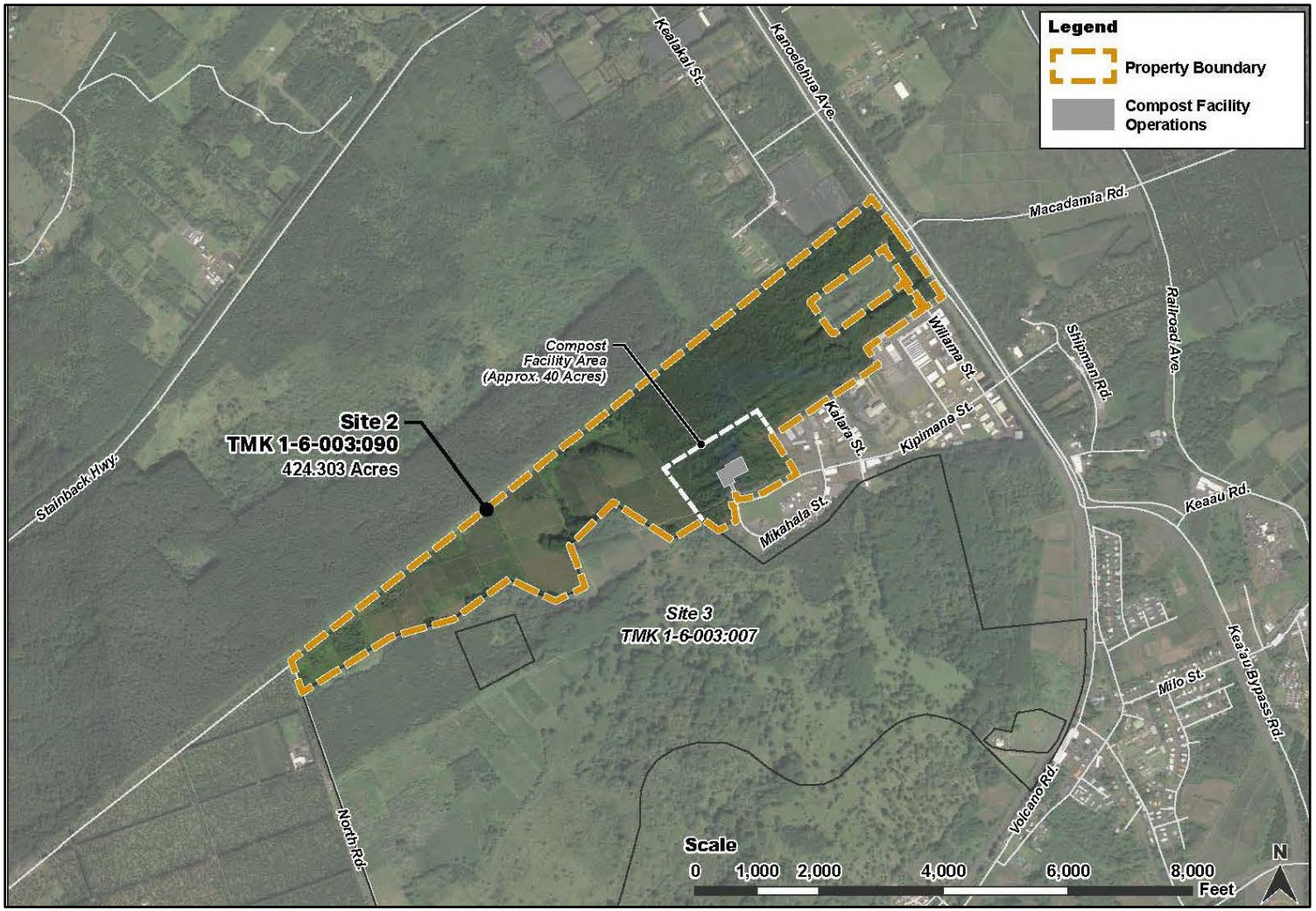


Figure 4. Conceptual layout illustrating proposed location within overall TMK: [3] 1-6-003:090 of compost facility area (current project area) and area of compost facility operations (in gray shading) (courtesy of client) within the larger tax map parcel

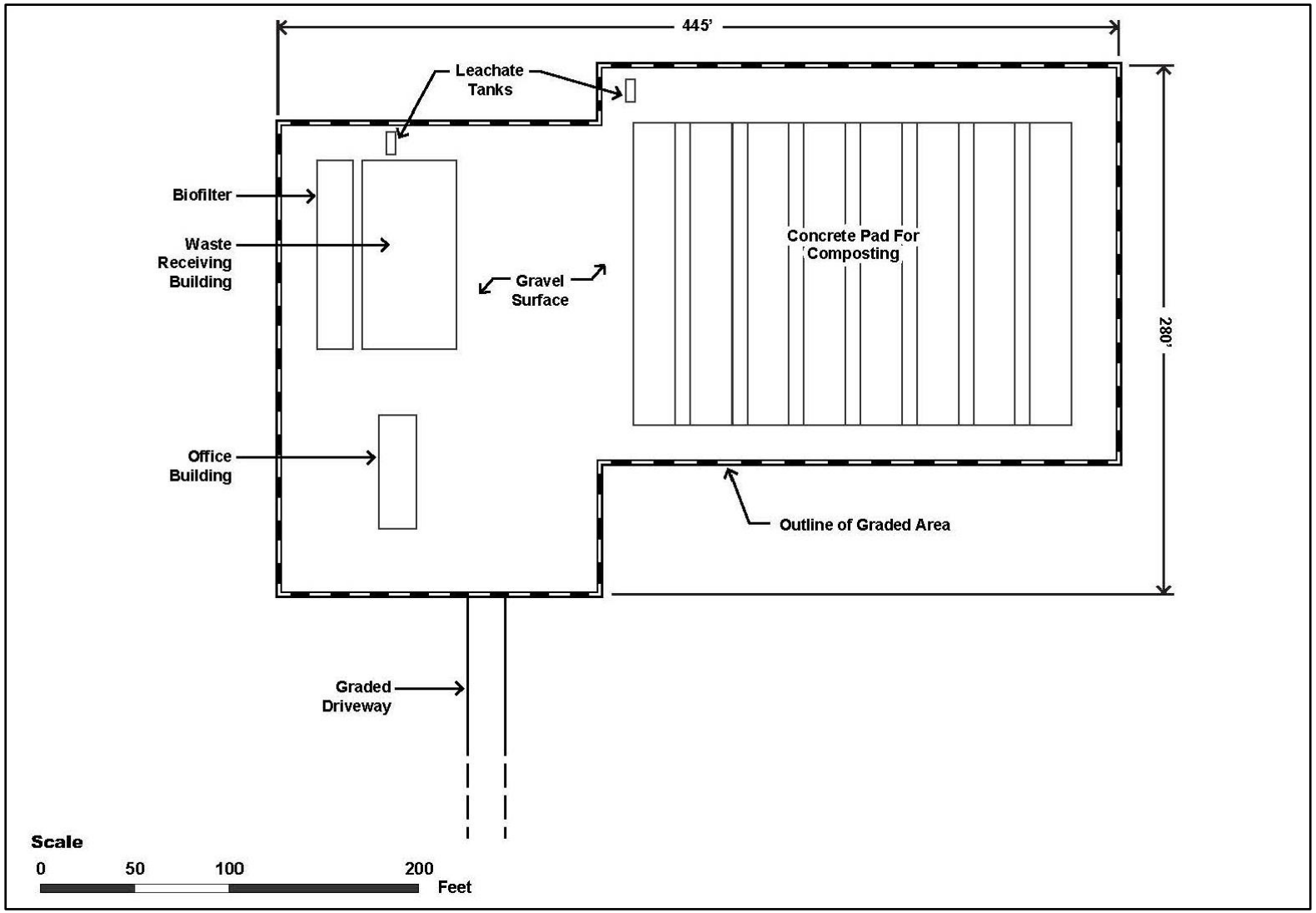


Figure 5. Conceptual compost facility layout (courtesy of client)

1.2 **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 and environmental review compliance. 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 State Historic Preservation Division (SHPD) review and acceptance.

1.3 **Environmental Setting**

1.3.1 Natural Environment

The project area is approximately 7.8 km (4.9 miles) from the coast, at an elevation of approximately 400 ft above mean sea level (AMSL). The Kea‘au town center, accessed from Hawai‘i Belt Road/Route 11 and Kea‘au-Pahoa Road (Route 130), is surrounded by agricultural fields and residential subdivisions. Mean annual rainfall in Kea‘au Village is 3,612 mm (142 inches) (Giambelluca et al. 2013), or more than enough to support non-irrigated agriculture. Papaya and macadamia nuts are the predominant commercial crops in the area.

Kea‘au is situated along the boundary between the volcanoes of Mauna Loa and Kīlauea. According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Sato et al. (1973), the project area's soils consist of Papai extremely stony muck, 3 to 25% slopes (rPAE) (Figure 6). Papai series soils are described as follows:

> . . . well-drained, thin, extremely stony organic soils over fragmental Aa lava. These soils are gently sloping to moderately steep. They are on uplands at an elevation ranging from near sea level to 1,000 feet and receive from 90 inches to more than 150 inches of rainfall annually. Their soil temperature is between 72 and 74 F. The natural vegetation consist of ohia, tree fern, uluhe fern, and guava . . .
>
> Papai soils are used mostly for woodland. Small areas are used for pasture, orchards, and truck crops.
>
> Papai extremely stony muck, 3 to 25 percent slopes (rPAE).—This soil is low on the windward side of Mauna Kea.
>
> In a representative profile the surface layer is very dark brown extremely stony muck about 8 inches thick. [Sato et al. 1973:46]

The project area is heavily vegetated by invasive species including guinea grass (*Panicum maximum*), bingabing (*Macaranga mappa*), albizia (*Albizia julibrissin*), wedelia (*Wedelia trilobata*), miconia (*Miconia calvescens*), *waiwi* (*Psidium cattleianum*), gunpowder tree (*Trema orientalis*), Koster's Curse (*Clidemia hirta*), eucalyptus (*Eucalyptus robusta*), melochia (*Melochia umbellata*), bamboo orchid (*Arundina graminifolia*), Cavendish banana (*Musa acuminata*),

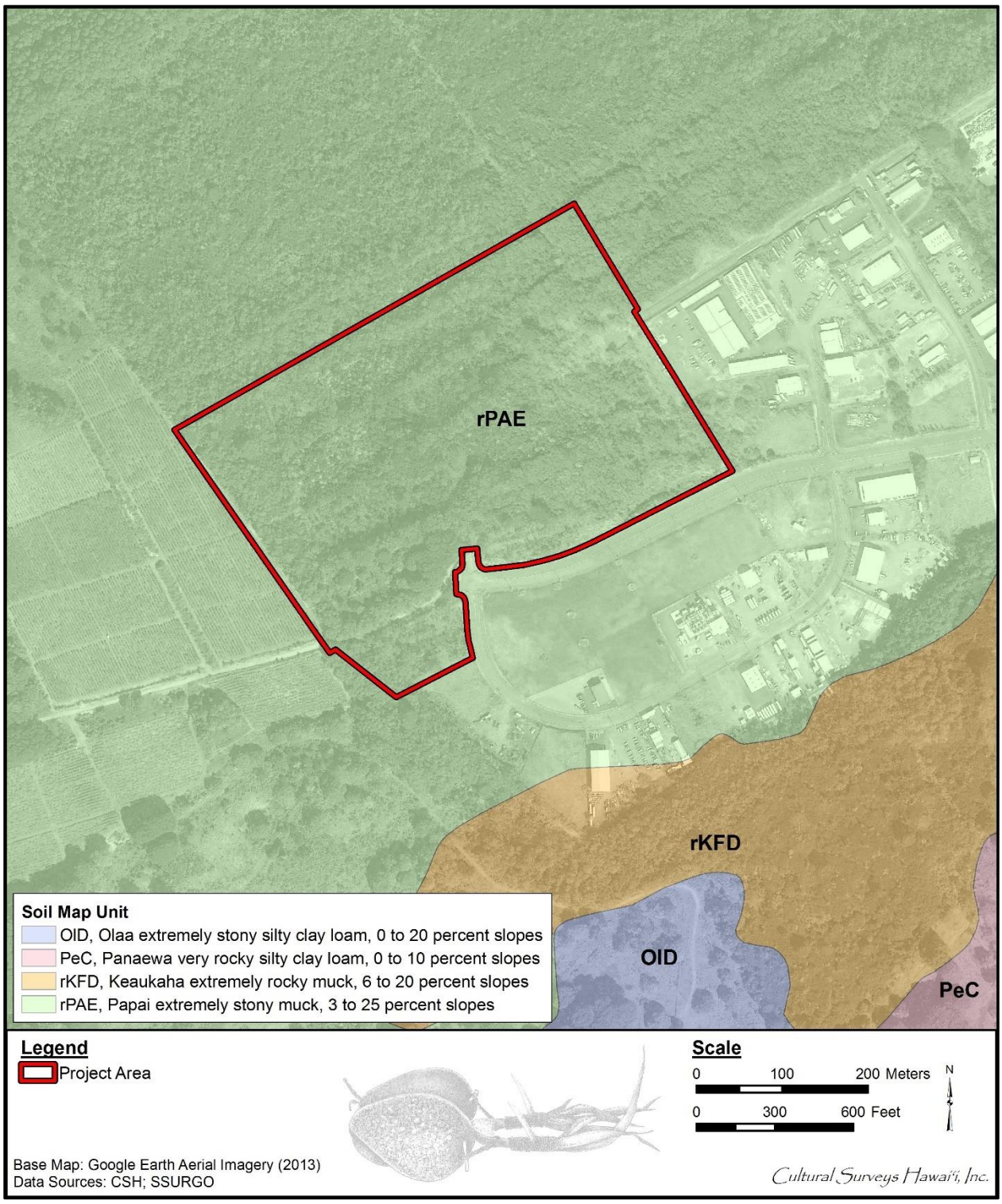


Figure 6. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972), indicating soil types within and surrounding the project area (USDA SSURGO 2001)

sleeping grass (*Mimosa pudica*), and cenchrus grass (*Cenchrus ciliaris*). The only native species observed were *ti* (*Cordyline fruticose*) and sword ferns (*Nephrolepis cordifolia*).

1.3.2 Built Environment

The project area is located within the W.H. Shipman Business Park, which is accessed by Highway 11, a major area thoroughfare. It is approximately 1.2 miles north of Kea‘au town, which comprises commercial establishments, residential neighborhoods, a post office, park, and school campuses.

The project area is bound to the south and southeast by Kipimana Street and Mikahala Street, to the west and north by active and fallow agricultural fields, and to the east by Shipman Self Storage and additional agricultural fields. Aerial photographs indicate the project area has been largely, if not completely, impacted by agricultural activity.

Section 2 Methods

2.1 Field Methods

CSH completed the fieldwork component of this study under archaeological fieldwork permit number 18-15, issued by the SHPD pursuant to HAR §13-282. CSH archaeologists Olivier M. Bautista, B.A., and McKenzie Wildey, B.A., conducted the fieldwork on 29 March 2018 under the general supervision of Hallett H. Hammatt, Ph.D. (Principal Investigator). This work required approximately 2 person-days to complete.

In general, fieldwork included a pedestrian inspection of the project area accompanied by photographic documentation.

2.1.1 Pedestrian Survey

CSH personnel undertook a pedestrian inspection of the project area for the purpose of surface archaeological feature identification and evaluation of the potential for subsurface archaeological features. The pedestrian survey was focused in areas not under active crops and was accomplished through systematic sweeps spaced 5 to 10 m apart depending on vegetation and ground visibility.

2.2 Research Methods

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; 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 ‘Aina database (Waihona ‘Aina 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

3.1.1 Mythological and Traditional Accounts

The project area is in the *ahupua‘a* (traditional land division) of Kea‘au (meaning unknown) in the Puna District of Hawai‘i Island. Few mythological and traditional accounts specifically discuss Kea‘au. According to Handy and Handy (1972:200, 205, 539–542), myths and legends provide an understanding of an early time when the district of Puna was famous for its long stretch of sand, fertile plains, and its *hala* (pandanus trees). Many legends describe Pele’s devouring of land by causing lava to cover either large areas of the region or more limited sections of it. Traditions imply that Puna was one of Hawai‘i’s wealthiest agricultural regions; it is only in relatively recent times that volcanic eruptions have destroyed much of Puna’s best land (Handy and Handy 1972:542).

Very few myths speak specifically about the individual *ahupua‘a* of Puna. Barrére (1971:11) speculated that the reason for this dearth of traditional literature was the “remarkably successful” conversion of the natives to Christianity that began with the visit to the district by the Reverend William Ellis’ missionary party in 1823, which was continued and strengthened during Rev. Titus Coan’s management of the mission district beginning in 1835. In 1841, Wilkes noted “[a]lmost all the hills or craters of any note [in Puna] have some tradition connected with them; but I found that the natives were now generally unwilling to narrate these tales, calling them ‘foolishness’” (Wilkes 1845:4:186).

Hurst and Shilz (1994) describe oral traditions relating to the activities of Kīlauea Volcano and events associated with original settlement, landmarks, and vegetation (Hurst and Shilz 1994:7). A legend about Pele tells how the chief of the Puna District, Ke-Lii-Kuku, while traveling on O‘ahu, boasted of the rich agricultural lands of Puna to a prophet of Pele, Kane-a-kalau. The prophet predicted the chief would return to Puna to find it destroyed by lava, and so it was (Hurst and Shilz 1994:7–8). This legend relates the importance of the volcano as an all-powerful force in the psyche of Puna residents.

Two legends refer to two different springs in the uplands of ‘Ōla‘a, the large Puna *ahupua‘a* inland and north of portions of Kea‘au and south of Waiākea (present Kea‘au town used to be referred to as ‘Ōla‘a, while a village at the coast was called Kea‘au). The first story tells of a brother, Ku-ka-ohia-a-ka-laka, and sister who came from Kahiki and settled (respectively) along the coast and in the mountains (Beckwith 1970:17). The legend indicates the importance of trade and sharing (specifically in the family) in a large *ahupua‘a* like Kea‘au where resources are widely distributed. The story also indicates habitation occurred both along the coast and in the uplands. The second story speaks of Ke‘amalu spring in upper ‘Ōla‘a. The legend describes a romance that occurred at the spring, therein alluding to the beauty of upper Kea‘au (Green et al. 1936:159–161).

3.1.2 Early Historic Period

The first westerners to describe Kea‘au were the British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM), Asa Thurston and Artemas Bishop. In 1823, they toured the island of Hawai‘i. After touring Ka‘ū District, they made

a side trip inland to the Kīlauea crater, then returned back to shore near the Ka‘ū/Puna border. They traveled along the Puna coast, stopping to preach sermons, then finally reached the village of Kea‘au:

> Soon after five p.m. we reached Kaau [Kea‘au], the last village in the division of Puna. It was extensive and populous, abounding with well-cultivated plantations of taro. Sweet potatoes, and sugar-cane; and probably owes its fertility to a fine rapid stream of water, which, descending from the mountains, runs through it into the sea. . . . [Ellis 1963:212].

He describes Kea‘au Ahupua‘a as having upland forests, a “wilderness of pandanus” (Ellis 1963:214) along the coast, and describes the interior as being an uninhabited wilderness with few inland settlements. Most the population inhabited the coast, where “the towns and villages of the natives are thickly scattered” (Ellis 1963:4). In 1826, Rev. Hiram Bingham recorded a settlement of about 100 residents in ‘Ōla‘a (Bingham 1847:290).

These accounts by Ellis and similar accounts of other early foreign visitors to Hilo and Puna informed McEldowney’s (1979:64) model for traditional settlement zones in Hilo and eastern Puna, summarized as follows:

I.	Coastal Settlement	20–50 ft in elevation	0–1.5 miles inland
II.	Upland Agricultural	50–1,500 ft in elevation	1.5–4.5 miles inland
III.	Lower Forest	1,500–2,500 ft in elevation	
IV.	Rainforest	2,599–5,500 ft in elevation	
V.	Subalpine/Montane	Over 5,500 ft in elevation	

Following this model, the current project area is in the “Upland Agricultural” zone. McEldowney (1979) discusses this zone as follows:

> Although estimates as to the extent of this zone vary in early journal accounts, most confirm an expanse of unwooded grasslands or a ‘plain’ behind Hilo and in a band from Kea‘au to roughly Mountain View, basically corresponding to the distribution of ash soils . . . On the widely spread pahoehoe flows of Kilauea that fall within Zone II, land-use may have focused on the extensive lava tube channels underlying the area. Within this zone, the possibilities of remnant agricultural complexes could be high on both ash and older aa or pahoehoe substrates that have not been disrupted by historic agricultural practices. [McEldowney 1979:18, 19]

High amounts of rainfall and porous substrate would have quickly leached nutrients from the soil, a fact that supports McEldowney’s (1979:21) hypothesis that traditional agriculture in this windward Upland Agricultural zone involved swidden or slash-and-burn practices that may have altered forested areas into the open grasslands observed by early foreign visitors. The current project area may be situated along the boundary between these grassland areas and the Pana‘ewa Forest, which McEldowney (1979:20) notes “in the early 1800s was one of the few forests to nearly reach the ocean.” Komori (1987:31) remarks “The establishment of agricultural complexes, far from the primary areas used for settlement on the coast (circa 5 km) sometime after A.D. 1450 is consistent with Kirch’s [1985:284–308] model for the development of Hawaiian culture.”

Cordy (2000:49–50) has estimated the population for each *ahupua‘a* in Puna may have ranged from 50 to 100 residents, based on the size of the *ahupua‘a* and the availability of food resources.

By the time of the first missionary census (1831–1832), the combined population of the districts of Hilo and Puna was 12,500, a decline of over 50% for Puna (Cordy 2000:49). Soon after Contact, people began to move to port cities or other trading areas. Since Puna has no good harbor, it lost a large portion of its population.

3.1.3 The Māhele and the Kuleana Act

In the mid-nineteenth century, the Kingdom of Hawai‘i initiated a program of massive land reform known as the Māhele (land division of 1848) and Kuleana (land division, right, privilege, property) Act. Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of the Land Commission Awards (LCAs) gives us insight into patterns of residence and agriculture at that time. Many of these patterns probably had existed for centuries past. By examining the patterns of *kuleana* LCA parcels in the vicinity of the school campus, insight can be gained to the likely intensity and nature of Hawaiian activity in the area.

Kea‘au Ahupua‘a was granted as chief lands to William C. Lunalilo as a portion of LCA 8559-B designated *‘āpana* (piece, slice, portion, land parcel) 16. Only one *kuleana* award, comprising 13.64 acres, was granted in Kea‘au: LCA 8081, RP 4360, to Hewahewa. The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst and Schilz 1994:12–13, 17). This LCA is not in proximity to the current project area.

The general lack of *kuleana* awards in Kea‘au may indicate the paucity of habitation in the region during the mid-1800s. The lack of *kuleana* awards along the coast, wherein numerous villages were documented by travelers in the early part of the century, may be due to a tsunami devastating the coast of East Hawai‘i sometime before 1846 (Hurst and Schilz 1994:12–13, 17). However, the lack of *kuleana* awards may be more related to political and/or other social factors than a total absence of inhabitants. Thus *kuleana* data cannot be utilized to reconstruct mid-1800s settlement patterns for Kea‘au.

3.1.4 Mid- to Late 1800s

The guardians of Lunalilo’s estate mortgaged Kea‘au Ahupua‘a to Honolulu banker Charles C. Bishop in the 1860s. In September 1872, 60,020 acres of Kea‘au were leased from the Lunalilo estate to O.B. Spencer. In September 1874 the lease was reassigned to Rufus A. Lyman (Hurst and Shilz 1994:13). Lyman completed a survey of his lands in 1875, at which time he recorded landmarks, vegetation zones, features, and “an old heiau [traditional place of worship] named Kawiakawa” (located at the border of Kea‘au and Waiakea Ahupua‘a at the shore), although no clear evidence of this *heiau* was found by Bishop Museum during a 1974 survey (Ewart and Luscomb 1974:52). It is reported that in the late-1800s, W.H. Shipman removed some of the stones for a cattle pen (Ewart and Luscomb 1974:12). One place name was recorded by Lyman at the east side of Puna and Hilo roads called “Kaluaike water” (Ewart and Luscomb 1974:13).

Kea‘au Ahupua‘a was sold to Samuel Damon, William H. Shipman, and J. Elderts in January 1882. By 1884, Shipman bought the interests of the other partners and became the sole owner. The lands were used as pasture for grazing cattle that were stock for the Hilo Meat Market and Waiakea Stock Ranch, also owned by Shipman. In 1889, a 40-ft right-of-way was granted by Shipman for the construction of Volcano Road. The road was completed sometime after 1893.

3.1.5 1900s

3.1.5.1 Olaa Sugar Company/Puna Sugar Company

In May 1899, Olaa Sugar Company leased 3,182 acres of land in ‘Ōla‘a (a large, landlocked *ahupua‘a* upland of Kea‘au) from W.H. Shipman for a term of 40 years. Several more land exchanges were made the same year. The lands were cleared by horse and mule for the cane fields, preserving only certain fruit trees on the property (Hurst and Shilz 1994:14–15). In 1901, Olaa Sugar Company is recorded as having 4,000 acres of land under cane cultivation, and employing 1,100 men (Hurst and Shilz 1994:16–17). Laborers at that time included Japanese, Puerto Ricans, Chinese, Portuguese, Caucasians, and Hawaiians living in segregated areas within camps along the Old Volcano Road.

According to Dorrance and Morgan (2000:106), “[b]y 1905 Olaa Sugar Company had a modern mill and 7,676 acres under cultivation serviced by the only standard gauge plantation railway in Hawai‘i.” Figure 7, Figure 8, and Figure 9 show the location of the project area in relation to the mill near Kea‘au Village (also called ‘Ōla‘a town) as early as 1901. The Olaa mill also processed cane from Puna Sugar Company, an affiliate of Olaa Sugar Company with cane fields located in Kapoho to the southeast (Dorrance and Morgan 2000:107).

This industrial expansion in Kea‘au marks the beginning of massive landscape alterations and clearing operations, which would have obliterated most, if not all, archaeological sites present on the leased lands. In the 1930s, over 15,000 acres were under cultivation. Dorrance and Morgan (2000:107) write that “[i]n 1935 the plantation housed 5,648 workers and dependents in 1,086 company-supplied houses distributed over 15 camps or villages . . . [and] . . . some 230 homesteaders lived and grew cane on family plots.”

During the early 1900s, cane was transported to the mill primarily by flume, and hauled by mules in remote fields. Soon, the harvested cane was also hauled by railway. The carts were loaded manually until industrial machinery took over in the 1940s. Cranes for loading, trucks for hauling, and tractors for plowing replaced the manual labor force, railway, and livestock.

A 1955 lava flow impacted Puna Sugar Company’s fields at Kapoho. According to Dorrance and Morgan (2000:107), in 1960 Olaa Sugar Company was given the Puna Sugar Company name “at the urging of landowner Herbert Shipman,” and the company “struggled on.” The wet weather, rocky soil, and large distances between some of the fields and the mill made profitability difficult, and ultimately the company closed in 1982. This closure negatively impacted many small businesses in Kea‘au that had serviced the mill camps and homesteads (Dorrance and Morgan 2000:106). The extent of the town and plantation holdings in the latter half of the twentieth century, including planting fields and associated roadways and labor camps, are depicted on Figure 10 and Figure 11. The current project area is indicated in a forested area on the outskirts of the cane fields.

3.1.5.2 Hilo Railroad Company/Hawaiian Consolidated Railway, Ltd.

A 40-ft right-of-way crossing Kea‘au was granted to Hilo Railroad Company (later reorganized as the Hawaiian Consolidated Railway, Ltd.) in December 1899. The right-of-way would revert to Shipman when the railway was no longer in use. In 1900, a 17-mile coastal extension was constructed to the sugarcane fields near Kapoho. Spurs were built inland to additional fields in Pāhoa and Kama‘ili (see Figure 7, Figure 12 and Figure 13). In 1901, the railway was extended

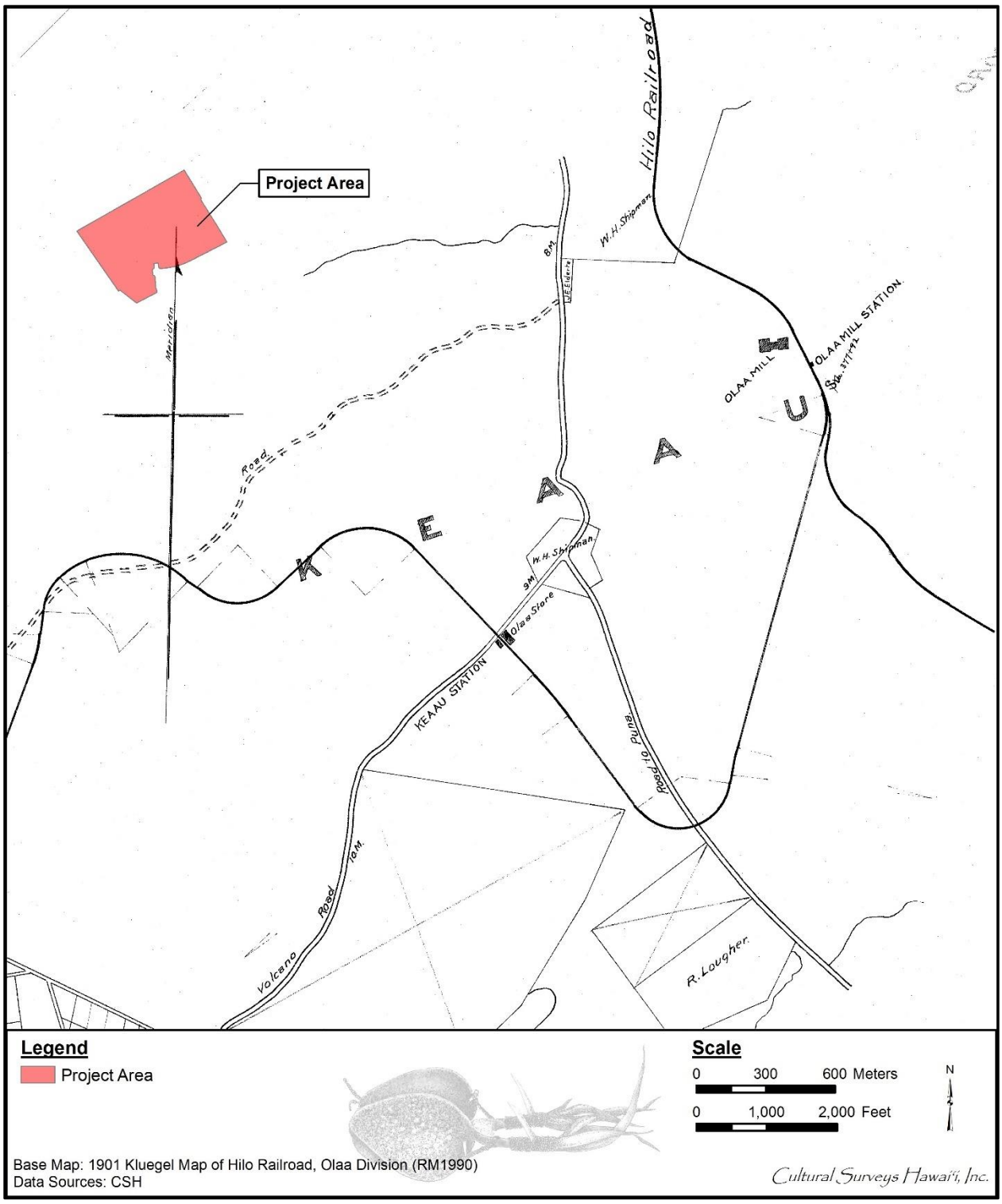


Figure 7. Portion of the 1901 map of Hilo Railroad, Olaa Division by C.H. Kluegel, showing the project area in relation to the Olaa Mill, the railroad, and other features in and around Kea‘au Village

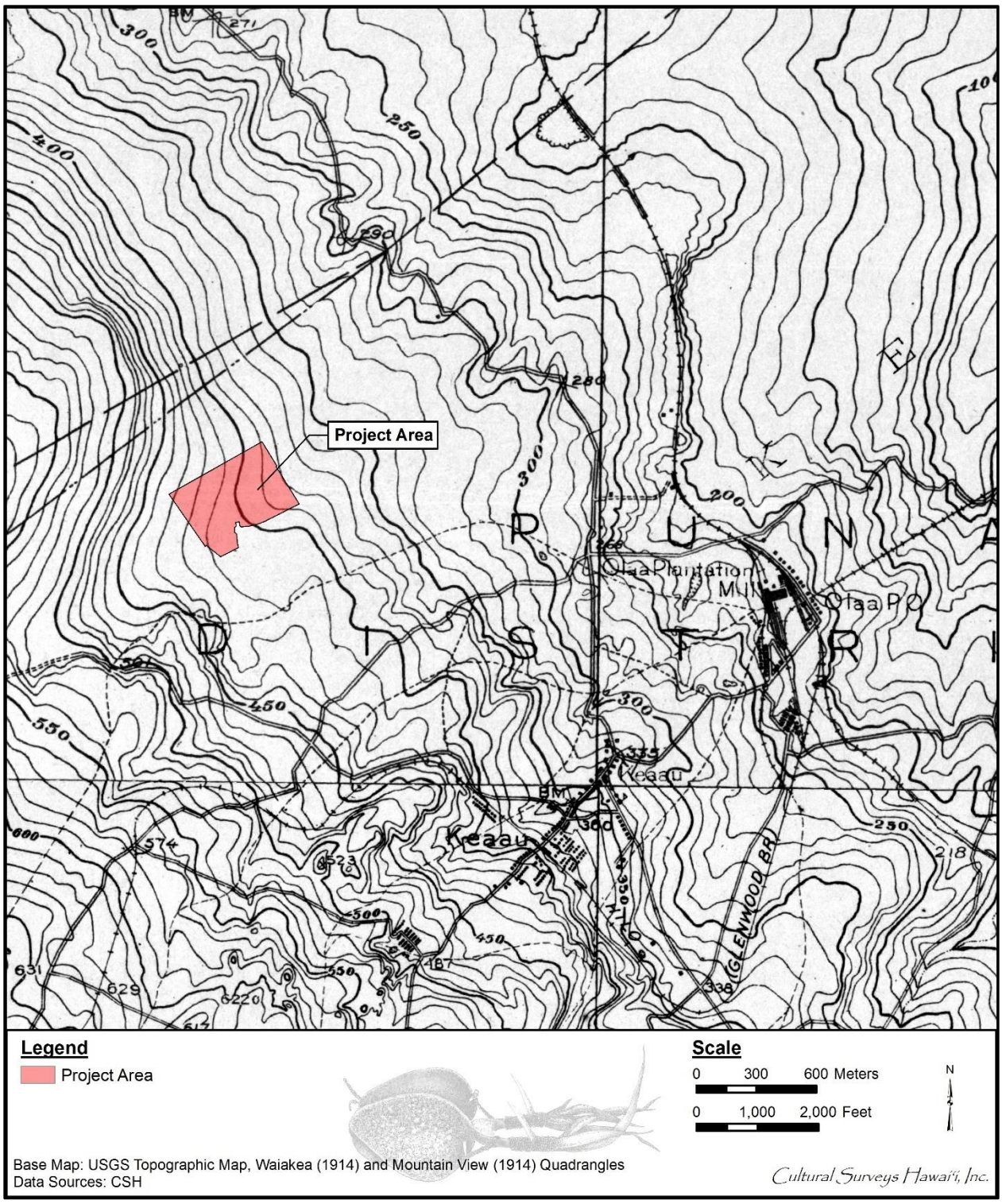


Figure 8. Portions of the 1914 Waiakea and Mountain View USGS 7.5-minute topographic quadrangles showing the location of the project area in relation to Olaa Mill, the railroad, and other features in and around Kea‘au Village

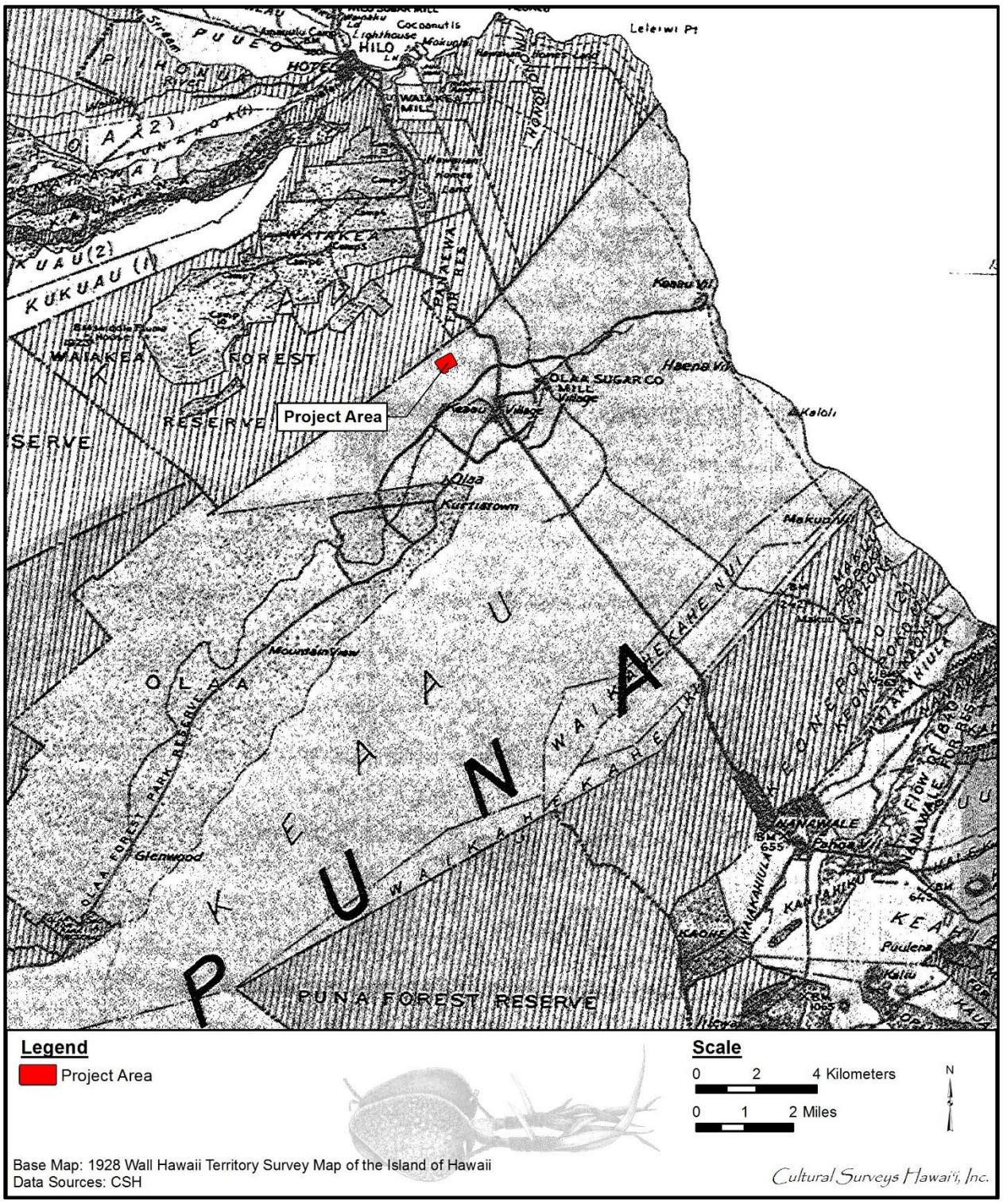


Figure 9. Portion of the 1928 map of Hawai‘i Island by Walter E. Wall, showing the project area in relation to Olaa Mill, the railroad, and other features in and around Kea‘au Village

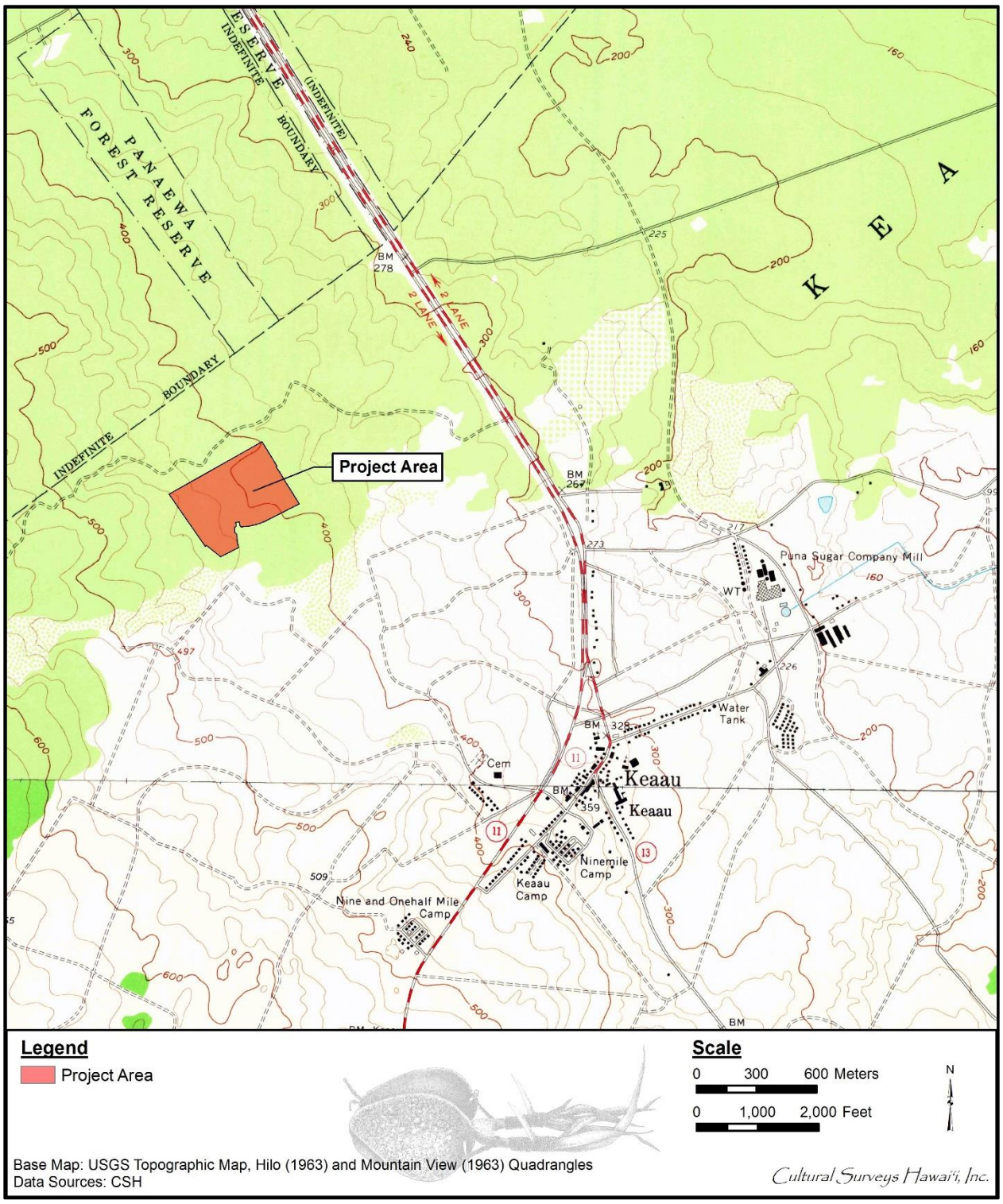


Figure 10. Portions of the 1963 Hilo and Mountain View USGS 7.5-minute topographic quadrangles showing the location of the project area in relation to the sugar mill, plantation camps in and around Kea‘au Village, and the network of jeep roads accessing the cane fields

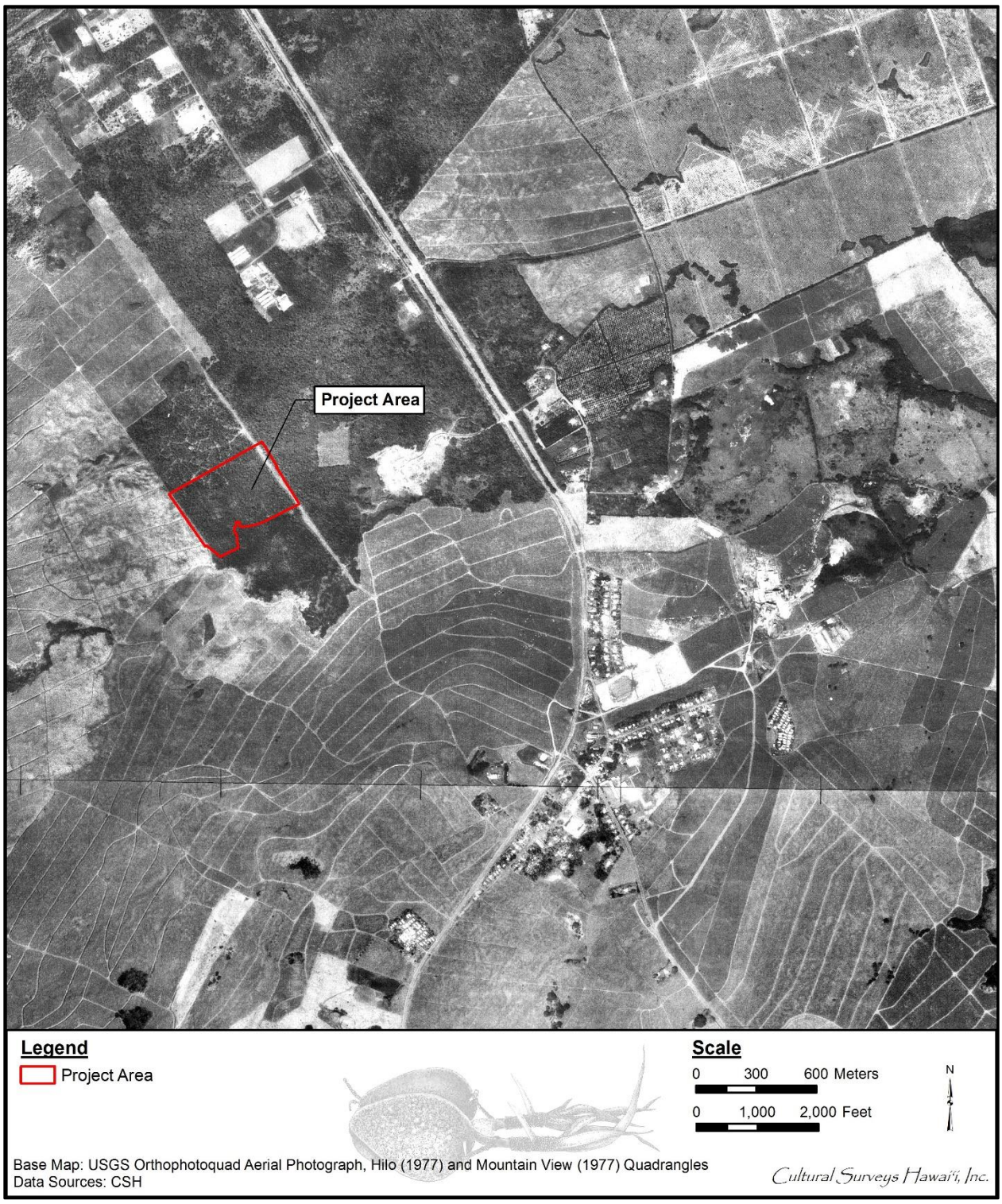


Figure 11. 1977 USGS Orthophoto, showing the location of the project area in relation to features discussed in the text

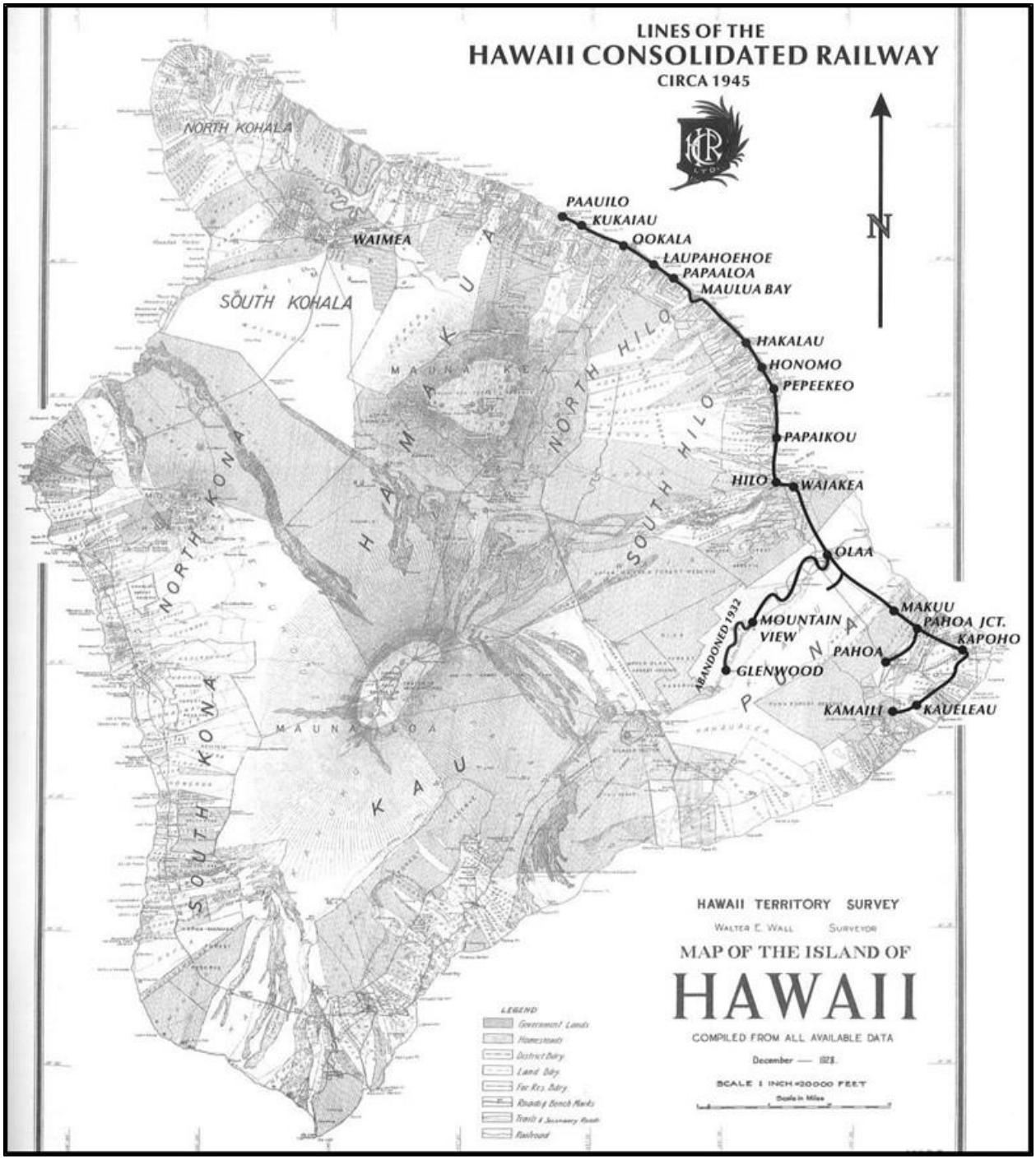


Figure 12. 1928 map of Hawai‘i Island by Walter E. Wall, overlain with the route of the Hawai‘i Consolidated Railway ca. 1945, illustrating the various railway spurs in Puna district (figure from Treiber 2005)

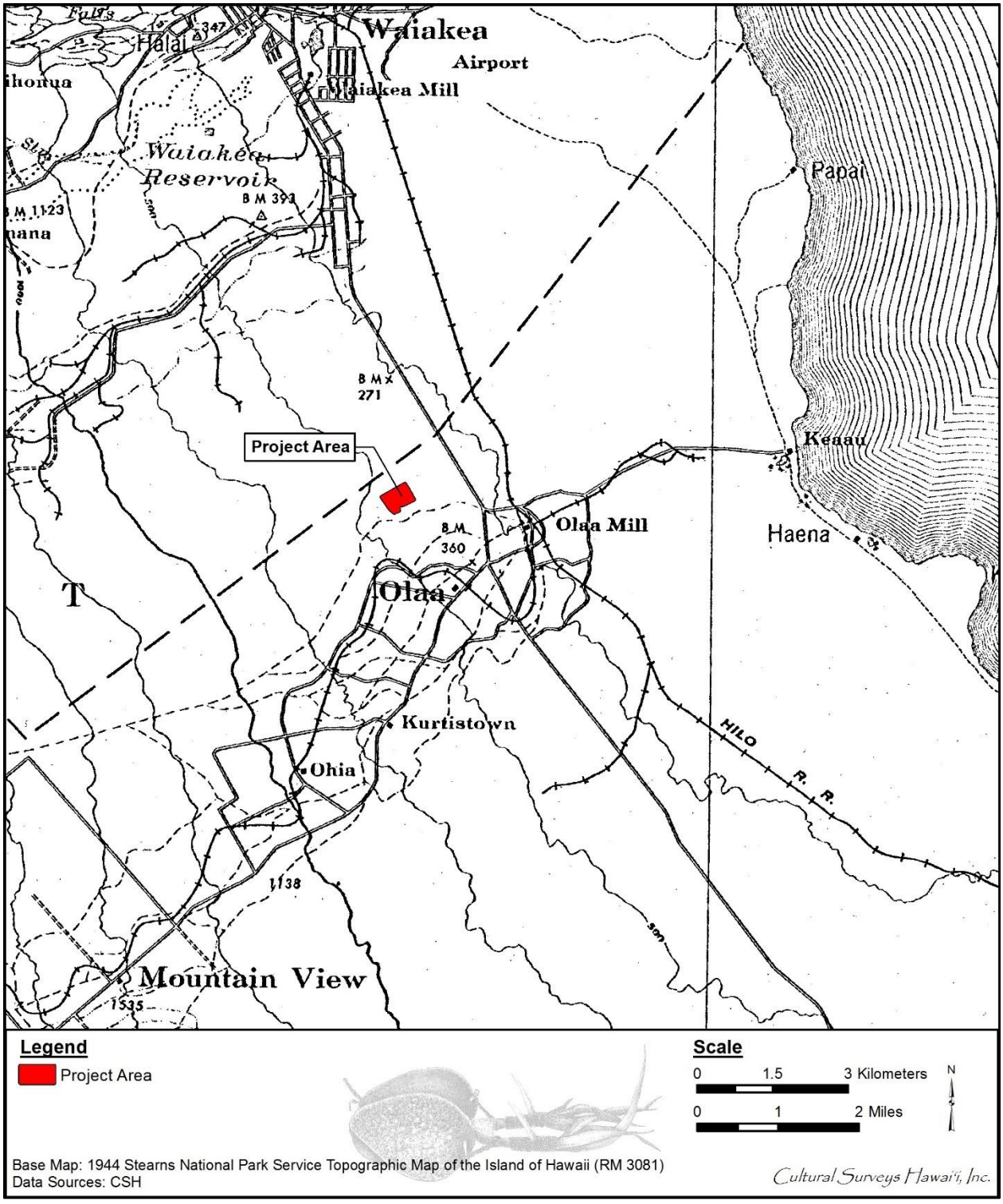


Figure 13. Portion of the 1944 map of Hawai‘i Island by H.T. Stearns showing the location of the project area in relation to the railroad system

from 8½ mile camp (located near the mill) to Mountain View, at the 17-mile mark of Volcano Road (Condé and Best 1973:92–94).

Wood from the lands cleared for the right-of-way was sold to the railroad companies for ties. In 1907, the Hawaiian Mahogany Lumber Company (later called the Pahoa Lumber Company) was founded, initially for the purpose of making *‘ōhi‘a* (*Metrosideros polymorpha*) wood rail ties for the railroad. Much woodland was cleared in ‘Ōla‘a, but the woodcutting was also conducted in other areas of Puna:

> Most of the ties for this contract will be cut in the Puna District on homestead lots above Olaa on lands of the Puna plantation that are being cleared for cane, and on other lands in Puna on which rubber will be planted. The ties will be shipped from Hilo by steamers and sailing vessels, the first shipment being sometime in the spring of 1908 [Board of Commissioners of Agriculture and Forestry 4th report in Condé and Best 1973:101].

The rail transportation occurred primarily from the ‘Ōla‘a, Pāhoa, and Kapoho fields. Portable tracks were used in the cane fields until 1945; however, prior to using these tracks, loaded carts were pulled by mule to the main line. On 1 April 1946 a tsunami inundated the railway on the Hāmākua Coast and in Hilo, forcing the Hawaii Consolidated Railway Company out of business (Condé and Best 1973:99, 211, 388). However, portions of the Puna Division continued to be operated by the Olaa Sugar Company until 1948, when trucks took over the transportation of the sugarcane (Treiber 2005:59).

The lands of Kea‘au south of the sugar plantation continued to be used for grazing. According to McEldowney (1979:41), “Shipman Ranch land between the Pana‘ewa Forest and Kapoho was burned regularly to retain grass as the dominant ground cover.” In the 1950s, prior to Statehood, the Shipman Estate began to subdivide and sell off large pieces of land to developers. The result was the gradual development of large residential subdivisions within Kea‘au including but not limited to Orchidland Estates, Hawaiian Paradise Park, and Hawaiian Acres (Wilkinson et al. 2010:55).

3.1.6 Contemporary Land Use

The closure of Puna Sugar Company in the 1980s caused the economy of Kea‘au to contract for a time, though the town is currently experiencing expansion as nearby residential subdivisions have seen substantial population growth in recent years. The W.H. Shipman Business Park was established in 1999. Prior to its construction, the land had been impacted by former agricultural pursuits and a quarry (see Figure 11 and Section 3.2). The industrial park contains a variety of businesses, including Big Island Biodiesel located across the street from the current project area.

3.2 **Previous Archaeological Research**

Over a dozen archaeological investigations have been conducted in the vicinity of the current project area. These studies are depicted on Figure 14 and outlined in Table 1. The earliest archaeological investigations in the Kea‘au vicinity (pre-1980) are not depicted on Figure 14 as they were part of island-wide surveys by Thomas G. Thrum (1908) and John F.G. Stokes (1919), as well as Alfred Hudson’s (1932) study of eastern Hawai‘i Island (see Table 1). These early investigations were typically limited to the old trails between towns and along the coast, focusing mainly on *heiau* (traditional places of worship) and other major sites. Emory’s (1945) work at Shipman Cave near the southern Kea‘au boundary provided the first evidence of traditional lava tube use for refuge and burial placement in the Puna District. These early investigations took place far outside the project area and are therefore not included on Figure 14.

Figure 14 depicts two previous studies overlapping the current project area (and overall TMK: [3] 1-6-003:090): Rosendahl (1982) and Hunt (1993). Discussions of these two overlapping studies follow.

In 1982, Paul H. Rosendahl, Inc. (PHRI) conducted an archaeological reconnaissance of approximately 490 acres for the proposed W.H. Shipman Industrial Park, in which the current project area is situated (Rosendahl 1982; see Figure 14). Rosendahl (1982:1–2) noted “[active] cane fields of Puna Sugar Co. border the parcel on the SE and SW boundaries,” and that the 1982 project area was bisected by a cinder road running parallel to and approximately 0.65 miles *mauka* of the highway. This cinder road divided the property into a 170-acre western or inland portion and a 320-acre eastern or seaward portion. The current project area is located within the inland 170-acre portion of the 1982 study area; of this portion Rosendahl (1982:2) wrote, “[T]he area had been bulldozed according to [a county planner] and was confirmed by a field check.” The remaining lands *makai* (seaward) of the cinder road were found to contain a quarry, abandoned cane field, an orchid farm, and an area of undisturbed forest. No archaeological sites were encountered and no further work was recommended.

In 1993, Terry Hunt undertook an archaeological reconnaissance (termed an assessment) of 600 acres of Shipman Company lands in Kea‘au overlapping the current project area (and overall TMK: [3] 1-6-003:090) (Hunt 1993; see Figure 14). No archaeological features were identified throughout the majority of the survey area, which had been heavily impacted by cane cultivation, including the lands of the current project area. However, 50 features were documented within five areas that were not heavily impacted, including walls, mounds, platforms, and multi-feature complexes. These features are located close to Kea‘au Town and not in the vicinity of the current project area. Hunt (1993:11–12) interpreted these features as likely “associated with historic plantation activities, such as field clearing, and other cultivation work. It is possible that some features may date to earlier, prehistoric times, but further research, including test excavations would be needed to evaluate such an hypothesis.” Archaeological inventory survey was recommended for areas of future development in which resources were identified (Hunt 1993:14).

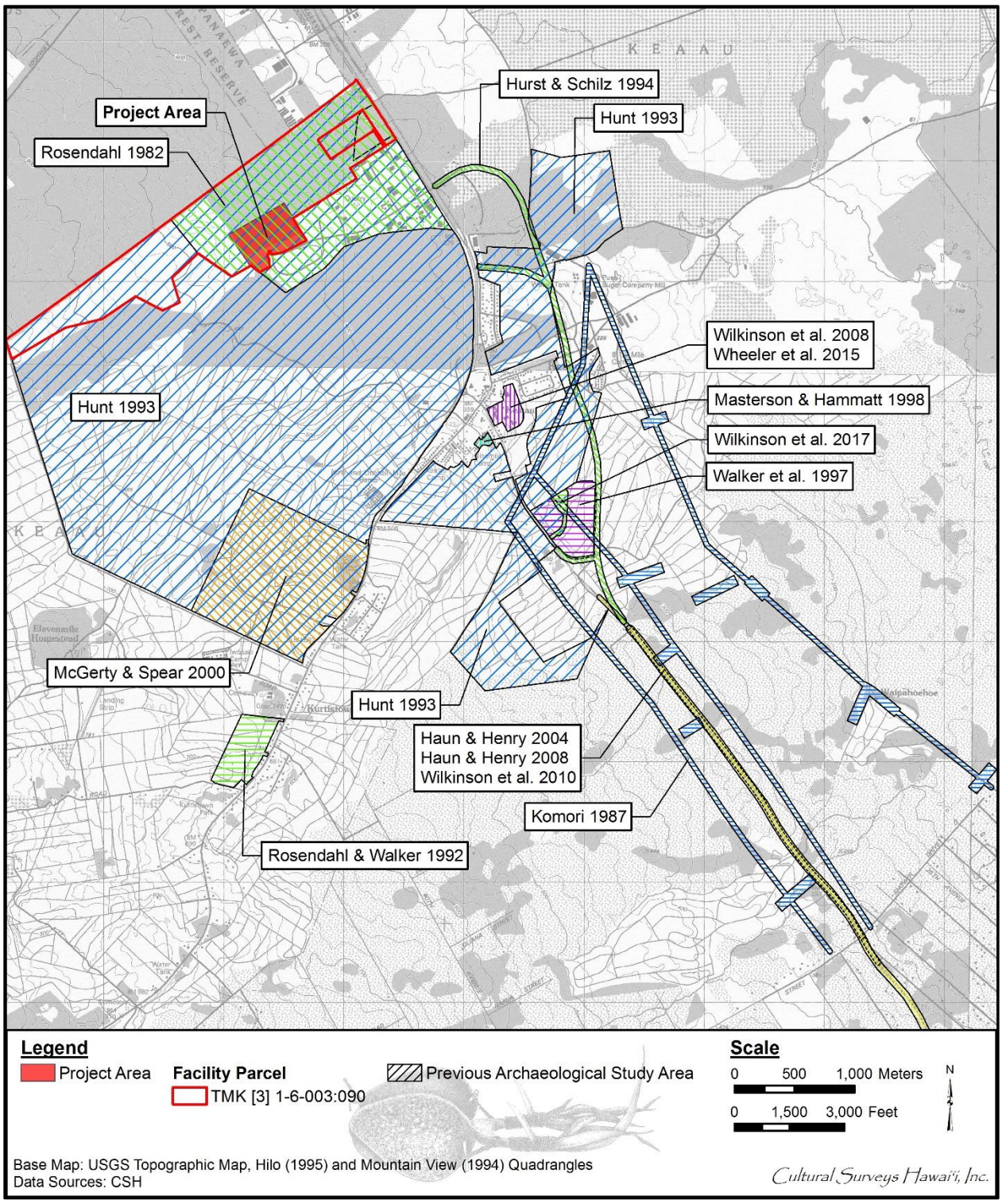


Figure 14. Portions of the 1995 Hilo and 1994 Mountain View USGS 7.5-minute topographic quadrangles showing the current project area in relation to previous archaeological studies in the vicinity

Table 1. Previous archaeological studies in the vicinity of the project area

Reference	Type of Study	Location	Results
Thrum 1908	Survey of *heiau*	Hawai‘i Island	Documented 18 *heiau* in Puna, none within Kea‘au (beyond the area shown in Figure 14)
Stokes 1919	Survey of *heiau*	Hawai‘i Island	Documented 12 *heiau* in Puna, many previously identified by Thrum (1908); none within Kea‘au (beyond the area shown in Figure 14)
Hudson 1932	Archaeological survey	Eastern Hawai‘i Island	Documented sites along coast in Puna, including some in vicinity of Pāpa‘i where Kamehameha declared the “Law of the Splintered Paddle” (beyond the area shown in Figure 14)
Emory 1945	Archaeological exploration	Shipman Cave, Kea‘au, TMK: [3] 1-6	State Inventory of Historic Places (SIHP) # 50-10-36-20678 (“Shipman Cave”), a lava tube used for refuge and burial (beyond the area shown in Figure 14)
Rosendahl 1982	Archaeological reconnaissance survey	Shipman Industrial Park, Kea‘au, TMK: [3] 1-6-003:012 por.	No historic properties or cultural materials identified; study noted prior land disturbance within TMK: [3] 1-6-003:090
Komori 1987	Cultural and biological resources survey	Pohoiki to Puna-Substation 69KV Transmission Corridor, Kapoho to Kea‘au, Puna TMKs: [3] 1-4, 1-5 and 1-6	Identified 11 archaeological and three historic sites. None of these are in the Compost Facility project area. None were assigned SIHP numbers, including mostly agricultural features with associated habitation areas; feature types included irrigation ditches, terraces, platforms, modified outcrops, refuge and burial caves, petroglyphs, and a historic cement and stone foundation
Rosendahl and Walker 1992	Archaeological reconnaissance survey	46 acres in ‘Ōla‘a, TMK: [3] 1-7-017:003	No historic properties or cultural materials identified

Reference	Type of Study	Location	Results
Hunt 1993	Archaeological reconnaissance survey	600 acres of Shipman Lands in Kea‘au, TMKs: [3] 1-6-003:003, 007, 008, 011, 012, 027, 029, 058, 073, 075, 084, 086, and 090	Identified 50 archaeological features. None of these are in the Compost Facility project area. None were assigned SIHP numbers and are in areas less impacted by cane cultivation, likely associated with historic plantation activities; features included walls, platforms, and mounds; features concentrated near Kea‘au town away from the current project area
Hurst and Schilz 1994	Archaeological inventory survey	Kea‘au–Pāhoa Rd, Kea‘au, TMK: [3] 1-6-003	No historic properties or cultural materials identified
Walker et al. 1997	Archaeological inventory survey	75 acres for Kea‘au High School site, TMKs: [3] 1-6-003:003 (por.), 015 (por.), 084 (por.)	Documented SIHP # 50-10-44-21191, Hilo Railway Co. Right-of-Way (ROW). It is not in the Compost Facility project area
Masterson and Hammatt 1998	Archaeological inventory survey	2.46 acres for Kea‘au Elderly Housing project, Kea‘au, TMKs: [3] 1-6-143:018 and 039 (por.)	No historic properties or cultural materials identified; modern Filipino Camp noted
McGerty and Spear 2000	Archaeological inventory survey	300 acres for proposed KSBE East Hawai‘i Campus, Kea‘au, TMK: [3] 1-6-03:012 (por.)	Documented SIHP # 50-10-44-21823 comprising seven mounds related to sugarcane clearing activities; no further work recommended. It is not in the Compost Facility project area
Haun and Henry 2004	Archaeological inventory survey	2-mile-long Kea‘au-Pāhoa Rd Shoulder Lane Conversion project, Kea‘au, multiple TMKs	No historic properties or cultural materials identified
Haun and Henry 2008	Archaeological inventory survey	8 acres in Kea‘au, TMKs: [3] 1-6-004:011, 047–053, 055, 056, and 1-6-064:266–269, 283–286	Documented SIHP # 50-10-44-26874 (Waipāhoehoe Stream Bridge), a historic-era concrete bridge. It is not in the Compost Facility project area

Reference	Type of Study	Location	Results
Wilkinson et al. 2008	Archaeological monitoring	Kea‘au Middle School, TMKs: [3] 1-6-002:001 and 1-6-003:059	No historic properties or cultural materials identified
Wilkinson et al. 2010	Archaeological inventory survey	Kea‘au-Pāhoa Rd, Kea‘au to Waiakahiula Ahupua‘a, TMKs: [3] 1-5 and 1-6	Documented one historic property previously recorded by Haun and Henry (2008): SIHP # 50-10-44-26874 (Waipāhoehoe Stream Bridge). It is not in the Compost Facility project area
Wheeler et al. 2015	Archaeological field inspection	Kea‘au Middle School, TMKs: [3] 1-6-002:001 and 1-6-003:059	Buildings B, C, D, and E found to be greater than 50 years old; consultation with SHPD Architecture Branch recommended; portion of an *‘auwai* (irrigation ditch) documented adjacent to Buildings D and G. These are not in the Compost Facility project area
Wilkinson et al. 2017	Archaeological field inspection	Kea‘au High School, TMKs: [3] 1-6-003:110 (por.), 111, 112 (por.), and 118	No historic properties or cultural materials identified; remnants of a historic railroad berm (SIHP # 50-10-44-21191) once located on property not confirmed. It is not in the Compost Facility project area

3.3 **Background Summary and Predictive Model**

Few mythological and traditional accounts specifically discuss Kea‘au Ahupua‘a, focusing rather on the overall district in which it is situated. The Puna District was traditionally regarded as one of the wealthiest agricultural regions on the island, but has been impacted extensively in the relatively recent past by lava flows from Kīlauea. The dearth of traditional literature throughout this region may in part be due to an unwillingness of recently converted Hawaiians to carry on their oral histories.

Pre-Contact settlement was typically concentrated near the coast, some distance from the project area. However, McEldowney's (1979) Upland Agricultural zone, in which the project area is situated, was traditionally used for scattered agricultural plots and associated settlements indicating moderate land use.

In the late nineteenth century, the lands of Kea‘au were used for cattle grazing. The Olaa Sugar Company/Puna Sugar Company operated in the area from 1899 to 1982, and became the driving factor for settlement in the town of Kea‘au (at that time called ‘Ōla‘a). For the first half of the twentieth century, the Hilo Railroad Company operated a line through Kea‘au toward its fields *mauka* in Mountain View and Glenwood and south in Pāhoa and Kapoho. The closure of Puna Sugar Company caused the economy of Kea‘au to contract for a time, though the town is currently experiencing expansion as nearby residential subdivisions have seen substantial population growth.

Previous archaeological studies in Kea‘au have confirmed that commercial agriculture has greatly modified the landscape of lands in and surrounding the town. A survey undertaken in 1982 for the W.H. Shipman Industrial Park (Rosendahl 1982) noted extensive disturbance throughout the vicinity of the present project area.

Based on the background research, there is a potential for the presence of historic surface and/or subsurface features related to commercial agriculture. Any traditional archaeological remains once present would have been obliterated by cattle grazing and a subsequent century of intensive commercial agriculture.

Section 4 Results of Fieldwork

CSH completed the fieldwork component of this field inspection under archaeological fieldwork permit number 18-15, issued by the SHPD pursuant to HAR §13-282. CSH archaeologists Olivier M. Bautista, B.A., and McKenzie Wildey, B.A., conducted fieldwork on 29 March 2018 by under the general supervision of Principal Investigator Hallett H. Hammatt, Ph.D. This work required approximately 2 person-days to complete.

4.1 Pedestrian Inspection Results

CSH personnel undertook a pedestrian inspection of the project area for the purpose of surface archaeological feature identification and evaluation of the potential for subsurface archaeological features. The pedestrian survey was focused in areas not under active crops and was accomplished through systematic sweeps spaced 5 to 10 m apart depending on vegetation and ground visibility. Areas currently planted in papaya have excellent ground visibility. The remaining areas are moderately to heavily vegetated with invasive plants and exhibit fair to poor ground visibility.

The field inspection confirmed that the entire project area has been impacted by agricultural endeavors. The northern approximately 50% of the project area is currently planted with papaya (Figure 15 through Figure 17). These newly planted fields are not depicted on the 2013 Google Earth aerial imagery (see Figure 3) indicating they were planted since 2013. These active papaya fields extend north, west, and east beyond the project area bounds.

The remainder of the project area exhibits evidence of heavy disturbance associated with former agricultural activities. The fallow, relatively level planting fields are divided by linear push piles or berms likely created when the area was grubbed (Figure 18 and Figure 19). These push piles extend east-west across the project area and are visible as bands in the vegetation on the 2013 Google Earth aerial imagery (see Figure 3). The fallow agricultural areas have become completely overgrown with invasive plant species; particularly albizia, bingabing, *waiwi*, gunpowder trees, and guinea grass (Figure 20 and Figure 21). These invasive species grow very quickly and it is possible these now heavily vegetated portions of the project area were in active agricultural use as few as 10 years ago. A system of jeep roads was also observed within the project area, accessing the various past and present agricultural plots (see Figure 16, Figure 17 and Figure 22).

No surface archaeological features, lava tubes, or other evidence of potential subsurface archaeological features were identified within the project area during the field inspection.



Figure 15. Photo of papaya fields in the project area; view to northeast



Figure 16. Photo of papaya fields and a jeep road in the project area; view to north



Figure 17. Photo showing the interface of fallow fields (foreground) and planted papaya fields (background) along the western border of the project area; view to north



Figure 18. Photo of a push pile between agricultural plots within the project area; view to southeast



Figure 19. Photo of a large push pile (visible across center) located within a heavily vegetated portion of the project area; view to southeast



Figure 20. Photo showing a stand of albizia trees located along the southern boundary of the project area; view to west



Figure 21. Photo showing a thicket of bingabing and gunpowder trees near the eastern boundary of the project area; view to east



Figure 22. Photo showing a portion of a jeep road within the project area; view to east

Section 5 Summary and Recommendations

5.1 Summary

Background research indicated the project area lands were used during the pre-Contact period primarily for scattered swidden agriculture and associated temporary habitation. In the historic era, the vicinity was heavily disturbed by cattle grazing and for sugarcane cultivation. The project area was found in the 1980s to have been mechanically altered. Given this history of known land use, little in the way of archaeological findings were anticipated.

Archaeologists conducted the field inspection on 29 March 2018. CSH archaeologists included Olivier Bautista, B.A. and McKenzie Wildey, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (Principal Investigator). Fieldwork required approximately 2 person-days to complete and consisted of pedestrian sweeps of the ground surface focused in areas not under active crops. No archaeological features were identified. The project area was found to be entirely disturbed by modern agricultural pursuits and associated unimproved roadways. Approximately half of the project area is presently planted in commercial papaya, with the remainder comprising fallow agricultural plots.

5.2 Recommendations

Based on the findings of this LRFI, the proposed Compost Facility project is not expected to affect any historic properties. Any pre-Contact and/or historic era subsurface deposits that may have once been present are likely to have been obliterated by bulldozing and plowing for agricultural plantings in the modern era.

Undetected lava tubes may be present and can contain cultural materials and modifications including human burials. However, no lava tube openings were found in the project area and no lava tubes have been documented in the near vicinity. SHPD should be consulted for determination of project historic preservation requirements.

Section 6 References Cited

Barrère, Dorothy B.

1971 *Historical Survey: Pualaa, Puna, Hawaii. In Archaeological and Historical Survey of the Ahupua‘a of Pu‘ala‘a, Puna District, Island of Hawai‘i,* by S. Neal Crozier and Dorothy B. Barrére. Department of Anthropology, Bernice Pauahi Bishop Museum, Honolulu.

Beckwith, Martha W.

1970 *Hawaiian Mythology*. University of Hawaii Press, Honolulu.

Bingham, Hiram

1847 *A Residence of Twenty-One Years in the Sandwich Islands*. Praeger Publishers, New York.

Condé, Jesse C. and Gerald M. Best

l973 *Sugar Trains.* Glenwood Publishers, Felton, California.

Cordy, Ross

2000 Exalted Sits the Chief: The Ancient History of Hawai‘i Island. Mutual Publishing, Honolulu.

Dorrance, William H. and Francis S. Morgan

2000 *The 165-Year Story of Sugar in Hawai‘i*. Mutual Publishing, Honolulu.

Ellis, William

1963 *Journal of William Ellis: Narrative of a Tour through Hawaii, or Owhyhee; With Observations on the Natural History of the Sandwich Islands and Remarks on the Manners, Customs, Traditions, History, and Language of their Inhabitants*. Advertiser Publishing Company, Honolulu.

Emory, Kenneth P.

1945 *Exploration of Herbert C. Shipman Cave, Keaau Division of Puna, Hawaii, Sept.13 and 14, 1945*. Bernice Pauahi Bishop Museum, Honolulu.

Ewart, Ned D. and Margaret L. K. Luscomb

1974 *Archaeological Reconnaissance of Proposed Kapoho-Keaukaha Highway, District of Puna, Island of Hawai‘i.* Department of Anthropology, Bernice Pauahi Bishop Museum, Honolulu.

Foote, D.E., E.L. Hill, S. Nakamura, and F. Stephens

1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.* U.S. Department of Agriculture, Soil Conservation Service. Government Printing Office, Washington, D.C.

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte

2013 Online Rainfall Atlas of Hawai‘i. *Bulletin of the American Meteorological Society volume 94, pp. 313-316, doi: 10.1175/BAMS-D-11-00228.1.* Electronic document, http://rainfall.geography.hawaii.edu (accessed 28 March 2018).

Google Earth
2013 Aerial photographs of Hawai‘i. Google Inc., Mountain View, California. Available online at www.google.com/earth.html.

Green, Laura S., Mary Kawena Pukui, and Martha Warren Beckwith
1936 *The Legend of Kawelo and Other Hawaiian Folktales*. Private printing, Honolulu.

Handy, E.S. Craighill and Elizabeth Green Handy
1972 *Native Planters in Old Hawai‘i: their Life, Lore, and Environment*. Bishop Museum Bulletin No. 233. Bishop Museum Press, Honolulu.

Haun, Alan E. and Dave Henry
2004 *Archaeological Assessment Survey, Keaau-Pahoa Road Shoulder Lane Conversion, Land of Keaau, Puna District, Island of Hawaii*. Haun and Associates, Kea‘au, Hawai‘i.

2008 *Archaeological Inventory Survey, Portions of TMK: (3) 1-6-04: 11, 47-53, 55, 56, and 1-6-64:266-269, 283-286, Land of Kea‘au, Puna District, Island of Hawaii*. Haun and Associates, Kea‘au, Hawai‘i.

Hawai‘i Tax Map Key (TMK)
2014 Hawai‘i Tax Map Key (TMK) [3] 1-6-003. Hawai‘i TMK Service, Honolulu.

Hudson, Alfred E.
1932 The Archaeology of Eastern Hawaii. Manuscript prepared for the Bishop Museum, Honolulu.

Hunt, Terry l.
1993 Assessment of Shipman Lands in Kea‘au, Puna Island of Hawai‘i. University of Hawai‘i, Honolulu.

Hurst, Gwen and Allan Schilz
1994 *Revised Archaeological Survey of the Kea‘au Town Section Project no. 130B-01-92 Puna, Hawai‘i (TMK 1-6-03).* Ogden Environmental and Energy Services, Inc., Honolulu.

Kirch, Patrick V.
1985 *Feathered God and Fishhooks*. University of Hawai‘i Press, Honolulu.

Kluegel
1901 Map of Hilo Railroad, Olaa Division. Registered Map 1990. Hawai‘i Land Survey Division, State of Hawai‘i, Department of Accounting and General Services, Honolulu. Available online at http://dags.hawaii.gov/survey/search.php.

Komori, Eric
1987 *Cultural and Biological Resources Survey of the Pohoiki to Puna-Substation 69KV Transmission Corridor, Kapoho to Kea‘au, Puna, Hawai‘i Island*. Bernice Pauahi Bishop Museum, Honolulu.

Masterson, Ian and Hallett H. Hammatt
1998 *Archaeological Inventory Survey for the Proposed Kea‘au Elderly Housing Project, Kea‘au, Puna District, Hawai‘i Island (TMK: 1-6-143: por. of 18 and 39).* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

McEldowney, Holly

1979 *Archaeological and Historical Literature Search and Research Design: Lava Flow Control Study, Hilo, Hawai‘i.* Department of Anthropology, Bernice Pauahi Bishop Museum, Honolulu.

McGerty, Leann and Robert Spear

2000 *An Archaeological Inventory Survey of the Proposed K.S.B.E. East Hawai‘i Campus, Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i (TMK 1-6-03: por. 12).* Scientific Consultant Services, Inc., Honolulu.

Rosendahl, Margaret L.K.

1982 *Archaeological Reconnaissance Survey, Proposed W.H. Shipman Industrial Park, TMK: 3-1-6-03: Por. 12*. Paul H. Rosendahl, Ph.D., Inc., Kurtistown, Hawai‘i.

Rosendahl, Paul and Alan Walker

1992 *Archaeological Field Inspection of TMK 3-1-7-17:3, Land of Ola‘a, Puna District, Hawai‘i*. Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai‘i.

Sato, Harry H., Warren Ikeda, Robert Paeth, Richard Smythe, and Minoru Takehiro, Jr.

1973 *Soil Survey of the Island of Hawaii*, State of Hawaii. U.S. Department of Agriculture, U.S. Government Printing Office, Washington, D.C.

Stearns, H.T.

1944 National Park Service topographic map of Hawaii Island. Registered Map 3081. Hawai‘i Land Survey Division, State of Hawai‘i, Department of Accounting and General Services, Honolulu. Available online at http://dags.hawaii.gov/survey/search.php.

Stokes, John F.G.

1919 *Notes on Hawaiian Heiaus*. Bishop Museum, Honolulu.

Thrum, Thomas G.

1908 Heiaus and Heiau Sites Throughout the Hawaiian Islands, Kauai. In *Hawaiian Almanac and Annual 1908*. Thos. G. Thrum, Honolulu.

Treiber, Gale E.

2005 *Hawaiian Railway Album. Volume 2. Along the Main Lines of the Oahu Railway and Land Co. and the Hawaii Consolidated Railway*. Hawaiian Railway Society and Railroad Press, Hanover, Pennsylvania.

USDA (U.S. Department of Agriculture)

2001 Soil Survey Geographic (SSURGO) database. U.S. Department of Agriculture, Natural Resources Conservation Service. Fort Worth, Texas. http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/ (accessed March 2018).

USGS (U.S. Geological Survey)

1914 Waiakea and Mountain View USGS Survey 7.5-Minute Series Topographic Quadrangles. USGS Information Services, Denver, Colorado.

1963 Hilo and Mountain View USGS Survey 7.5-Minute Series Topographic Quadrangles. USGS Information Services, Denver, Colorado.

1977 USGS Orthophotoquad, Hilo and Mountain View Quadrangles. USGS Information Services, Denver, Colorado.

1994 Mountain View USGS Survey 7.5-Minute Series Topographic Quadrangle. USGS Information Services, Denver, Colorado.

1995 Hilo USGS Survey 7.5-Minute Series Topographic Quadrangle. USGS Information Services, Denver, Colorado.

Waihona ‘Aina

2000 *The Māhele Database.* Electronic document, http://waihona.com

Walker, Alan, Kepā Maly, and Paul Rosendahl

1997 *Historical and Archaeological Research Proposed Kea‘au High School Site Land of Kea‘au, Puna District, Island of Hawai‘i (TMK: 1-6-03: Por 3, 15, 84).* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai‘i.

Wall, Walter E.

1928 Hawai‘i Island. Hawai‘i Land Survey Division, State of Hawai‘i, Department of Accounting and General Services, Honolulu. Available online at http://dags.hawaii.gov/survey/search.php.

Wheeler, Momi, Sarah Wilkinson, and Hallett H. Hammatt

2015 *Archaeological Literature Review and Field Inspection for Buildings B, D, E and G Demolition Project at Kea‘au Middle School, Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i, TMK [3] 1-6-002:001 and 1-6-003:059*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wilkes, Charles

1845 *Narrative of the U.S. Exploring Expedition during the Years 1838-1842*, Vol. IV. Lea and Blanchard, Philadelphia, Pennsylvania.

Wilkinson, Sarah, Aulii Mitchell, and Hallett H. Hammatt

2010 *Archaeological Inventory Survey Report for the Kea‘au-Pāhoa Road Widening Project, Kea‘au Ahupua‘a to Waiakahiula Ahupua‘a, Puna District, Island of Hawai‘i TMK [3] 1-5 (various plats and parcels); 1-6 (various plats and parcels).* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wilkinson, Sarah, Olivier Bautista, and Hallett H. Hammatt

2017 *Archaeological Literature Review and Field Inspection Report for the Kea‘au High School Proposed Clearing and Grubbing of Approximately 4 Acres Project, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, TMKs: [3] 1-6-003:110 (por.), 111, 112 (por.), and 118*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wilkinson, Sarah, Rosanna Runyon, and Hallett H. Hammatt

2008 *Archaeological Monitoring Report for Kea‘au Middle School, Hawai‘i Inter-Island DOE Cesspool Project, Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i, TMK: [3] 1-6-002:001 and 1-6-003:059.* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Appendix G

Traffic Impact Assessment Report

This page intentionally blank.

FINAL

East Hawaii Organics Facility

Tax Map Key 1-6-003: 090

Traffic Impact Analysis Report

Keaau, Island of Hawai'i

August 1, 2018

Prepared for

Solid Waste Division,

Department of Environmental Management,

County of Hawaii

Prepared by

SSFM International

Table of Contents

I. PROJECT DESCRIPTION 4
II. EXISTING CONDITIONS 7
A. Geometric Configuration 7
1. Roadway Configuration 7
B. Volumes 8
1. Vehicular Volume 8
C. Level of Service 12
1. Methodology 12
2. Existing Intersection Level of Service Results 13
III. FUTURE CONDITIONS 14
A. Surrounding Area Conditions 14
B. Volumes 14
1. Future Without Project Volumes 14
2. Project Related Volumes 16
3. Future With Project Volumes 17
C. Future Level of Service 20
1. Intersection LOS Results for Future without project conditions 20
2. Intersection LOS Results for Future With project conditions 20
3. Mitigation 21
IV. SUMMARY 24
V. RECOMMENDATIONS 24
VI. REFERENCES 26

List of Figures

Figure 1: Project Location Map 5
Figure 2: Proposed Site Plan 6
Figure 3: Existing 2018 Lane Configurations 9
Figure 4: Mamalahoa Highway (Kilauea Avenue-Waianuhea Place), 24-Hour Volume Distribution (2015) 10
Figure 5: Existing 2018 Peak Hour Traffic Volumes 11
Figure 6: Future 2020 Without Project Peak Hour Traffic Volumes 15
Figure 7: Project Related Trips 18
Figure 8: Future 2020 With Project Peak Hour Traffic Volumes 19

List of Tables

Table 1: Roadway Traffic Volumes 8
Table 2: LOS Criteria for Unsignalized Intersections 12
Table 3: LOS Criteria for Signalized Intersections 13
Table 4: Existing 2018 Intersection Level of Service 14
Table 5: Estimated Trips Generated by Project, Based on Number of Loads to/from Current Facility 16
Table 6: Future 2020 Without Project Intersection Level of Service 20
Table 7: Future 2020 With Project Intersection Level of Service 21

List of Appendices

Appendix A – 24-Hour and Peak Period Traffic Counts
Appendix B – Analysis Reports Existing (2018) Conditions
Appendix C – Analysis Reports Future (2020) Without Project Conditions
Appendix D – Analysis Reports Future (2020) With Project Conditions
Appendix E – Analysis Reports Future (2020) With Project and 2nd Access Conditions

I. PROJECT DESCRIPTION

The County of Hawaii Department of Environmental Management (DEM) proposes to construct and operate an organics facility in Keaau. The purpose and need for the project is to divert organics from disposal in the county landfills in order to extend the life of the landfills and to create compost and mulch to support local agriculture. The facility would be operated by Hawaii Earth Recycling, under contract to the County of Hawaii. The site with TMK: 1-6-003:090 is the proposed location for the organics facility. It is located within W. H. Shipman Business Park. The project proposed driveway access is located at the intersection of Kipimana Street and Mikahala Street.

This traffic impact analysis report (TIAR) is being completed in support of the Environmental Assessment (EA). This report contains an analysis of the existing conditions, the future without project and the future with project conditions. The facility is expected to be fully built and operational by 2020. The project location along with the study intersections associated with the TIAR are shown in Figure 1. East Hawaii Organics Facility's proposed site plan is shown in Figure 2.

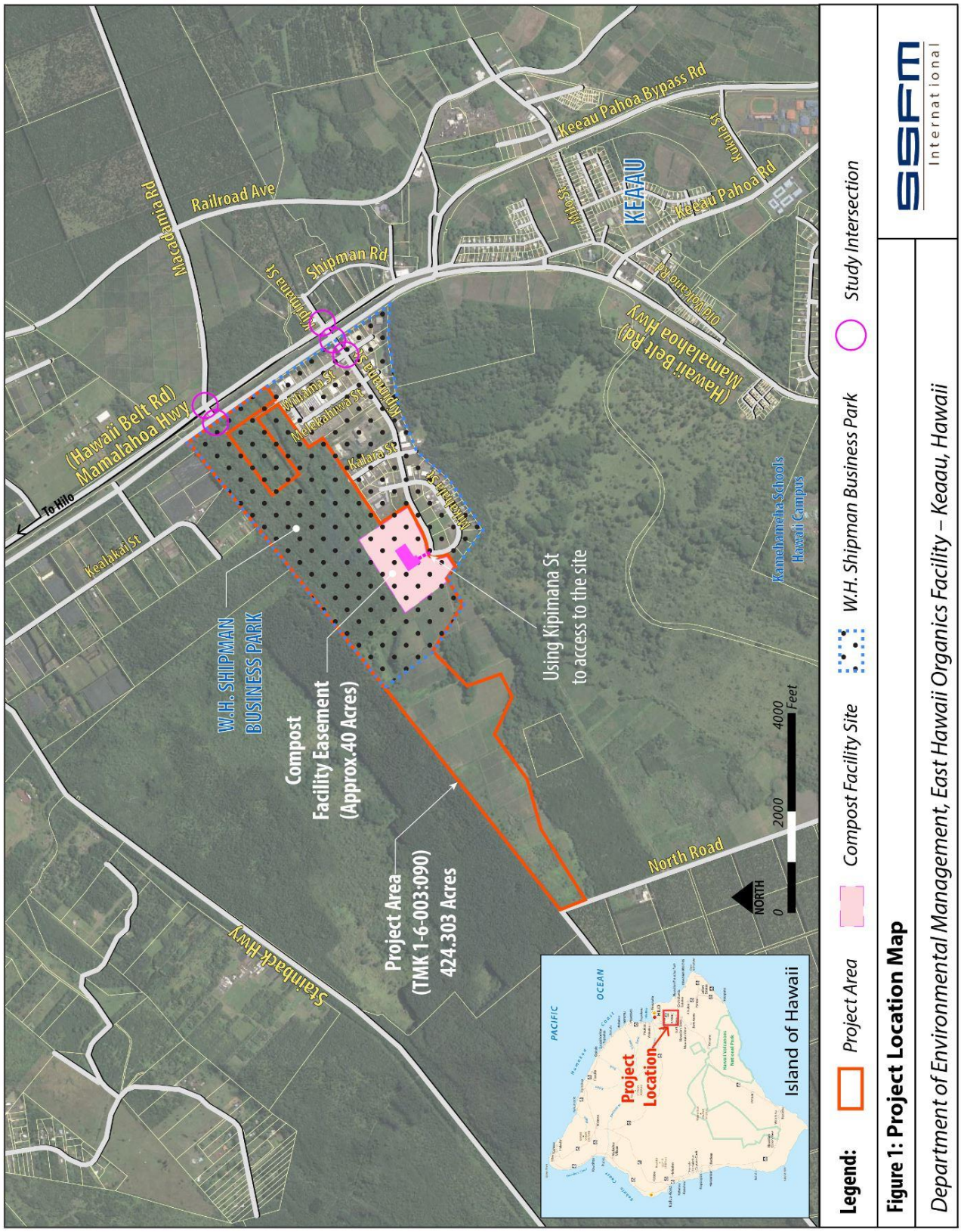


Figure 1: Project Location Map

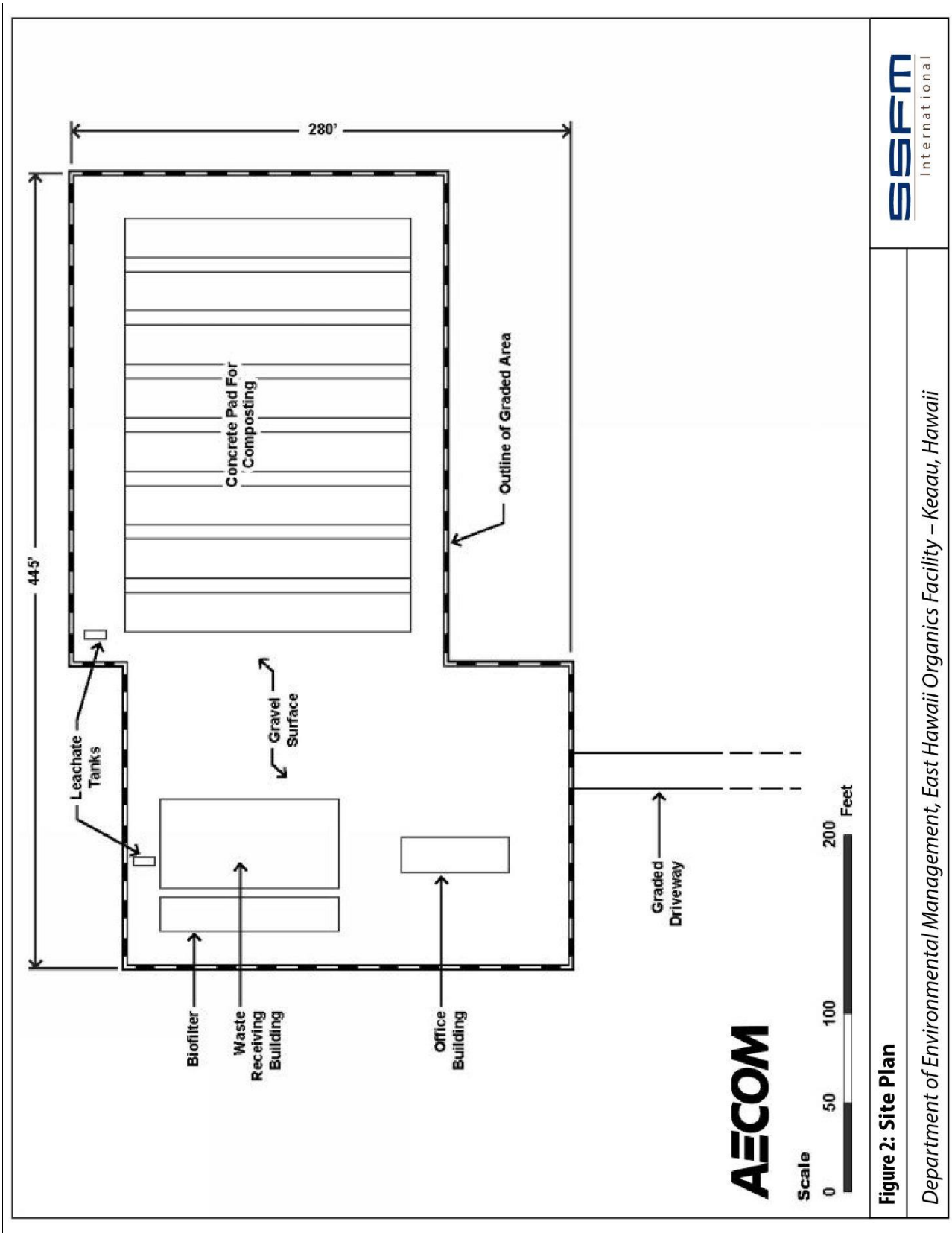


Figure 2: Proposed Site Plan

II. EXISTING CONDITIONS

A. Geometric Configuration

1. Roadway Configuration

a) Kipimana Street

Kipimana Street is an undivided, four-lane, commercial collector road, oriented in the east-west direction. Kipimana Street is the main street within the W. H. Shipman Business Park and connects to Mamalahoa Highway (Hawaii Belt Road 11). It starts from west end of Mikahala Street in the west and ends at Shipman Road in the east. The posted speed limit is 25 mph. Access to the proposed facility would be located at the westernmost Kipimana Street/Mikahala Street intersection. The intersection is currently configured as an unsignalized intersection with a stop sign on the Mikahala Street approach and free flow on Kipimana Street. Kipimana Street intersects Mamalahoa Highway and forms two intersections: one with southbound Mamalahoa Highway and one with northbound Mamalahoa Highway due to the wide median. The Kipimana Street and Wiliama Street intersection is analyzed as part of the study. Wiliama Street runs parallel to Mamalahoa Highway and provides access to businesses within the business park.

b) Māmalahoa Highway (Hawaii Belt Road 11)

Māmalahoa Highway (also named State Route 11) is a State Route arterial, oriented in the north-south direction. Māmalahoa Highway extends from Kamehameha Avenue (Route 19) in the north to the intersection with Keaau Pahoa Road (Route 130) where it turns into Volcano Road in the south. The posted speed limit varies from 35-55 mph along the corridor, but at the study intersections it is 55 mph. Mamalahoa Highway is a divided highway in the study location at the intersections with Kipimana Street and Macadamia Nut Road. Each side street intersection with Mamalahoa Highway is analyzed as two closely spaced intersections due to the wide median between the two directions of Mamalahoa Highway traffic.

The study intersections include the following:

1. Kipimana Street and Wiliama Street
    a. Four-leg intersection with stop signs on Wiliama Street and free flow on Kipimana Street
2. Kipimana Street and Mamalahoa Highway Southbound
    a. Four-leg intersection with stop signs on Kipimana Street and free flow on Mamalahoa Highway. Right turn channelization islands are provided for traffic turning to and from Mamalahoa Highway.
3. Kipimana Street and Mamalahoa Street Northbound
    a. Four-leg intersection with stop signs on Kipimana Street and free flow on Mamalahoa Highway. An outside acceleration lane is provided for traffic turning right onto Mamalahoa Highway.
4. Mamalahoa Highway Northbound and Macadamia Nut Road
    a. Four-leg intersection with stop signs on Macadamia Nut Road and free flow on Mamalahoa Highway. Right turn channelization islands are provided for traffic turning to and from Mamalahoa Highway.

5. Mamalahoa Highway Southbound and Macadamia Nut Road
    a. Three-leg intersection with stop signs on Macadamia Nut Road and free flow on Mamalahoa Highway

Existing (2018) lane configurations and traffic controls at the study intersections are shown in Figure 3.

B. Volumes

1. Vehicular Volume

a) Roadway Traffic Volumes

The Average Daily Traffic (ADT) volume along Mamalahoa Highway (between Kilauea Avenue and Waianuhea Place) is shown in Table 1. The ADT is based on Hawaii DOT traffic counts included in *Historical Traffic Station Maps, 2015*.

Table 1: Roadway Traffic Volumes

Roadway	Location	2015 ADT
Mamalahoa Highway	Between Kilauea Avenue and Waianuhea Place	32,700

Source: *Historical Traffic Station Maps* (HDOT)

The 24-hour traffic volume distribution along Mamalahoa Highway (see Figure 4) at the traffic count station shows a variation in travel patterns throughout the day. Detailed 24-hour counts are included in Appendix A.

Along Mamalahoa Highway, during the morning peak hour of 6:45 – 7:45 AM, there are approximately 614 vehicles per hour (vph) travelling southbound and 1,728 vph travelling northbound for a total of 2,342 vph. During the afternoon peak hour of 3:00 – 4:00 PM, there are approximately 1,424 vph travelling southbound and 1,145 travelling northbound for a total of 2,569 vph.

b) Intersection Peak Hour Volumes

Manual intersection turning movement traffic counts were taken at the study intersections during the peak periods on Tuesday March 27 and Wednesday April 18, 2018. Counts were collected and included tabulation of passenger vehicles, heavy trucks, pedestrians, and bicycles. The Existing (2018) peak hour volumes are shown in Figure 5. Detailed peak period counts are included in Appendix A.

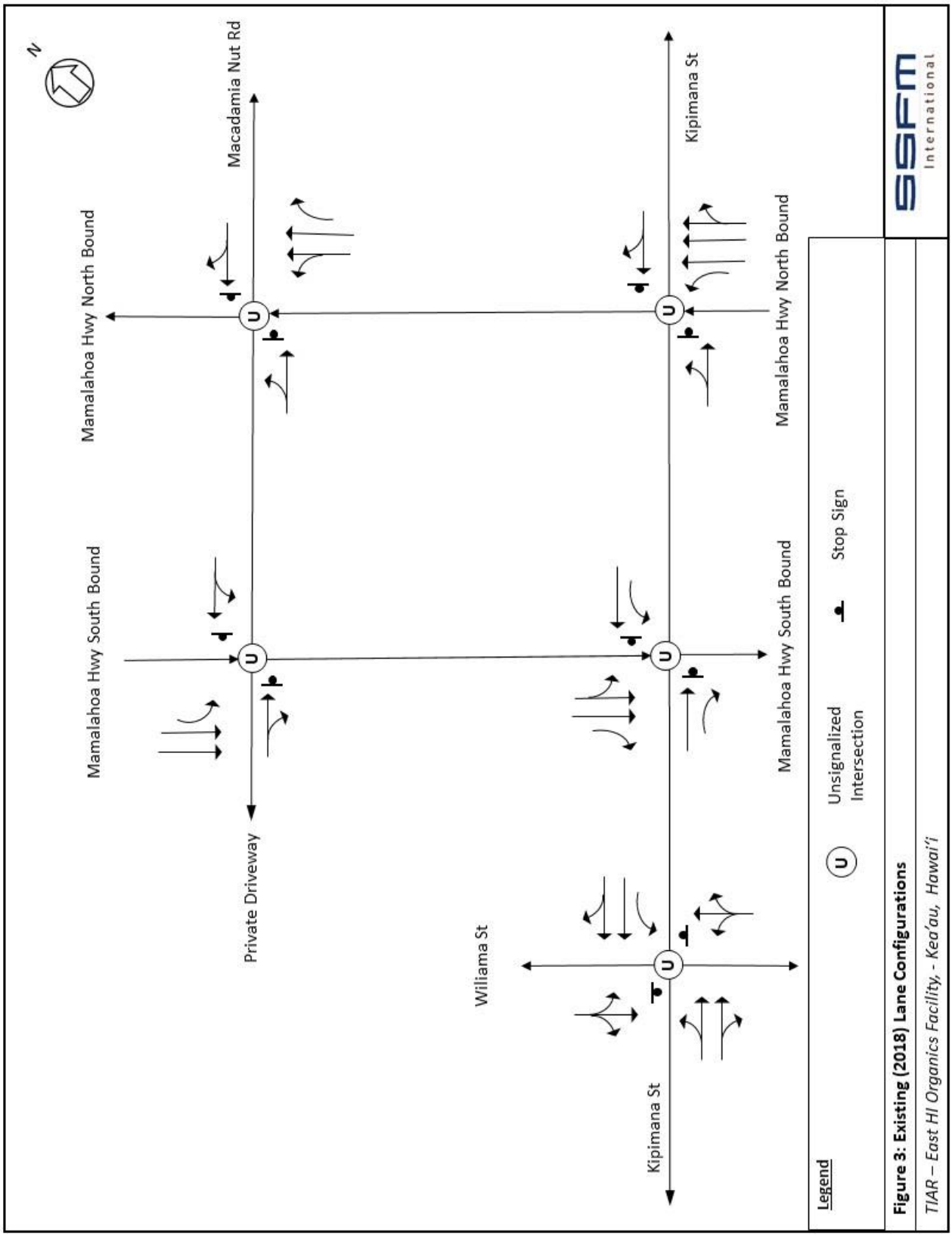


Figure 3: Existing 2018 Lane Configurations

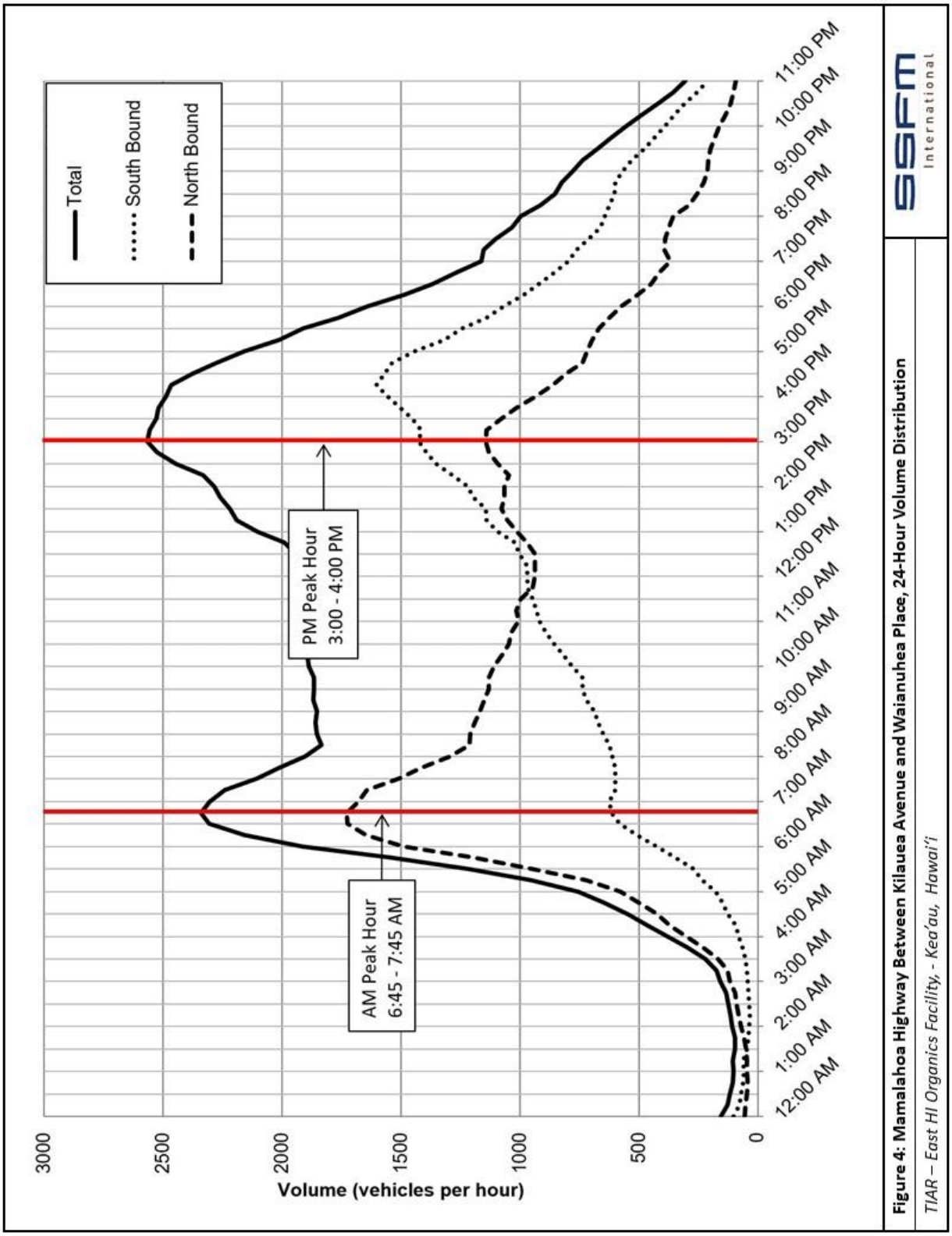


Figure 4: Mamalahoa Highway (Kilauea Avenue-Waianuhea Place), 24-Hour Volume Distribution (2015)

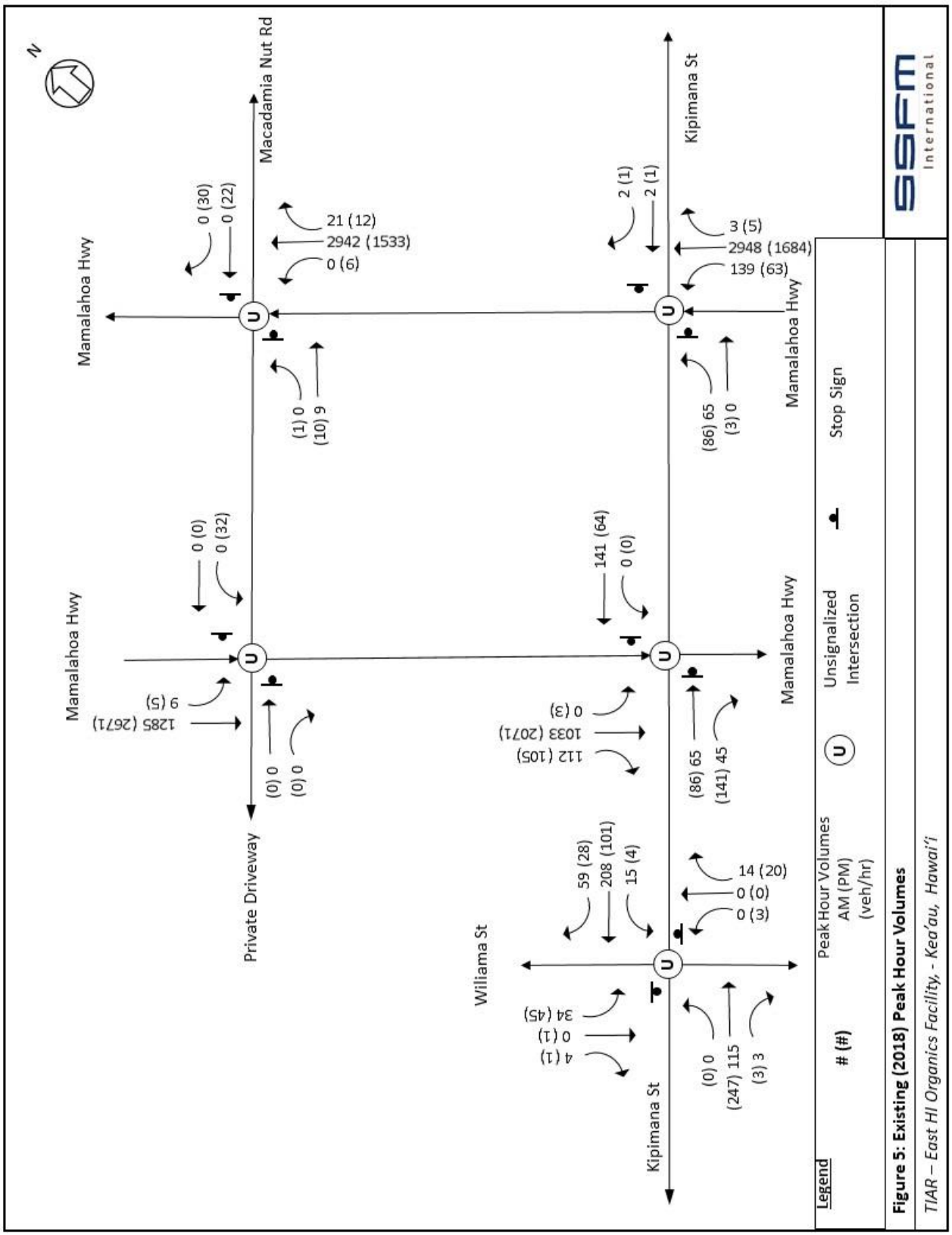


Figure 5: Existing 2018 Peak Hour Traffic Volumes

C. Level of Service

1. Methodology

Level of service (LOS) is an operational analysis rating system used in traffic engineering to measure the effectiveness of roadway operating conditions. There are six LOS ranging from A to F. LOS A is defined as being the least interrupted flow conditions with little or no delays, whereas LOS F is defined as conditions where extreme delays exist. Guidelines from the *Statewide Uniform Design Manual for Streets and Highways* (HDOT, 1980) and *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2011) state that an appropriate peak hour LOS for an urban arterial is LOS C or D. Intersection LOS and delay were determined for the AM and PM peak hours using *Synchro 10* traffic analysis software and analyzed using *HCM* 6th Edition (TRB, 2016) methodologies.

As stated in the *Highway Capacity Manual* (*HCM*) 6th Edition (TRB, 2016), LOS for a two-way stop controlled (TWSC) intersection is determined by the measured control delay (see Table 2) and is defined for each minor movement, not for the intersection as a whole. Vehicles traveling along the major, free-flow road, of a TWSC intersection, proceed through with minimal delay or no delay at all. Those vehicles approaching the intersection along the minor movement are controlled by a stop sign and thus experience delay attributable to the volume of vehicles passing along the free-flow road and the gaps available.

Table 2: LOS Criteria for Unsignalized Intersections

Average Control Delay (s/veh)	LOS by v/c Ratio	
	<=1.0	>1.0
≤ 10.0	A	F
>10 and ≤15	B	F
>15 and ≤25	C	F
>25 and ≤35	D	F
>35 and ≤50	E	F
>50	F	F

Source: *HCM* (TRB, 2016)

The LOS analysis for signalized intersections is based on average total vehicle delay based on the methodologies of the *HCM* (TRB, 2016), as shown in Table 3. High numbers of vehicles passing the intersection, long cycle lengths, inappropriate signal phasing, or poor signal progression can result in long delays, and consequently poor LOS.

Another measure of intersection delay is the volume to capacity (v/c) ratio. This is the ratio of the volume of traffic utilizing the intersection compared to the maximum volume of vehicles that can be accommodated by the intersection during a specific period of time. A v/c ratio under 0.85 means the intersection is operating under capacity and excessive delays are not experienced. An intersection is operating near its capacity when v/c ratios range from 0.85 to 0.95. Unstable flows are expected when the v/c ratio is between 0.95 and 1.0. Any v/c ratio greater than or equal to 1.0 indicates that the intersection is operating at or above capacity which results in a LOS F. A traffic movement can have a poor

LOS but low v/c which suggests that the traffic volumes along that movement are low but have to wait a long time to make the movement. This is common for low volume protected turn movements or side streets that have to wait through a long cycle length for their split to come up.

Table 3: LOS Criteria for Signalized Intersections

Average Control Delay (s/veh)	LOS by v/c Ratio	
	<=1.0	>1.0
≤ 10.0	A	F
>10 and ≤20	B	F
>20 and ≤35	C	F
>35 and ≤55	D	F
>55 and ≤80	E	F
>80	F	F

Source: *HCM* (TRB, 2016)

2. Existing Intersection Level of Service Results

Using Synchro software, existing LOS by movement and average delay (in seconds per vehicle) were determined for the AM and PM weekday peak hours and are shown in Table 4. Synchro reports are in Appendix B. All the intersections are unsignalized (stop sign controlled). At the intersection of Kipimana Street & Mamalahoa Highway Southbound, the eastbound and westbound through movements are operating at LOS E or F. During the PM peak hour, the eastbound and westbound movements are at more than 2x capacity. At the intersection of Kipimana Street and Mamalahoa Northbound, both the eastbound and westbound approaches are operating at LOS F for the AM peak hour. All the approaches at Kipimana Street and Wiliama Street intersection are operating at LOS A or B. At the intersection of Macadamia Nut Road and Mamalahoa Highway Southbound, the westbound approach is operating at LOS F for the PM peak hour. At the intersection of Macadamia Nut Road and Mamalahoa Highway Northbound, the eastbound approach is operating at LOS F for both the AM and PM peak hours. Because the northbound and southbound traffic on Mamalahoa Highway is free flow (no stop signs) at the study intersections, HCS does not calculate delay. Delay for those movements is theoretically minimal.

Drivers currently experience delays of 5-10 minutes or more at Kipimana Street and Mamalahoa Highway southbound in the evening. Similar delays are experienced by side street drivers at Kipimana Street and Mamalahoa Highway northbound in the morning. This is due to the high volume of traffic going northbound and southbound on Mamalahoa Highway, and the limited availability of gaps to allow traffic entry from the side streets.

Table 4: Existing 2018 Intersection Level of Service

Intersection		AM			PM		
Approach	**Movement**	**Delay (sec)**	**v/c**	**LOS**	**Delay (sec)**	**v/c**	**LOS**
1: Kipimana St & Wiliama St							
Westbound	**L**	7.8	0.01	A	8.3	0.01	A
Northbound	**LTR**	9.0	0.03	A	9.4	0.03	A
Southbound	**LTR**	13.7	0.12	B	11.7	0.15	B
2: Kipimana St & Mamalahoa Highway SB*							
Eastbound	**T**	46.8	0.46	E	719	2.15	F
Westbound	**T**	82.2	0.85	F	1048	2.70	F
3: Kipimana St & Mamalahoa Highway NB*							
Eastbound	**LT**	663	2.00	F	27.6	0.43	D
Westbound	**TR**	486	0.62	F	39.3	0.04	E
4: Macadamia Nut Rd & Mamalahoa Highway SB*							
Westbound	**LT**	-	-	-	95.3	0.64	F
5: Macadamia Nut Rd & Mamalahoa Highway NB*							
Eastbound	**LT**	976	1.33	F	50.4	0.17	F

*NOTE: HCS does not calculate delay for Mamalahoa Highway Northbound and Southbound traffic since it is free flow with little to no delay.

III. FUTURE CONDITIONS

East Hawaii Organics Facility is expected to be fully built out and operational by 2020.

A. Surrounding Area Conditions

No significant developments or construction projects are expected in the project area that would significantly affect the roadway geometrics or traffic volumes at the study intersections. This is based on research completed on June 1st 2018 at the State of Hawaii Office of Environmental Quality Control (OEQC) website and the Statewide Transportation Improvements Program (STIP).

B. Volumes

1. Future Without Project Volumes

The project study area within Hilo is experiencing moderate growth. HDOT ADT counts on Mamalahoa Highway at Mile Post 5.29 showed a growth rate of 1.8% per year from 2011 to 2015. Although no major developments are anticipated in the vicinity of proposed location, a background growth rate of 2% per year was assumed, to account for additional traffic at the study intersections. The estimated future traffic volumes without the project for the year 2020 are shown in Figure 6.

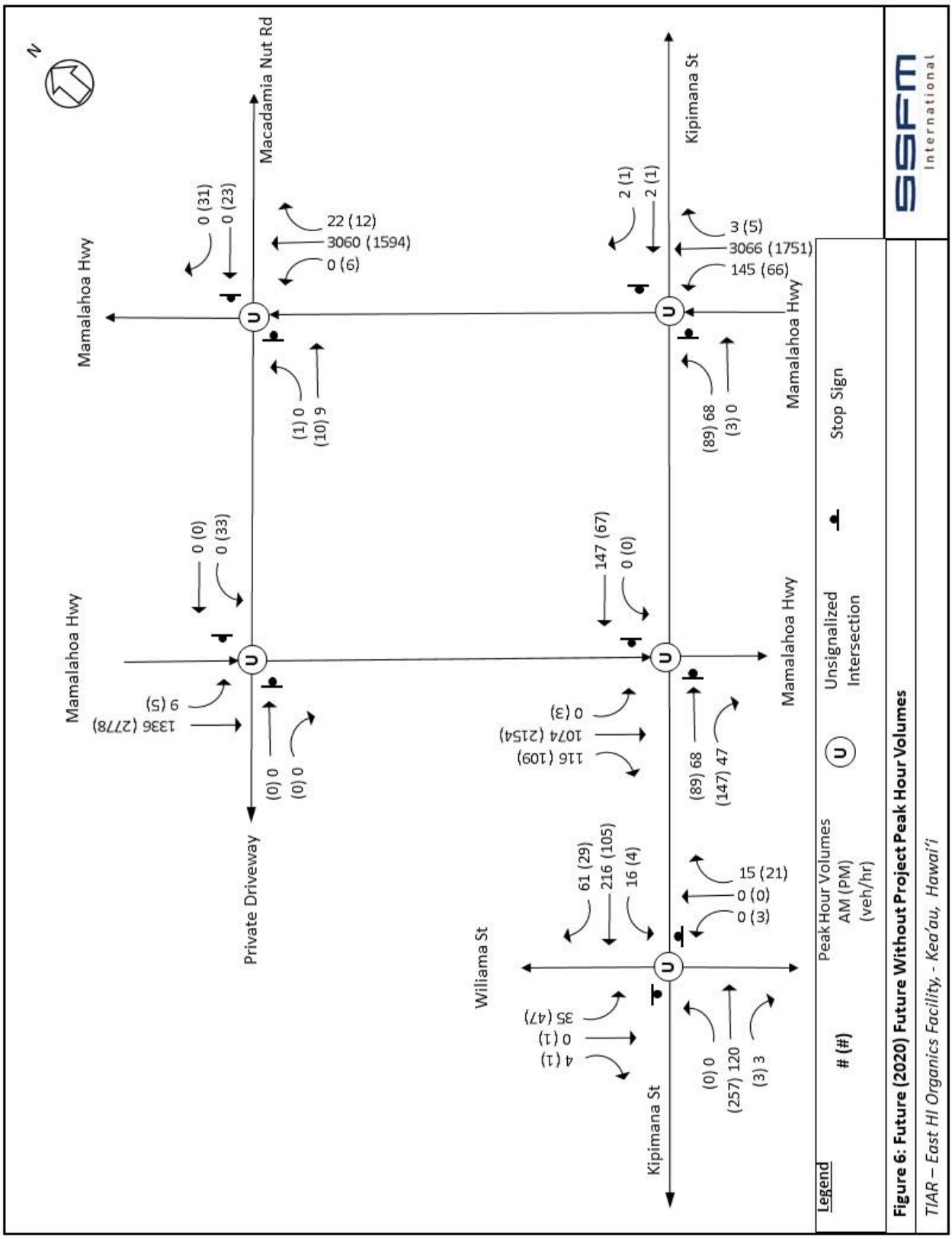


Figure 6: Future 2020 Without Project Peak Hour Traffic Volumes

2. Project Related Volumes

To estimate the trips expected from the proposed project, DEM provided the monthly number of loads from incoming Green waste and Pallets, and the number of outgoing loads for Mulch for the last 12 months (May 2017 to April 2018) for the existing facility. 45,212 Incoming and 14,276 Outgoing loads were documented. This data was used to calculate the total average loads per day: 163. Each load consists of a trip in and a trip out and therefore results in 2 trips. Only a proportion of the daily trips will occur in the peak hours: a factor of 20% was used for the AM peak hour, and 10% for the PM peak hour. The directional split for In Trips vs Out Trips was assumed to be 60%, 40% for the AM peak hour and 40%, 60% for the PM peak hour. The new employee trips are also included in the estimation. The distribution of project related trips is shown in Figure 7.

Table 5: Estimated Trips Generated by Project, Based on Number of Loads to/from Current Facility

Month	**Number of loads for Incoming Waste**		**Number of loads for Outgoing Mulch**	
May-17	4,041		1,578	
Jun-17	4,142		1,456	
Jul-17	4,083		1,457	
Aug-17	4,259		1,240	
Sep-17	4,230		1,293	
Oct-17	3,966		1,066	
Nov-17	3,400		917	
Dec-17	3,778		942	
Jan-18	3,533		1,388	
Feb-18	3,099		1,111	
Mar-18	3,372		838	
Apr-18	3,309		990	
Loads per year	45,212		14,276	
Total Loads per year	59,488			
Avg. Loads per day	**163**			
Avg. Trips per day	326			
Peak Hour	AM		PM	
Factor from Daily trips in peak hr	20%		10%	
Peak hour trips	66		32	
	In	Out	In	Out
	60%	40%	40%	60%
Facility Trips	40	26	13	19
Employee Trips	4	0	0	4
Total Trips generated	**44**	**26**	**13**	**23**

3. Future With Project Volumes

Project related trips were added to the Future Without Project volumes to estimate Future With Project peak hour volumes. The traffic volumes for future with project conditions for 2020 are shown in Figure 8.

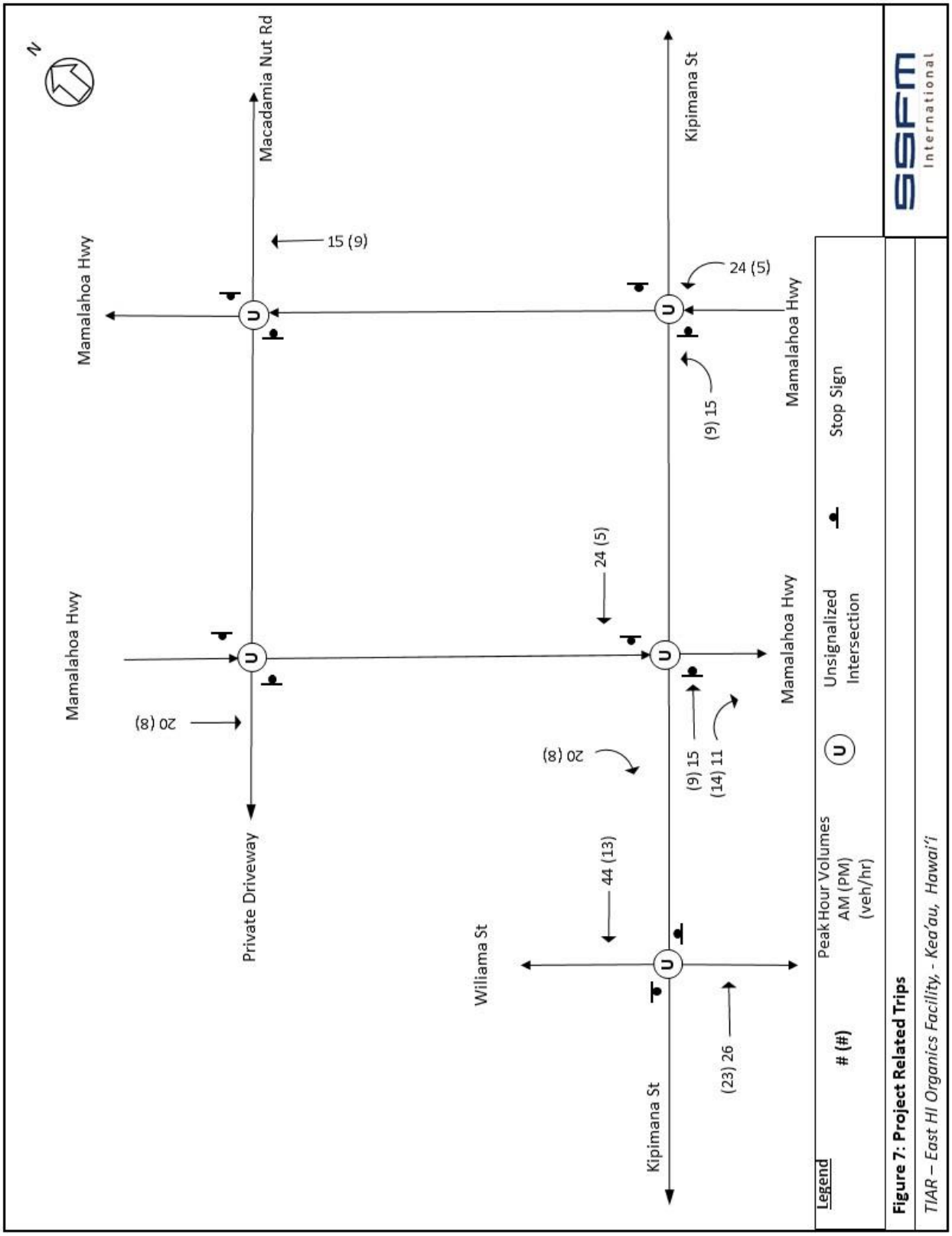


Figure 7: Project Related Trips

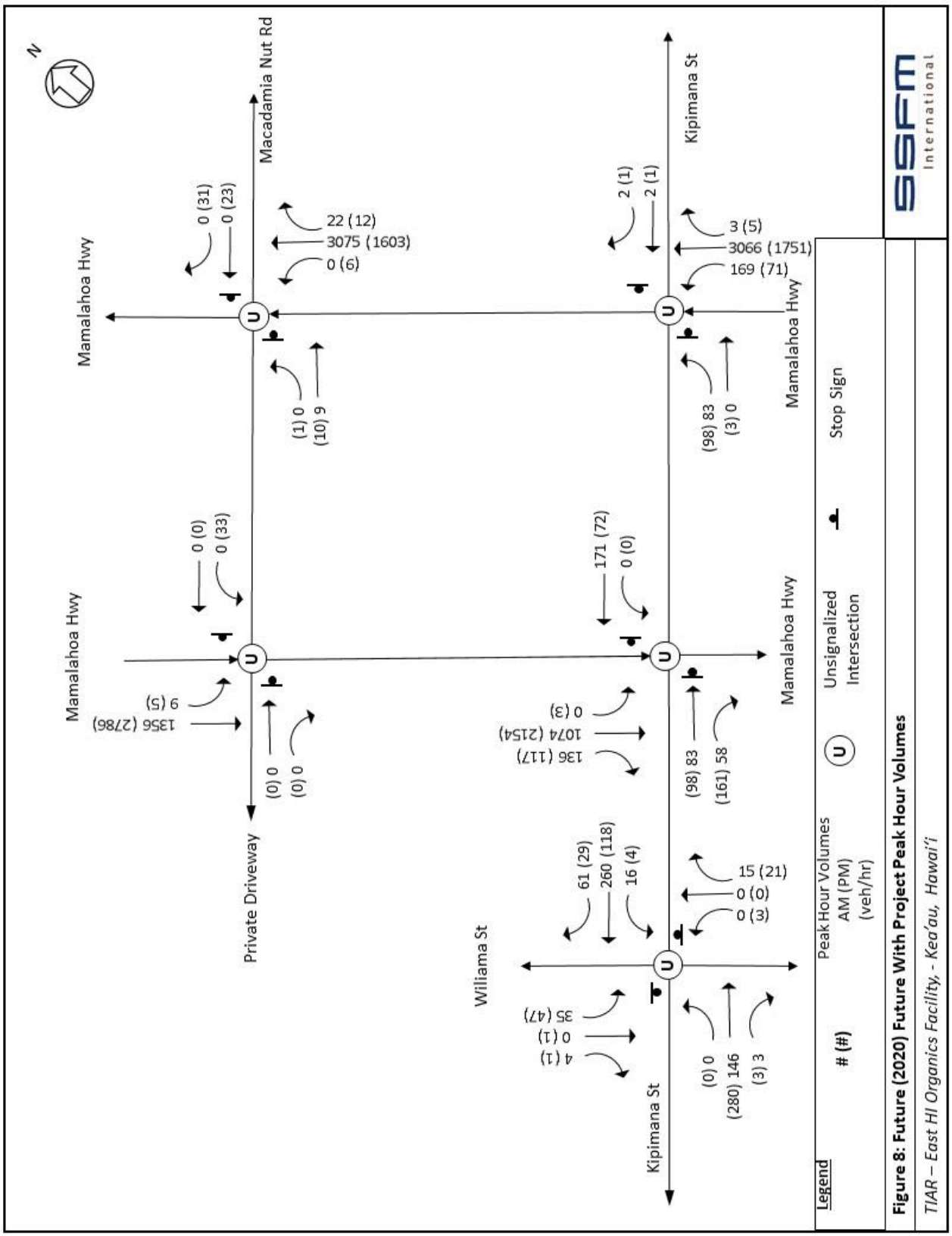


Figure 8: Future 2020 With Project Peak Hour Traffic Volumes

C. Future Level of Service

1. Intersection LOS Results for Future without project conditions

Using the Volumes from Figure 6, the Levels of Service were determined for Future 2020 Without Project. At the intersection of Kipimana Street & Mamalahoa Highway Southbound, the eastbound and westbound through movements are operating at LOS F for AM and PM peak hour. Similarly at the intersection of Kipimana Street and Mamalahoa Northbound, both the east and westbound approaches are operating at LOS F for AM peak hour and westbound approach operating at E for PM peak hour. All the approaches at Kipimana Street and Wiliama Street intersection are operating at LOS A or B. At the intersection of Macadamia Nut Road and Mamalahoa Highway Southbound, westbound approach is operating at LOS F for PM peak hour. At the intersection of Macadamia Nut Road and Mamalahoa Highway Northbound, eastbound approach is operating at LOS F for both AM and PM peak hour. The results are shown in Table 6 and Synchro reports are in Appendix C.

Table 6: Future 2020 Without Project Intersection Level of Service

Intersection		AM			PM		
Approach	**Movement**	**Delay (sec)**	**v/c**	**LOS**	**Delay (sec)**	**v/c**	**LOS**
1: Kipimana St & Wiliama St							
Westbound	**L**	7.8	0.02	A	8.3	0.01	A
Northbound	**LTR**	9.0	0.04	A	9.5	0.04	A
Southbound	**LTR**	14.1	0.13	B	11.9	0.16	B
2: Kipimana St & Mamalahoa Highway SB							
Eastbound	**T**	53.8	0.51	F	889	2.50	F
Westbound	**T**	107.3	0.94	F	1332	3.26	F
3: Kipimana St & Mamalahoa Highway NB							
Eastbound	**LT**	1019	2.70	F	30.4	0.47	D
Westbound	**TR**	604	0.73	F	43.3	0.04	E
4: Macadamia Nut Rd & Mamalahoa Highway SB							
Westbound	**LT**	-	-	-	120	0.73	F
5: Macadamia Nut Rd & Mamalahoa Highway NB							
Eastbound	**LT**	1130	1.50	F	56.2	0.19	F

2. Intersection LOS Results for Future With project conditions

A similar analysis was performed Future 2020 With Project conditions, using volumes from Figure 8. At the intersection of Kipimana Street & Mamalahoa Highway Southbound, the eastbound and westbound through movements are operating at LOS F for AM and PM peak hour. Similarly at the intersection of Kipimana Street and Mamalahoa Northbound, both the eastbound and westbound approaches are operating at LOS E or F for both AM and PM peak hour. All the approaches at the intersection of Kipimana

Street and Wiliama Street are operating at LOS A or B. At the intersection of Macadamia Nut Road and Mamalahoa Highway Southbound, the westbound approach is operating at LOS F for PM peak hour. At the intersection of Macadamia Nut Road and Mamalahoa Highway Northbound, the eastbound approach is operating at LOS F for both AM and PM peak hour. The results are shown in Table 7 and Synchro reports are in Appendix D.

As is currently the case, drivers are expected to experience delays of 10 minutes or more at Kipimana Street and Mamalahoa Highway southbound in the evening. Similar delays are expected for side street drivers at Kipimana Street and Mamalahoa Highway northbound in the morning. This is due to the high volume of traffic going northbound and southbound on Mamalahoa Highway, and the limited availability of gaps to allow traffic entry from the side streets.

Table 7: Future 2020 With Project Intersection Level of Service

Intersection		AM			PM		
Approach	**Movement**	**Delay (sec)**	**v/c**	**LOS**	**Delay (sec)**	**v/c**	**LOS**
1: Kipimana St & Wiliama St							
West Bound	**L**	8.	0.02	A	8.5	0.01	A
Northbound	**LTR**	9.1	0.04	A	9.6	0.04	A
Southbound	**LTR**	15.4	0.14	C	12.3	0.16	B
2: Kipimana St & Mamalahoa Highway SB							
Eastbound	**T**	79.5	0.69	F	1193	3.13	F
Westbound	**T**	201.4	1.22	F	1592	3.80	F
3: Kipimana St & Mamalahoa Highway NB							
Eastbound	**LT**	2459	5.61	F	36.5	0.56	E
Westbound	**TR**	781	0.89	F	43.7	0.04	E
4: Macadamia Nut Rd & Mamalahoa Highway SB							
Westbound	**LT**	-	-	-	122.6	0.74	F
5: Macadamia Nut Rd & Mamalahoa Highway NB							
Eastbound	**LT**	1330	1.71	F	85.0	0.19	F

3. Mitigation

To mitigate the delays at the side streets of Kipimana Street and Macadamia Nut Road, several options exist. Because the traffic peaks during very predictable times, businesses within the business park could open or close earlier or later, to even out traffic peaks somewhat, and avoid the additive effects of everyone arriving and leaving at the same times. The intersections with longest delays should be evaluated for MUTCD Traffic Signal warrants to determine if they are an appropriate solution. However,

traffic signals would introduce delays onto Mamalahoa Highway, which now has free flow. Another potential mitigation would be to introduce another alternative for drivers to use for entering and exiting the Shipman Business Park. Extending Macadamia Nut Road to the west and connecting it to Wiliama Street, providing another entrance and exit for the Shipman Business Park, could alleviate traffic backups at Kipimana Street. Figure 9 shows the expected redistribution of traffic for this scenario.

A Synchro analysis with this reallocation of traffic showed a reduction in delays at Kipimana Street and Mamalahoa Highway northbound, but still LOS F in the AM. In the PM, there would be a reduction in delay for eastbound traffic at Kipimana Street and Mamalahoa Highway southbound, but still LOS F. The delay for the remaining movements would be the same or slightly longer. The results are in Table 8 and the Synchro reports are in Appendix E.

Table 8: Future 2020 LOS With Project and Wiliama Street to Macadamia Nut Road Connection

Intersection		AM			PM		
Approach	**Movement**	**Delay (sec)**	**v/c**	**LOS**	**Delay (sec)**	**v/c**	**LOS**
1: Kipimana St & Wiliama St							
Eastbound	**L**	8.8	0.07	A	7.9	0.07	A
Westbound	**L**	7.8	0.02	A	8.2	0.004	A
Northbound	**LTR**	8.9	0.04	A	9.6	0.04	A
Southbound	**LTR**	15.3	0.24	C	13.9	0.28	B
2: Kipimana St & Mamalahoa Highway SB							
Eastbound	**T**	49.0	0.36	E	576	1.66	F
Westbound	**T**	215	1.26	F	1679	3.96	F
3: Kipimana St & Mamalahoa Highway NB							
Eastbound	**LT**	1232	2.84	F	28.4	0.32	D
Westbound	**TR**	781	0.89	F	43.7	0.04	E
4: Macadamia Nut Rd & Mamalahoa Highway SB							
Eastbound	**TR**	41.8	0.39	E	1788	4.21	F
Westbound	**LT**	-	-	-	122.6	0.74	F
5: Macadamia Nut Rd & Mamalahoa Highway NB							
Eastbound	**LT**	928	2.38	F	67.3	0.62	F

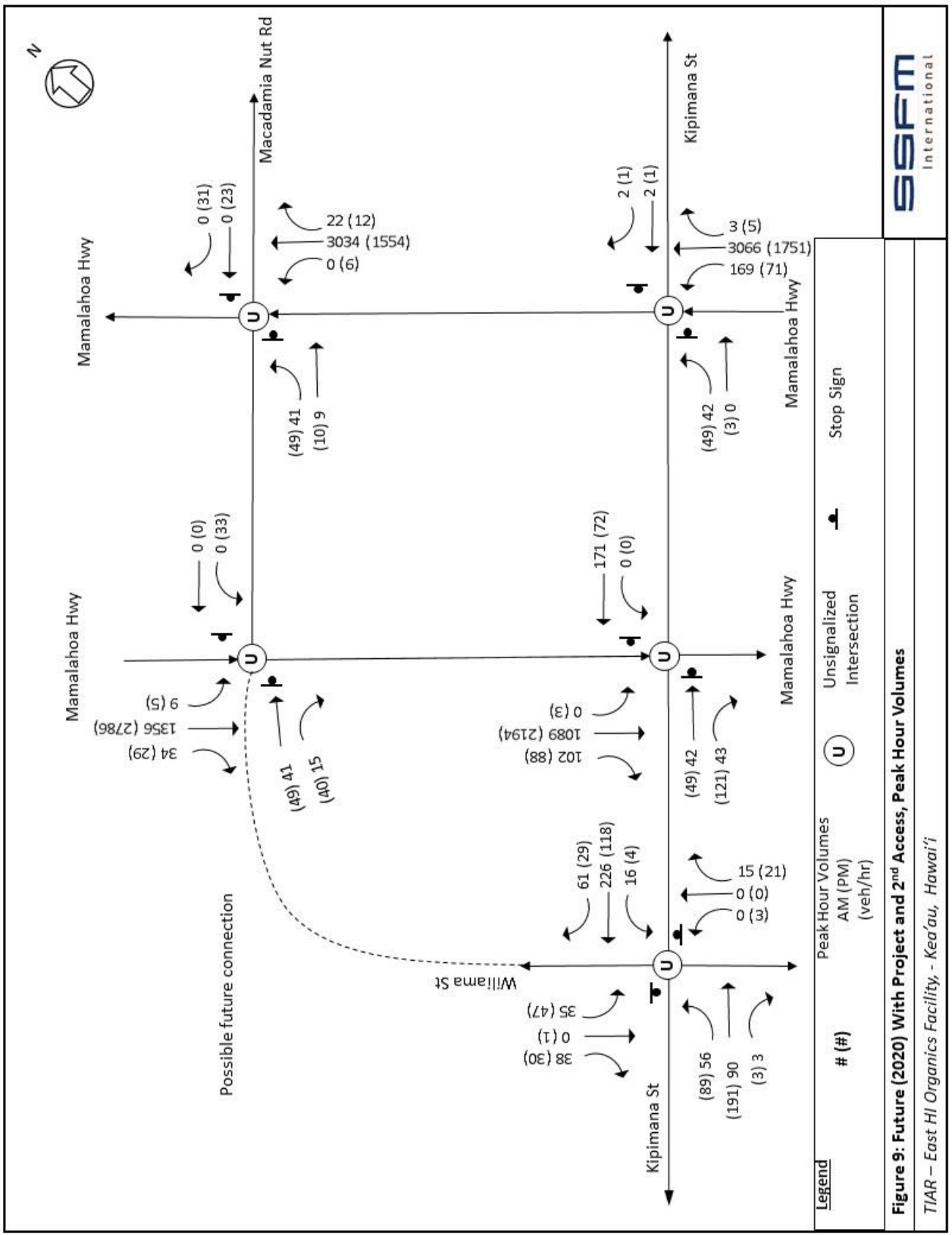


Figure 9: Future 2020 With Project and 2nd Access Peak Hour Volumes

IV. SUMMARY

The County of Hawaii Department of Environmental Management (DEM) is planning to build and operate the East Hawaii Organics Facility in Keaau to divert organics from the county landfills in order to extend the life of the landfills and to create compost and mulch to support local agriculture. It is planned for a site within W.H. Shipman Business Park. The driveway access is planned at the intersection of Kipimana Street and Mikahala Street.

In 2018, without the East Hawaii Organics Facility, traffic from Kipimana Street and Macadamia Nut Road experiences delays when entering Mamalahoa Highway. Those delays will get longer as traffic grows and additional traffic generators are built within the W.H. Shipman Business Park. The EHOF is not expected to be a significant generator of the additional trips. Only 5-24 vehicles are expected for any given movement during the peak hours at the Mamalahoa Highway study intersections. However, some of the movements are already over capacity.

One mitigation strategy, opening another access to W.H. Shipman Business Park at Macadamia Nut Road, was analyzed and there would be significant reductions in delays for certain exiting movements, however, LOS will still be F for those movements.

Mamalahoa Highway is a busy highway with 55 mph speed limits. It will have gaps to absorb the additional traffic from the planned East Hawaii Organics Facility, but during the peak AM and PM hours of traffic, drivers already need to wait 5-10 minutes or more to enter Mamalahoa Highway. Those wait times may increase to 10-15 minutes or more as background traffic grows and the EHOF is added. Outside the peak hours, drivers will much more easily be able to make these movements, and people tend to realize that they can avoid long wait times if they avoid the peak hours of traffic. Driving habits may adjust to arriving and leaving earlier or later.

V. RECOMMENDATIONS

EHOF can help to reduce peak hour traffic by scheduling or encouraging truck arrivals and departures outside of the peak hours of 6:30-7:30 AM and 3:00-4:00 PM (identified in intersection count at Kipimana Street and Mamalahoa Highway).

In addition, the following measures are recommended to improve existing traffic operations:

- Provide good visibility at all intersection with Māmalahoa Highway by clearing any vegetation interfering with sightlines and moving signage out of sightlines.
- Add left-turn acceleration lanes at the following intersections:
    - Kipimana Street and Māmalahoa Highway southbound
    - Māmalahoa Highway northbound and Macadamia Nut Road
    - Māmalahoa Highway southbound and Macadamia Nut Road

DEM can coordinate with HDOT regarding suggested intersection improvements to alleviate existing traffic operation problems, as well as measures to minimize impacts associated with the Proposed Action.

VI. REFERENCES

American Association of State Highway and Transportation Officials. *A Policy on Geometric Design of Highways and Streets*, 2011.

Institute of Transportation Engineers. *Trip Generation, 10th Edition: An ITE Informational Report*, September, 2017.

Office of Environmental Quality Control. *EA and EIS Online Library*, Accessed June 2018. <http://oeqc.doh.hawaii.gov/default.aspx>.

State of Hawaii, Department of Transportation. *Federal-Aid Functional Classification Update: Policy and Procedures*, December, 2012.

State of Hawaii, Department of Transportation. *Historical Traffic Station Maps,* 2015.

State of Hawaii, Department of Transportation. *Statewide Transportation Improvements Program*, Accessed June 2018. <http://hawaii.gov/dot/highways/STIP>.

State of Hawaii, Department of Transportation. *Statewide Uniform Design Manual for Streets and Highways*, 1980.

Transportation Research Board, National Research Council. *Highway Capacity Manual*, Washington, D.C., 6th Edition.

APPENDIX A
24 Hour and Peak Period Traffic Counts

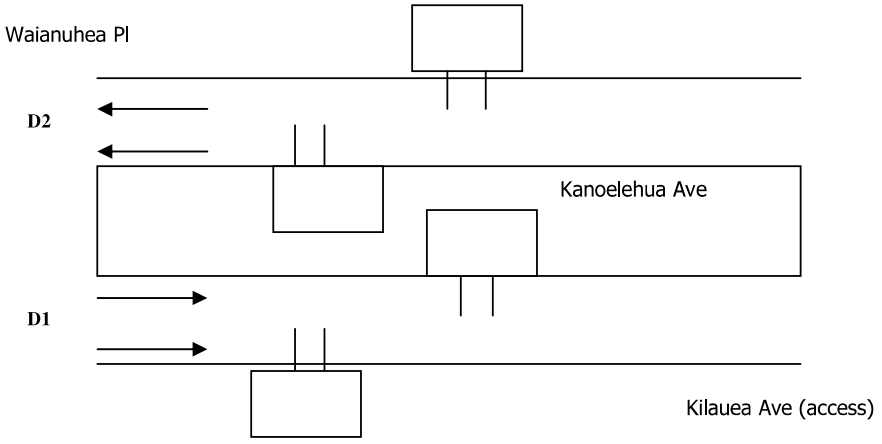
Traffic Data Service

Traffic Station Sketch

N

Island: Hawaii
Area: Hilo

Section ID/Station: B71001100320



Meter #	File Name	GPS
1. bt31	D0813027_B71001100320	19.6742, -155.0647
Ce48	D0813028_B71001100320	

Station Description: Kanoelehua Ave: Waianuhea Pl to Kilauea Ave (access)					
Survey Beginning Date/Time: 8/13/15 @ 0000				Survey Ending Date/Time: 8/14/15 @ 2400	
Survey Method:	Road Tube		Data Type:	Class	
Survey Crew:	LM			C4	
Sketch Updated:			By:	SR	
Remarks:	1381				
FACILITY NAME	JURI	FUNC CLASS	AREA TYPE	ROUTE NO.	MILE
Kanoelehua Ave		14		0011	
D1= Direction to End D2= Direction to Begin	D1: Kilauea Ave (access) / Palani Rd (Rte 190) D2: Waianuhea Pl / Kamehameha Ave (Rte 19)				

Run Date: 2016/05/18

Hawaii Department of Transportation
Highways Division — Highways Planning Survey Section
2015 Program Count - Summary

Site ID: B71001100320 **Town:** Hawaii **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 32700
Functional Class: URBAN:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 11
Location: Kanoelehua Ave - Waianuhea Pl to Kilauea Ave (access)

TIME-AM	DIR 1	DIR 2	TOTAL	TIME-AM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL
DATE : 08/13/2015															
12:00-12:15	39	22	61	06:00-06:15	91	246	337	12:00-12:15	213	201	414	06:00-06:15	283	136	419
12:15-12:30	21	16	37	06:15-06:30	89	364	453	12:15-12:30	237	193	430	06:15-06:30	240	122	362
12:30-12:45	23	16	39	06:30-06:45	127	423	550	12:30-12:45	220	243	463	06:30-06:45	262	118	380
12:45-01:00	16	12	28	06:45-07:00	129	493	622	12:45-01:00	221	223	444	06:45-07:00	214	113	327
01:00-01:15	10	12	22	07:00-07:15	163	379	542	01:00-01:15	232	222	454	07:00-07:15	190	92	282
01:15-01:30	28	14	42	07:15-07:30	157	429	586	01:15-01:30	262	207	469	07:15-07:30	194	78	272
01:30-01:45	15	11	26	07:30-07:45	154	451	605	01:30-01:45	249	287	536	07:30-07:45	175	72	247
01:45-02:00	9	15	24	07:45-08:00	137	437	574	01:45-02:00	278	237	515	07:45-08:00	151	69	220
02:00-02:15	11	9	20	08:00-08:15	155	345	500	02:00-02:15	267	264	531	08:00-08:15	137	78	215
02:15-02:30	8	14	22	08:15-08:30	135	303	438	02:15-02:30	276	231	507	08:15-08:30	139	61	200
02:30-02:45	11	20	31	08:30-08:45	141	325	466	02:30-02:45	306	273	579	08:30-08:45	134	59	193
02:45-03:00	8	24	32	08:45-09:00	159	282	441	02:45-03:00	332	240	572	08:45-09:00	163	55	218
03:00-03:15	12	23	35	09:00-09:15	170	257	427	03:00-03:15	367	264	631	09:00-09:15	117	47	164
03:15-03:30	8	20	28	09:15-09:30	194	306	500	03:15-03:30	364	275	639	09:15-09:30	99	54	153
03:30-03:45	10	25	35	09:30-09:45	159	305	464	03:30-03:45	341	285	626	09:30-09:45	113	46	159
03:45-04:00	14	48	62	09:45-10:00	182	288	470	03:45-04:00	378	251	629	09:45-10:00	95	43	138
04:00-04:15	12	31	43	10:00-10:15	192	248	440	04:00-04:15	351	235	586	10:00-10:15	71	37	108
04:15-04:30	19	67	86	10:15-10:30	196	273	469	04:15-04:30	406	212	618	10:15-10:30	79	40	119
04:30-04:45	29	83	112	10:30-10:45	187	256	443	04:30-04:45	419	235	654	10:30-10:45	85	26	111
04:45-05:00	19	108	127	10:45-11:00	207	252	459	04:45-05:00	401	178	579	10:45-11:00	75	24	99
05:00-05:15	36	106	142	11:00-11:15	228	205	433	05:00-05:15	387	158	545	11:00-11:15	60	26	86
05:15-05:30	53	122	175	11:15-11:30	234	230	464	05:15-05:30	319	165	484	11:15-11:30	37	17	54
05:30-05:45	45	178	223	11:30-11:45	213	275	488	05:30-05:45	336	158	494	11:30-11:45	38	21	59
05:45-06:00	50	189	239	11:45-12:00	222	215	437	05:45-06:00	271	146	417	11:45-12:00	31	16	47

AM COMMUTER PERIOD (05:00-09:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
AM - PEAK HR TIME	06:45 AM to 07:45 AM		
AM - PEAK HR VOLUME	603	1752	2355
AM - K FACTOR (%)			7.66
AM - D (%)	25.61	74.39	100.00
DIRECTIONAL PEAK			
AM - PEAK HR TIME	07:00 AM to 08:00 AM	06:45 AM to 07:45 AM	
AM - PEAK HR VOLUME	611	1752	

PM COMMUTER PERIOD (15:00-19:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
PM - PEAK HR TIME	03:00 PM to 04:00 PM		
PM - PEAK HR VOLUME	1450	1075	2525
PM - K FACTOR (%)			8.21
PM - D (%)	57.43	42.57	100.00
DIRECTIONAL PEAK			
PM - PEAK HR TIME	04:15 PM to 05:15 PM	03:00 PM to 04:00 PM	
PM - PEAK HR VOLUME	1613	1075	

AM PERIOD (00:00-12:00)			
TWO DIRECTIONAL PEAK			
AM - PEAK HR TIME	06:45 AM to 07:45 AM		
AM - PEAK HR VOLUME	603	1752	2355
AM - K FACTOR (%)			7.66
AM - D (%)	25.61	74.39	100.00

PM PERIOD (12:00-24:00)			
TWO DIRECTIONAL PEAK			
PM - PEAK HR TIME	03:00 PM to 04:00 PM		
PM - PEAK HR VOLUME	1450	1075	2525
PM - K FACTOR (%)			8.21
PM - D (%)	57.43	42.57	100.00

NON-COMMUTER PERIOD (09:00-15:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
PEAK HR TIME	02:00 PM to 03:00 PM		
PEAK HR VOLUME	1181	1008	2189
DIRECTIONAL PEAK			
PEAK HR TIME	02:00 PM to 03:00 PM	09:00 AM to 10:00 AM	
PEAK HR VOLUME	1181	1156	

6-HR, 12-HR, 24-HR PERIODS	DIR 1	DIR 2	Total
AM 6-HR PERIOD (06:00-12:00)	4,021	7,587	11,608
AM 12-HR PERIOD (00:00-12:00)	4,527	8,772	13,299
PM 6-HR PERIOD (12:00-18:00)	7,433	5,383	12,816
PM 12-HR PERIOD (12:00-24:00)	10,615	6,833	17,448
24 HOUR PERIOD	15,142	15,605	30,747
D (%)	49.25	50.75	100.00

Run Date: 2016/05/18

Hawaii Department of Transportation

Highways Division — Highways Planning Survey Section

2015 Program Count - Summary

Site ID: B71001100320 **Town:** Hawaii **DIR 1:** +MP **DIR 2:** -MP **Final AADT:** 32700
Functional Class: URBAN:PRINCIPAL ARTERIAL - OTHER **Count Type:** CLASS **Counter Type:** Tube **Route No:** 11
Location: Kanoelehua Ave - Waianuhea Pl to Kilauea Ave (access)

TIME-AM	DIR 1	DIR 2	TOTAL	TIME-AM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL
DATE : 08/14/2015															
12:00-12:15	30	7	37	06:00-06:15	76	240	316	12:00-12:15	277	277	554	06:00-06:15	274	193	467
12:15-12:30	34	13	47	06:15-06:30	82	340	422	12:15-12:30	261	258	519	06:15-06:30	321	182	503
12:30-12:45	25	11	36	06:30-06:45	120	403	523	12:30-12:45	253	251	504	06:30-06:45	266	142	408
12:45-01:00	12	12	24	06:45-07:00	130	467	597	12:45-01:00	253	229	482	06:45-07:00	271	142	413
01:00-01:15	9	8	17	07:00-07:15	176	425	601	01:00-01:15	264	254	518	07:00-07:15	202	99	301
01:15-01:30	18	8	26	07:15-07:30	157	430	587	01:15-01:30	300	247	547	07:15-07:30	243	110	353
01:30-01:45	14	11	25	07:30-07:45	159	381	540	01:30-01:45	260	273	533	07:30-07:45	220	121	341
01:45-02:00	8	11	19	07:45-08:00	145	427	572	01:45-02:00	337	295	632	07:45-08:00	212	92	304
02:00-02:15	14	11	25	08:00-08:15	132	384	516	02:00-02:15	323	293	616	08:00-08:15	191	162	353
02:15-02:30	7	18	25	08:15-08:30	181	288	469	02:15-02:30	294	273	567	08:15-08:30	199	125	324
02:30-02:45	5	19	24	08:30-08:45	170	322	492	02:30-02:45	312	260	572	08:30-08:45	159	101	260
02:45-03:00	6	26	32	08:45-09:00	149	334	483	02:45-03:00	330	293	623	08:45-09:00	160	70	230
03:00-03:15	7	17	24	09:00-09:15	141	311	452	03:00-03:15	353	259	612	09:00-09:15	177	60	237
03:15-03:30	11	28	39	09:15-09:30	169	277	446	03:15-03:30	344	320	664	09:15-09:30	192	59	251
03:30-03:45	11	29	40	09:30-09:45	198	308	506	03:30-03:45	358	322	680	09:30-09:45	173	59	232
03:45-04:00	8	44	52	09:45-10:00	156	286	442	03:45-04:00	341	311	652	09:45-10:00	170	52	222
04:00-04:15	16	29	45	10:00-10:15	191	281	472	04:00-04:15	355	281	636	10:00-10:15	145	64	209
04:15-04:30	15	64	79	10:15-10:30	196	272	468	04:15-04:30	375	257	632	10:15-10:30	109	52	161
04:30-04:45	14	95	109	10:30-10:45	171	355	526	04:30-04:45	381	249	630	10:30-10:45	114	44	158
04:45-05:00	33	118	151	10:45-11:00	218	280	498	04:45-05:00	423	217	640	10:45-11:00	99	35	134
05:00-05:15	22	98	120	11:00-11:15	231	256	487	05:00-05:15	417	215	632	11:00-11:15	80	28	108
05:15-05:30	45	115	160	11:15-11:30	235	260	495	05:15-05:30	393	191	584	11:15-11:30	66	25	91
05:30-05:45	42	156	198	11:30-11:45	213	316	529	05:30-05:45	400	191	591	11:30-11:45	52	25	77
05:45-06:00	61	193	254	11:45-12:00	256	255	511	05:45-06:00	363	207	570	11:45-12:00	60	27	87

AM COMMUTER PERIOD (05:00-09:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
AM - PEAK HR TIME	06:45 AM to 07:45 AM		
AM - PEAK HR VOLUME	622	1703	2325
AM - K FACTOR (%)			6.84
AM - D (%)	26.75	73.25	100.00
DIRECTIONAL PEAK			
AM - PEAK HR TIME	07:00 AM to 08:00 AM	06:30 AM to 07:30 AM	
AM - PEAK HR VOLUME	637	1725	

PM COMMUTER PERIOD (15:00-19:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
PM - PEAK HR TIME	03:15 PM to 04:15 PM		
PM - PEAK HR VOLUME	1398	1234	2632
PM - K FACTOR (%)			7.75
PM - D (%)	53.12	46.88	100.00
DIRECTIONAL PEAK			
PM - PEAK HR TIME	04:45 PM to 05:45 PM	03:15 PM to 04:15 PM	
PM - PEAK HR VOLUME	1633	1234	

AM PERIOD (00:00-12:00)			
TWO DIRECTIONAL PEAK			
AM - PEAK HR TIME	06:45 AM to 07:45 AM		
AM - PEAK HR VOLUME	622	1703	2325
AM - K FACTOR (%)			6.84
AM - D (%)	26.75	73.25	100.00

PM PERIOD (12:00-24:00)			
TWO DIRECTIONAL PEAK			
PM - PEAK HR TIME	03:15 PM to 04:15 PM		
PM - PEAK HR VOLUME	1398	1234	2632
PM - K FACTOR (%)			7.75
PM - D (%)	53.12	46.88	100.00

NON-COMMUTER PERIOD (09:00-15:00)	DIR 1	DIR 2	
TWO DIRECTIONAL PEAK			
PEAK HR TIME	01:45 PM to 02:45 PM		
PEAK HR VOLUME	1266	1121	2387
DIRECTIONAL PEAK			
PEAK HR TIME	01:45 PM to 02:45 PM	09:45 AM to 10:45 AM	
PEAK HR VOLUME	1266	1194	

6-HR, 12-HR, 24-HR PERIODS	DIR 1	DIR 2	Total
AM 6-HR PERIOD (06:00-12:00)	4,052	7,898	11,950
AM 12-HR PERIOD (00:00-12:00)	4,519	9,039	13,558
PM 6-HR PERIOD (12:00-18:00)	7,967	6,223	14,190
PM 12-HR PERIOD (12:00-24:00)	12,122	8,292	20,414
24 HOUR PERIOD	16,641	17,331	33,972
D (%)	48.98	51.02	100.00

Run Date: 2016/05/18

Hawaii Department of Transportation
Highways Division
Highways Planning Survey Section

Vehicle Classification Data Summary
2015

Site ID: B71001100320 **Route No:** 11 **Date From:** 2015/08/13 0:00

Town: Hawaii **Direction:** +MP **Date To:** 2015/08/14 23:45

Location: Kanoelehua Ave - Waianuhea Pl to Kilauea Ave (access)

Functional Classification: 14 URBAN:PRINCIPAL ARTERIAL - OTHER

REPORT TOTALS - 48 HOURS RECORDED

	VOLUME	%	NUMBER OF AXLES
Cycles	272	0.42%	544
PC	53196	82.20%	106392
2A-4T	10344	15.98%	20688
LIGHT VEHICLE TOTALS	63812	98.60%	127624
HEAVY VEHICLES			
Bus	221	0.34%	553
SINGLE UNIT TRUCK			
2A-6T	444	0.69%	888
3A-SU	125	0.19%	375
4A-SU	1	0.00%	4
SINGLE-TRAILER TRUCKS			
4A-ST	5	0.01%	20
5A-ST	110	0.17%	550
6A-ST	0	0.00%	0
MULTI-TRAILER TRUCKS			
5A-MT	0	0.00%	0
6A-MT	0	0.00%	0
7A-MT	1	0.00%	7
HEAVY VEHICLE TOTALS	907	1.40%	2397
CLASSIFIED VEHICLES TOTALS	64719 (A)	100.00%	130020 (B)
UNCLASSIFIED VEHICLES TOTALS	0	0.00%	

AXLE CORRECTION FACTOR (A/C) = 0.996

ROADTUBE EQUIVALENT(B/2) = 65010 (C)

PEAK HOUR VOLUME : 2608 2015/08/14 15:00	PEAK HOUR TRUCK VOLUME	% TOTAL PEAK HOUR VOLUME	24 HOUR TRUCK VOLUME	AADT	% OF AADT	HPMS K-FACTOR (PEAK/AADT) (ITEM 66)
SINGLE UNIT TRUCKS (TYPE 4-7)	34	(65A-1) 1.30%	395	32700	(65A-2) 1.21%	7.98%
COMBINATION (TYPE 8-13)	6	(65B-1) 0.23%	58		(65B-2) 0.18%	7.98%

National Data & Surveying Services

Intersection Turning Movement Count

Location: Wiliama St & Kipimana St
City: Keaau
Control: 2-Way Stop(NB/SB)

Project ID: 18-02054-002
Date: 4/18/2018

Total

NS/EW Streets:	Wiliama St				Wiliama St				Kipimana St				Kipimana St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	2	0	0	0	2	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
6:00 AM	0	0	1	0	2	0	0	0	1	26	0	0	1	39	11	0	81
6:15 AM	0	0	1	0	8	0	0	0	0	13	0	0	4	43	9	0	78
6:30 AM	0	0	1	0	9	0	2	0	0	21	0	0	3	34	9	0	79
6:45 AM	0	0	3	0	4	0	0	0	0	16	0	0	5	33	13	0	74
7:00 AM	0	0	0	0	4	0	2	0	1	24	0	0	9	38	14	0	92
7:15 AM	0	0	2	0	7	0	0	0	0	19	0	0	8	48	15	0	99
7:30 AM	0	0	1	0	8	0	0	0	0	24	1	0	2	56	19	0	111
7:45 AM	0	0	3	0	9	0	2	0	0	23	0	0	3	64	19	0	123
8:00 AM	0	0	8	0	5	0	0	0	0	38	1	0	7	48	8	0	115
8:15 AM	0	0	2	0	12	0	2	0	0	30	1	0	3	40	13	0	103
8:30 AM	1	1	6	0	11	1	0	0	0	28	1	0	6	32	10	0	97
8:45 AM	0	0	3	0	6	0	0	0	1	20	0	0	3	25	5	0	63
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	1	1	31	0	85	1	8	0	3	282	4	0	54	500	145	0	1115
APPROACH %'s :	3.03%	3.03%	93.94%	0.00%	90.43%	1.06%	8.51%	0.00%	1.04%	97.58%	1.38%	0.00%	7.73%	71.53%	20.74%	0.00%	
PEAK HR :	07:30 AM - 08:30 AM																TOTAL
PEAK HR VOL :	0	0	14	0	34	0	4	0	0	115	3	0	15	208	59	0	452
PEAK HR FACTOR :	0.000	0.000	0.438	0.000	0.708	0.000	0.500	0.000	0.000	0.757	0.750	0.000	0.536	0.813	0.776	0.000	0.919
			0.438				0.679				0.756				0.820		

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	1	0	0	0	1	0	0	0	2	0	0	0	2	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
2:30 PM	0	0	1	0	5	0	0	0	0	45	1	0	1	27	9	0	89
2:45 PM	1	0	5	0	3	0	1	0	1	18	1	0	1	33	9	0	73
3:00 PM	1	1	3	0	11	0	1	0	2	51	1	0	4	27	10	0	112
3:15 PM	0	0	3	0	15	0	0	0	0	42	3	0	3	29	10	0	105
3:30 PM	2	0	5	0	5	1	0	0	0	64	1	0	1	32	7	0	118
3:45 PM	1	0	4	0	7	0	0	0	0	60	1	0	2	26	8	1	110
4:00 PM	0	0	5	0	10	0	1	0	0	61	1	0	0	24	5	0	107
4:15 PM	0	0	6	0	23	0	0	0	0	62	0	0	1	19	8	0	119
4:30 PM	0	0	2	0	8	0	0	0	1	49	1	0	0	15	6	0	82
4:45 PM	1	0	2	0	9	0	0	0	0	37	1	0	1	11	4	0	66
5:00 PM	0	0	2	0	10	0	0	0	0	26	0	0	0	9	4	0	51
5:15 PM	0	0	4	0	8	0	0	0	0	25	0	0	0	13	7	0	57
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	6	1	42	0	114	1	3	0	4	540	11	0	14	265	87	1	1089
APPROACH %'s :	12.24%	2.04%	85.71%	0.00%	96.61%	0.85%	2.54%	0.00%	0.72%	97.30%	1.98%	0.00%	3.81%	72.21%	23.71%	0.27%	
PEAK HR :	03:30 PM - 04:30 PM																TOTAL
PEAK HR VOL :	3	0	20	0	45	1	1	0	0	247	3	0	4	101	28	1	454
PEAK HR FACTOR :	0.375	0.000	0.833	0.000	0.489	0.250	0.250	0.000	0.000	0.965	0.750	0.000	0.500	0.789	0.875	0.250	0.954
			0.821				0.511				0.962				0.838		

Prepared by National Data & Surveying Services

Wiliama St & Kipimana St

Peak Hour Turning Movement Count

ID: 18-02054-002
City: Keaau

Day: Wednesday
Date: 04/18/2018

PEAK HOURS

AM: 07:30 AM - 08:30 AM
NOON: NONE
PM: 03:30 PM - 04:30 PM

COUNT PERIODS

AM: 06:00 AM - 09:00 AM
NOON: NONE
PM: 02:30 PM - 05:30 PM

SOUTHBOUND — Wiliama St

AM	4	0	34	0	59	AM
NOON	0	0	0	0	0	NOON
PM	1	1	45	0	28	PM

EASTBOUND — Kipimana St

AM	NOON	PM	
212	0	105	⇦
0	0	0	↶ 0
0	0	0	↱ 0
115	0	247	→ 2
3	0	3	↷ 0
AM	NOON	PM	

WESTBOUND — Kipimana St

PM	NOON	AM	
28	0	59	0 ↶
101	0	208	2 ←
4	0	15	0 ↰
1	0	0	0 ↩
313	0	163	⇨
PM	NOON	AM	

NORTHBOUND — Wiliama St

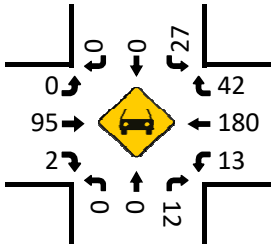
PM	8	0	3	0	20	PM
NOON	0	0	0	0	0	NOON
AM	18	0	0	0	14	AM

CONTROL

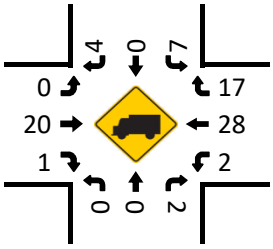
2-Way Stop(NB/SB)

TEV	452 AM	0 NOON	454 PM
PHF	0.92		0.95

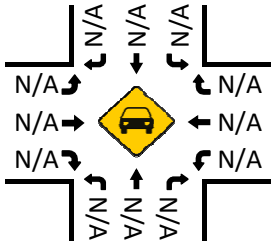
Cars (AM)



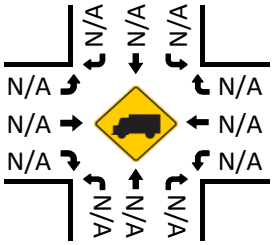
HT (AM)



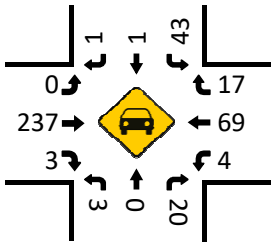
Cars (NOON)



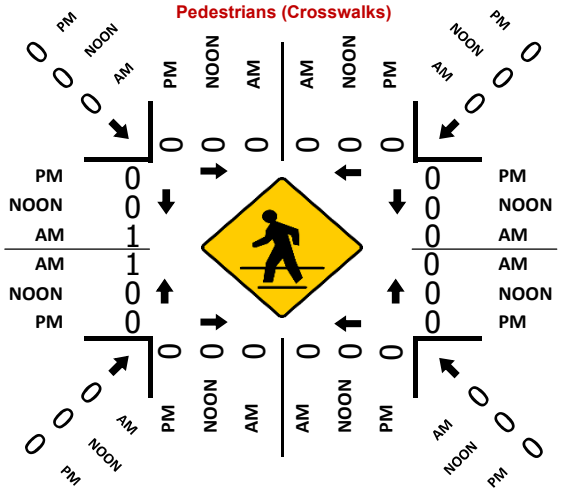
HT (NOON)



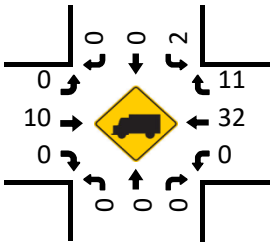
Cars (PM)



Pedestrians (Crosswalks)



HT (PM)



National Data & Surveying Services

Intersection Turning Movement Count

Location: Hawaii Belt Rd/SH 11 & Kipimana St
City: Keaau
Control: 2-Way Stop (EB/WB)

Project ID: 18-2042-001
Date: 3/27/2018

Total

NS/EW Streets:	Hawaii Belt Rd/SH 11				Hawaii Belt Rd/SH 11				Kipimana St				Kipimana St				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	1	3	0	0	0	2	1	0	0	1	1	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
6:00 AM	35	454	0	0	2	105	17	0	8	1	17	0	0	1	0	0	640
6:15 AM	34	593	0	0	1	144	24	0	15	0	10	0	0	0	0	0	821
6:30 AM	33	735	1	0	0	163	16	0	22	0	8	0	0	0	1	0	979
6:45 AM	36	788	1	0	0	268	37	0	15	0	11	0	0	0	0	0	1156
7:00 AM	31	722	0	0	0	306	25	0	15	0	10	0	0	1	0	0	1110
7:15 AM	39	703	1	0	0	296	34	0	13	0	16	0	0	1	1	0	1104
7:30 AM	40	562	0	0	0	255	31	0	24	0	10	0	0	0	0	0	922
7:45 AM	44	507	0	2	0	225	35	0	17	0	19	0	0	0	0	0	849
8:00 AM	29	507	2	0	0	194	34	0	25	0	19	0	0	0	1	0	811
8:15 AM	22	472	0	0	0	220	28	0	26	0	17	0	0	0	0	0	785
8:30 AM	23	473	2	0	2	221	24	0	22	0	21	0	0	0	0	0	788
8:45 AM	25	425	0	0	0	227	23	0	24	0	21	0	0	0	1	0	746
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	391	6941	7	2	5	2624	328	0	226	1	179	0	0	3	4	0	10711
APPROACH %'s :	5.33%	94.55%	0.10%	0.03%	0.17%	88.74%	11.09%	0.00%	55.67%	0.25%	44.09%	0.00%	0.00%	42.86%	57.14%	0.00%	
PEAK HR :	06:30 AM - 07:30 AM																TOTAL
PEAK HR VOL :	139	2948	3	0	0	1033	112	0	65	0	45	0	0	2	2	0	4349
PEAK HR FACTOR :	0.891	0.935	0.750	0.000	0.000	0.844	0.757	0.000	0.739	0.000	0.703	0.000	0.000	0.500	0.500	0.000	0.941
	0.936				0.865				0.917				0.500				

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	1	3	0	0	0	2	1	0	0	1	1	0	1	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
2:30 PM	13	424	0	0	0	515	31	0	30	0	28	0	1	1	4	0	1047
2:45 PM	14	367	1	0	0	460	28	0	24	0	24	0	0	0	1	0	919
3:00 PM	20	429	1	0	2	498	17	0	29	0	27	0	0	1	0	0	1024
3:15 PM	15	440	1	0	0	496	33	0	18	0	37	0	0	0	0	0	1040
3:30 PM	16	427	3	0	0	540	30	0	15	0	36	0	0	0	1	0	1068
3:45 PM	12	388	0	0	1	537	25	0	24	0	41	0	0	0	0	0	1028
4:00 PM	3	319	1	1	1	533	24	1	21	0	65	0	0	0	4	0	973
4:15 PM	7	332	2	0	1	581	23	1	13	0	36	0	0	0	0	0	996
4:30 PM	3	288	0	0	0	603	21	2	15	0	63	0	0	0	2	0	997
4:45 PM	4	273	1	0	1	611	14	1	16	0	36	0	0	0	0	0	957
5:00 PM	5	251	0	0	0	654	16	1	8	0	29	0	1	0	1	0	966
5:15 PM	2	282	0	0	0	676	14	1	14	0	31	0	0	0	3	0	1023
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	114	4220	10	1	6	6704	276	7	227	0	453	0	2	2	16	0	12038
APPROACH %'s :	2.62%	97.12%	0.23%	0.02%	0.09%	95.87%	3.95%	0.10%	33.38%	0.00%	66.62%	0.00%	10.00%	10.00%	80.00%	0.00%	
PEAK HR :	03:00 PM - 04:00 PM																TOTAL
PEAK HR VOL :	63	1684	5	0	3	2071	105	0	86	0	141	0	0	1	1	0	4160
PEAK HR FACTOR :	0.788	0.957	0.417	0.000	0.375	0.959	0.795	0.000	0.741	0.000	0.860	0.000	0.000	0.250	0.250	0.000	0.974
	0.961				0.956				0.873				0.500				

Prepared by National Data & Surveying Services

Hawaii Belt Rd/SH 11 & Kipimana St

Peak Hour Turning Movement Count

ID: 18-2042-001
City: Keaau

Day: Tuesday
Date: 03/27/2018

PEAK HOURS		COUNT PERIODS
AM	06:30 AM - 07:30 AM	06:00 AM - 09:00 AM
NOON	NONE	NONE
PM	03:00 PM - 04:00 PM	02:30 PM - 05:30 PM

SOUTHBOUND — Hawaii Belt Rd/SH 11

AM	112	1033	0	0	3015	AM
NOON	0	0	0	0	0	NOON
PM	105	2071	3	0	1771	PM
	1	2	0	0		

EASTBOUND — Kipimana St

AM	NOON	PM	
253	0	169	
0	0	0	0
65	0	86	0
0	0	0	1
45	0	141	1
AM	NOON	PM	

WESTBOUND — Kipimana St

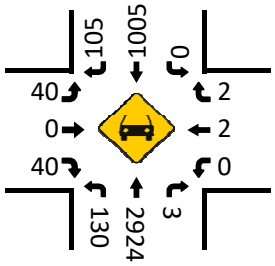
PM	NOON	AM	
1	0	2	0
1	0	2	1
0	0	0	1
0	0	0	0
8	0	3	
PM	NOON	AM	

NORTHBOUND — Hawaii Belt Rd/SH 11

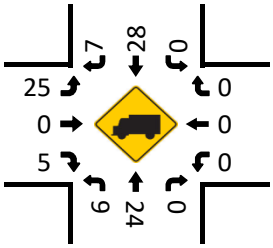
PM	2212	0	63	1684	5	PM
NOON	0	0	0	0	0	NOON
AM	1078	0	139	2948	3	AM
		0	1	3	0	

CONTROL			
2-Way Stop (EB/WB)			
TEV	4349	0	4160
	AM	NOON	PM
PHF	0.94		0.97

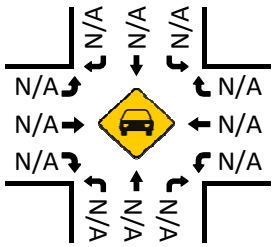
Cars (AM)



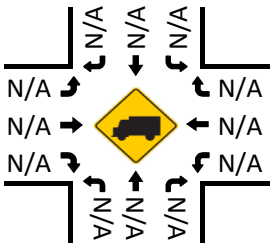
HT (AM)



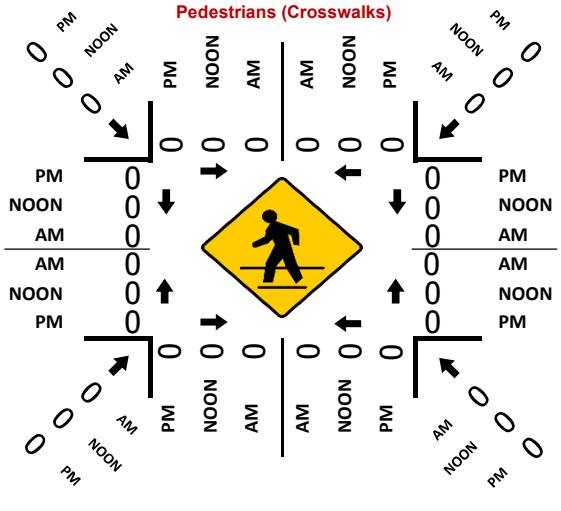
Cars (NOON)



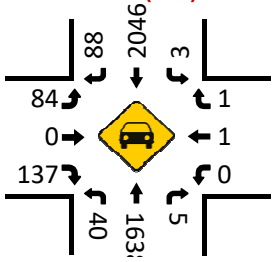
HT (NOON)



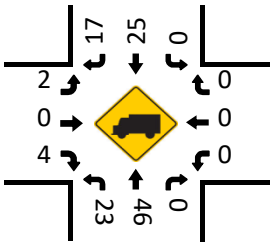
Pedestrians (Crosswalks)



Cars (PM)



HT (PM)



National Data & Surveying Services

Intersection Turning Movement Count

Location: Mamalahoa Hwy & Macadamia Nut Rd
City: Keaau
Control: 2-Way Stop(EB/WB)

Project ID: 18-02054-101
Date: 4/18/2018

Total

NS/EW Streets:	Mamalahoa Hwy				Mamalahoa Hwy				Macadamia Nut Rd				Macadamia Nut Rd				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	1	2	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
6:00 AM	0	0	0	0	2	118	0	0	0	0	0	0	0	0	0	0	120
6:15 AM	0	0	0	0	2	153	0	0	0	0	0	0	0	0	0	0	155
6:30 AM	0	0	0	0	3	216	0	0	0	0	0	0	0	0	0	0	219
6:45 AM	0	0	0	0	2	292	0	0	0	0	0	0	0	0	0	0	294
7:00 AM	0	0	0	0	2	331	0	0	0	0	0	0	0	0	0	0	333
7:15 AM	0	0	0	0	2	336	0	0	0	0	0	0	0	0	0	0	338
7:30 AM	0	0	0	0	3	326	0	0	0	0	0	0	0	0	0	0	329
7:45 AM	0	0	0	0	3	272	0	0	0	0	0	0	0	0	0	0	275
8:00 AM	0	0	0	0	5	256	0	0	0	0	0	0	1	0	0	0	262
8:15 AM	0	0	0	0	5	257	0	0	0	0	0	0	1	1	0	0	264
8:30 AM	0	0	0	0	2	249	0	0	0	0	0	0	0	0	0	0	251
8:45 AM	0	0	0	0	2	237	0	0	0	0	0	0	2	1	0	0	242
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	33	3043	0	0	0	0	0	0	4	2	0	0	3082
APPROACH %'s :					1.07%	98.93%	0.00%	0.00%					66.67%	33.33%	0.00%	0.00%	
PEAK HR :	06:45 AM - 07:45 AM																TOTAL
PEAK HR VOL :	0	0	0	0	9	1285	0	0	0	0	0	0	0	0	0	0	1294
PEAK HR FACTOR :	0.000	0.000	0.000	0.000	0.750	0.956	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.957
						0.957											

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	0	0	0	1	2	0	0	0	1	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
2:30 PM	0	0	0	0	7	469	0	0	0	0	0	0	14	0	0	0	490
2:45 PM	0	0	0	0	2	535	0	0	0	0	0	0	5	1	0	0	543
3:00 PM	0	0	0	0	6	513	0	0	0	0	0	0	2	0	0	0	521
3:15 PM	0	0	0	0	3	576	0	0	0	0	0	0	4	0	0	0	583
3:30 PM	0	0	0	0	1	584	0	0	0	0	1	0	14	0	0	0	600
3:45 PM	0	0	0	0	4	620	0	0	0	0	0	0	3	0	0	0	627
4:00 PM	0	0	0	0	2	658	0	0	0	0	0	0	6	0	0	0	666
4:15 PM	0	0	0	0	1	642	0	0	0	0	0	0	7	0	0	0	650
4:30 PM	0	0	0	0	1	663	0	0	0	0	0	0	15	0	0	0	679
4:45 PM	0	0	0	0	2	666	0	0	0	0	0	0	4	0	0	0	672
5:00 PM	0	0	0	0	1	700	0	0	0	0	0	0	6	0	0	0	707
5:15 PM	0	0	0	0	0	586	0	0	0	0	0	0	0	0	0	0	586
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	0	0	0	0	30	7212	0	0	0	0	1	0	80	1	0	0	7324
APPROACH %'s :					0.41%	99.59%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	98.77%	1.23%	0.00%	0.00%	
PEAK HR :	04:15 PM - 05:15 PM																TOTAL
PEAK HR VOL :	0	0	0	0	5	2671	0	0	0	0	0	0	32	0	0	0	2708
PEAK HR FACTOR :	0.000	0.000	0.000	0.000	0.625	0.954	0.000	0.000	0.000	0.000	0.000	0.000	0.533	0.000	0.000	0.000	0.958
						0.954								0.533			

Prepared by National Data & Surveying Services

Mamalahoa Hwy & Macadamia Nut Rd

Peak Hour Turning Movement Count

ID: 18-02054-101
City: Keaau

Day: Wednesday
Date: 04/18/2018

PEAK HOURS		COUNT PERIODS
06:45 AM - 07:45 AM	AM	06:00 AM - 09:00 AM
NONE	NOON	NONE
04:15 PM - 05:15 PM	PM	02:30 PM - 05:30 PM

Mamalahoa Hwy — SOUTHBOUND

AM	0	1285	9	0	0	AM
NOON	0	0	0	0	0	NOON
PM	0	2671	5	0	0	PM

0 2 1 0

Macadamia Nut Rd — EASTBOUND

AM	NOON	PM	
0	0	0	
0	0	0	0
0	0	0	0
0	0	0	1
0	0	0	0
AM	NOON	PM	

CONTROL

2-Way Stop(EB/WB)

	AM	NOON	PM
TEV	1294	0	2708
PHF	0.96		0.96

Macadamia Nut Rd — WESTBOUND

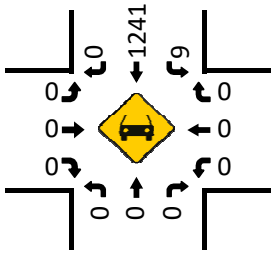
	PM	NOON	AM
0	0	0	0
1	0	0	0
0	32	0	0
0	0	0	0
	5	0	9
	PM	NOON	AM

0 0 0 0

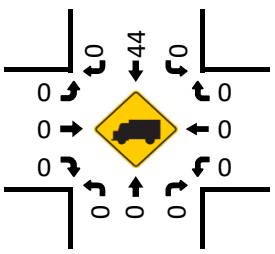
PM	2703	0	0	0	0	PM
NOON	0	0	0	0	0	NOON
AM	1285	0	0	0	0	AM

NORTHBOUND — Mamalahoa Hwy

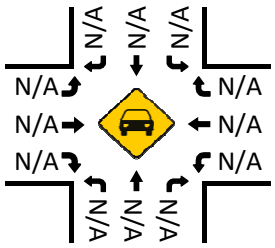
Cars (AM)



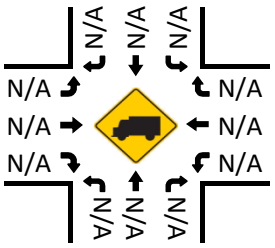
HT (AM)



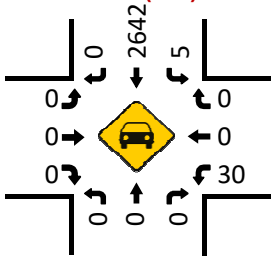
Cars (NOON)



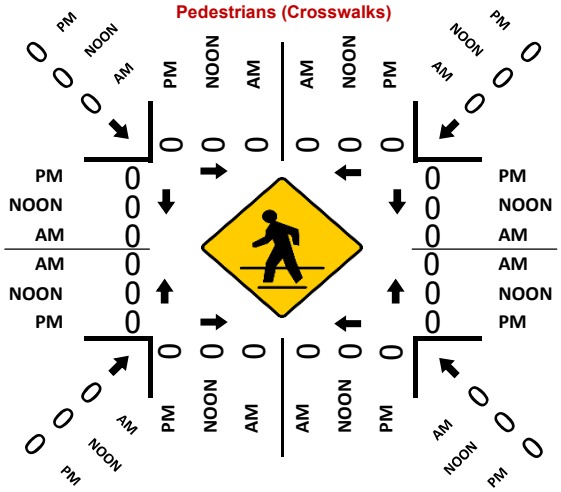
HT (NOON)



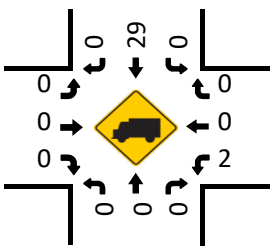
Cars (PM)



Pedestrians (Crosswalks)



HT (PM)



National Data & Surveying Services

Intersection Turning Movement Count

Location: Mamalahoa Hwy & Macadamia Nut Rd
City: Keaau
Control: 2-Way Stop(EB/WB)

Project ID: 18-02054-001
Date: 4/18/2018

Total

NS/EW Streets:	Mamalahoa Hwy				Mamalahoa Hwy				Macadamia Nut Rd				Macadamia Nut Rd				
AM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	2	1	0	0	0	0	0	0	1	0	0	0	0.5	0.5	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
6:00 AM	0	504	7	0	0	0	0	0	0	2	0	0	0	0	1	0	514
6:15 AM	0	675	4	0	0	0	0	0	0	2	0	0	0	0	0	0	681
6:30 AM	0	755	5	0	0	0	0	0	0	3	0	0	0	0	0	0	763
6:45 AM	0	804	7	0	0	0	0	0	0	2	0	0	0	0	0	0	813
7:00 AM	0	708	5	0	0	0	0	0	0	2	0	0	0	0	0	0	715
7:15 AM	0	662	1	0	0	0	0	0	2	0	0	0	0	0	0	0	665
7:30 AM	0	699	2	0	0	0	0	0	0	3	0	0	0	0	0	0	704
7:45 AM	0	525	1	0	0	0	0	0	0	4	0	0	0	0	0	0	530
8:00 AM	0	562	4	0	0	0	0	0	1	3	0	0	0	1	1	0	572
8:15 AM	2	581	1	0	0	0	0	0	1	4	0	0	0	0	2	0	591
8:30 AM	0	540	4	0	0	0	0	0	0	2	0	0	0	0	0	0	546
8:45 AM	2	487	2	0	0	0	0	0	0	2	0	0	0	1	4	0	498
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	4	7502	43	0	0	0	0	0	4	29	0	0	0	2	8	0	7592
APPROACH %'s :	0.05%	99.38%	0.57%	0.00%					12.12%	87.88%	0.00%	0.00%	0.00%	20.00%	80.00%	0.00%	
PEAK HR :	06:15 AM - 07:15 AM																TOTAL
PEAK HR VOL :	0	2942	21	0	0	0	0	0	0	9	0	0	0	0	0	0	2972
PEAK HR FACTOR :	0.000	0.915	0.750	0.000	0.000	0.000	0.000	0.000	0.000	0.750	0.000	0.000	0.000	0.000	0.000	0.000	0.914
		0.913								0.750							

PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				
	0	2	1	0	0	0	0	0	0	1	0	0	0	0.5	0.5	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
2:30 PM	2	388	4	0	0	0	0	0	0	6	0	0	0	13	9	0	422
2:45 PM	1	365	1	0	0	0	0	0	1	2	0	0	0	4	2	0	376
3:00 PM	1	387	3	0	0	0	0	0	0	6	0	0	0	1	4	0	402
3:15 PM	1	318	2	0	0	0	0	0	0	3	0	0	0	5	12	0	341
3:30 PM	0	427	1	0	0	0	0	0	1	0	0	0	0	12	10	0	451
3:45 PM	1	386	4	0	0	0	0	0	0	4	0	0	0	2	2	0	399
4:00 PM	4	402	5	0	0	0	0	0	0	3	0	0	0	3	6	0	423
4:15 PM	3	308	6	0	0	0	0	0	0	0	0	0	0	4	5	0	326
4:30 PM	3	308	5	0	0	0	0	0	0	1	0	0	0	11	14	0	342
4:45 PM	1	276	0	0	0	0	0	0	0	2	0	0	0	3	5	0	287
5:00 PM	1	298	3	0	0	0	0	0	0	1	0	0	0	5	4	1	313
5:15 PM	0	264	0	0	0	0	0	0	0	0	0	0	0	0	3	0	267
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL
TOTAL VOLUMES :	18	4127	34	0	0	0	0	0	2	28	0	0	0	63	76	1	4349
APPROACH %'s :	0.43%	98.76%	0.81%	0.00%					6.67%	93.33%	0.00%	0.00%	0.00%	45.00%	54.29%	0.71%	
PEAK HR :	03:15 PM - 04:15 PM																TOTAL
PEAK HR VOL :	6	1533	12	0	0	0	0	0	1	10	0	0	0	22	30	0	1614
PEAK HR FACTOR :	0.375	0.898	0.600	0.000	0.000	0.000	0.000	0.000	0.250	0.625	0.000	0.000	0.000	0.458	0.625	0.000	0.895
		0.906								0.688				0.591			

Prepared by National Data & Surveying Services

Mamalahoa Hwy & Macadamia Nut Rd

Peak Hour Turning Movement Count

ID: 18-02054-001
City: Keaau

Day: Wednesday
Date: 04/18/2018

PEAK HOURS

AM: 06:15 AM - 07:15 AM
NOON: NONE
PM: 03:15 PM - 04:15 PM

COUNT PERIODS

AM: 06:00 AM - 09:00 AM
NOON: NONE
PM: 02:30 PM - 05:30 PM

Mamalahoa Hwy — SOUTHBOUND

AM	0	0	0	0	2942	AM
NOON	0	0	0	0	0	NOON
PM	0	0	0	0	1564	PM

Macadamia Nut Rd — EASTBOUND

AM	NOON	PM	
0	0	28	
0	0	0	0
0	0	1	0
9	0	10	1
0	0	0	0

CONTROL

2-Way Stop(EB/WB)

TEV	2972	0	1614
	AM	NOON	PM
PHF	0.91		0.89

WESTBOUND — Macadamia Nut Rd

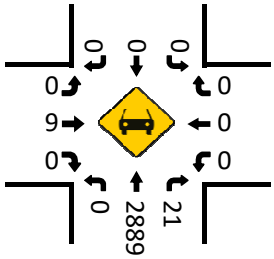
PM	NOON	AM	
30	0	0	0.5
22	0	0	0.5
0	0	0	0
0	0	0	0
22	0	30	

Mamalahoa Hwy — NORTHBOUND

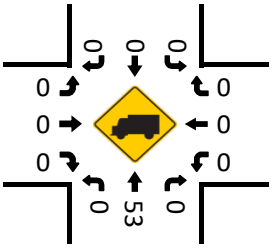
PM	0	0	6	1533	12	PM
NOON	0	0	0	0	0	NOON
AM	0	0	0	2942	21	AM

0 0 2 1

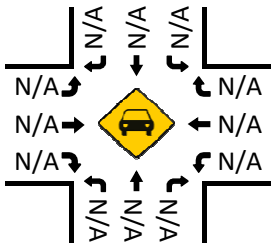
Cars (AM)



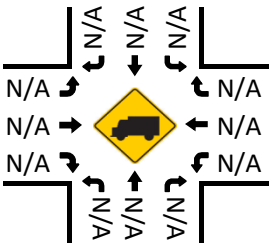
HT (AM)



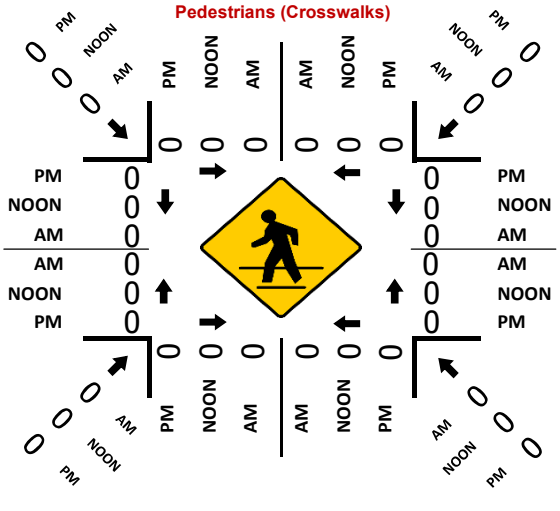
Cars (NOON)



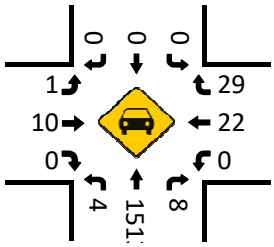
HT (NOON)



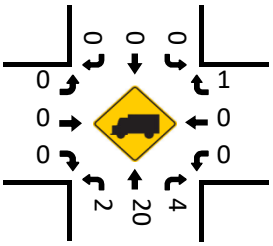
Pedestrians (Crosswalks)



Cars (PM)



HT (PM)



APPENDIX B
Existing (2018) Conditions

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	115	3	15	208	59	0	0	14	34	0	4
Future Vol, veh/h	0	115	3	15	208	59	0	0	14	34	0	4
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	76	76	76	82	82	82	44	44	44	68	68	68
Heavy Vehicles, %	18	18	18	17	17	17	14	14	14	29	29	29
Mvmt Flow	0	151	4	18	254	72	0	0	32	50	0	6

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	328	0	0	155	0	0	316	517	78	404	483	165
Stage 1	-	-	-	-	-	-	153	153	-	328	328	-
Stage 2	-	-	-	-	-	-	163	364	-	76	155	-
Critical Hdwy	4.46	-	-	4.44	-	-	7.78	6.78	7.18	8.08	7.08	7.48
Critical Hdwy Stg 1	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Follow-up Hdwy	2.38	-	-	2.37	-	-	3.64	4.14	3.44	3.79	4.29	3.59
Pot Cap-1 Maneuver	1121	-	-	1320	-	-	584	436	930	471	427	772
Stage 1	-	-	-	-	-	-	800	742	-	589	583	-
Stage 2	-	-	-	-	-	-	789	593	-	851	707	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1119	-	-	1320	-	-	573	429	930	449	420	771
Mov Cap-2 Maneuver	-	-	-	-	-	-	573	429	-	449	420	-
Stage 1	-	-	-	-	-	-	800	742	-	588	574	-
Stage 2	-	-	-	-	-	-	772	584	-	822	707	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.4	9	13.7
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	930	1119	-	-	1320	-	-	470
HCM Lane V/C Ratio	0.034	-	-	-	0.014	-	-	0.119
HCM Control Delay (s)	9	0	-	-	7.8	-	-	13.7
HCM Lane LOS	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.4

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	0	65	45	0	141	0	0	0	0	0	1033	112
Future Vol, veh/h	0	65	45	0	141	0	0	0	0	0	1033	112
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	89	89	89	94	94	94	87	87	87
Heavy Vehicles, %	27	27	27	2	2	2	2	2	2	3	3	3
Mvmt Flow	0	71	49	0	158	0	0	0	0	0	1187	129

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	1187	-	629	1187	-			0	0	0
Stage 1	-	1187	-	0	0	-			-	-	-
Stage 2	-	0	-	629	1187	-			-	-	-
Critical Hdwy	-	7.04	-	7.54	6.54	-			4.16	-	-
Critical Hdwy Stg 1	-	6.04	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-			-	-	-
Follow-up Hdwy	-	4.27	-	3.52	4.02	-			2.23	-	-
Pot Cap-1 Maneuver	0	154	0	367	187	0			-	-	0
Stage 1	0	214	0	-	-	0			-	-	0
Stage 2	0	-	0	437	260	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	154	-	235	187	-			-	-	-
Mov Cap-2 Maneuver	-	154	-	235	187	-			-	-	-
Stage 1	-	214	-	-	-	-			-	-	-
Stage 2	-	-	-	293	260	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	46.8	82.2	0
HCM LOS	E	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	154	-	-	187	-	-
HCM Lane V/C Ratio	0.459	-	-	0.847	-	-
HCM Control Delay (s)	46.8	0	0	82.2	0	-
HCM Lane LOS	E	A	A	F	A	-
HCM 95th %tile Q(veh)	2.1	-	-	6.1	-	-

Intersection	
Int Delay, s/veh	18.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	65	0	0	0	2	2	139	2948	3	0	0	0
Future Vol, veh/h	65	0	0	0	2	2	139	2948	3	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	94	94	94	92	92	92
Heavy Vehicles, %	38	38	38	2	2	2	2	2	2	2	2	2
Mvmt Flow	88	0	0	0	4	4	148	3136	3	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1552	3435	-	-	3434	1570	0	0	0
Stage 1	0	0	-	-	3434	-	-	-	-
Stage 2	1552	3435	-	-	0	-	-	-	-
Critical Hdwy	7.16	7.26	-	-	6.54	7.14	5.34	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	7.46	6.26	-	-	-	-	-	-	-
Follow-up Hdwy	4.18	4.38	-	-	4.02	3.92	3.12	-	-
Pot Cap-1 Maneuver	~ 85	3	0	0	7	85	-	-	-
Stage 1	-	-	0	0	18	-	-	-	-
Stage 2	~ 75	9	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	~ 44	3	-	-	7	85	-	-	-
Mov Cap-2 Maneuver	~ 44	3	-	-	7	-	-	-	-
Stage 1	-	-	-	-	18	-	-	-	-
Stage 2	~ 56	9	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	$ 662.8	$ 485.5	
HCM LOS	F	F	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	44	13
HCM Lane V/C Ratio	-	-	-	1.996	0.615
HCM Control Delay (s)	-	-	-	-$ 662.8	$ 485.5
HCM Lane LOS	-	-	-	F	F
HCM 95th %tile Q(veh)	-	-	-	9.1	1.4

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1285	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1285	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	0	0	0	0	0	0	0	0	0	9	1339	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	1357	670	688	1357	-		0	0	0
Stage 1	-	1357	-	0	0	-		-	-	-
Stage 2	-	0	-	688	1357	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.54	6.54	-		4.16	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.52	4.02	-		2.23	-	-
Pot Cap-1 Maneuver	0	148	399	333	148	0		-	-	0
Stage 1	0	215	-	-	-	0		-	-	0
Stage 2	0	-	-	403	215	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	148	399	333	148	-		-	-	-
Mov Cap-2 Maneuver	-	148	-	333	148	-		-	-	-
Stage 1	-	215	-	-	-	-		-	-	-
Stage 2	-	-	-	403	215	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	
HCM LOS	A	A	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	0	0	-	-
HCM Lane LOS	A	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

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	0	9	0	0	0	0	0	2942	21	0	0	0
Future Vol, veh/h	0	9	0	0	0	0	0	2942	21	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	75	75	75	92	92	92	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	12	0	0	0	0	0	3233	23	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1617	3233	-	-	3233	-	0	0	-
Stage 1	0	0	-	-	3233	-	-	-	-
Stage 2	1617	3233	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	69	~ 9	0	0	9	0	-	-	0
Stage 1	-	-	0	0	23	0	-	-	0
Stage 2	108	23	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	69	~ 9	-	-	9	-	-	-	-
Mov Cap-2 Maneuver	69	~ 9	-	-	9	-	-	-	-
Stage 1	-	-	-	-	23	-	-	-	-
Stage 2	108	23	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	$ 975.6	0	0
HCM LOS	F	A	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	9	-
HCM Lane V/C Ratio	-	-	1.333	-
HCM Control Delay (s)	0	-	$ 975.6	0
HCM Lane LOS	A	-	F	A
HCM 95th %tile Q(veh)	-	-	2.3	-

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	0	247	3	4	101	28	3	0	20	45	1	1
Future Vol, veh/h	0	247	3	4	101	28	3	0	20	45	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	84	84	84	82	82	82	51	51	51
Heavy Vehicles, %	4	4	4	32	32	32	2	2	2	4	4	4
Mvmt Flow	0	257	3	5	120	33	4	0	24	88	2	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	153	0	0	260	0	0	330	422	130	276	407	77
Stage 1	-	-	-	-	-	-	259	259	-	147	147	-
Stage 2	-	-	-	-	-	-	71	163	-	129	260	-
Critical Hdwy	4.18	-	-	4.74	-	-	7.54	6.54	6.94	7.58	6.58	6.98
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Follow-up Hdwy	2.24	-	-	2.52	-	-	3.52	4.02	3.32	3.54	4.04	3.34
Pot Cap-1 Maneuver	1411	-	-	1110	-	-	599	522	896	649	528	962
Stage 1	-	-	-	-	-	-	723	692	-	835	770	-
Stage 2	-	-	-	-	-	-	931	762	-	855	687	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1411	-	-	1110	-	-	594	519	896	629	525	962
Mov Cap-2 Maneuver	-	-	-	-	-	-	594	519	-	629	525	-
Stage 1	-	-	-	-	-	-	723	692	-	835	766	-
Stage 2	-	-	-	-	-	-	923	758	-	832	687	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.2	9.4	11.7
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	840	1411	-	-	1110	-	-	631
HCM Lane V/C Ratio	0.033	-	-	-	0.004	-	-	0.146
HCM Control Delay (s)	9.4	0	-	-	8.3	-	-	11.7
HCM Lane LOS	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.5

Intersection	
Int Delay, s/veh	66.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↰↑	↱
Traffic Vol, veh/h	0	86	141	0	64	0	0	0	0	3	2071	105
Future Vol, veh/h	0	86	141	0	64	0	0	0	0	3	2071	105
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	79	79	79	92	92	92	96	96	96
Heavy Vehicles, %	3	3	3	37	37	37	2	2	2	2	2	2
Mvmt Flow	0	99	162	0	81	0	0	0	0	3	2157	109

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	2163	-	1134	2163	-			0	0	0
Stage 1	-	2163	-	0	0	-			-	-	-
Stage 2	-	0	-	1134	2163	-			-	-	-
Critical Hdwy	-	6.56	-	8.24	7.24	-			4.14	-	-
Critical Hdwy Stg 1	-	5.56	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	7.24	6.24	-			-	-	-
Follow-up Hdwy	-	4.03	-	3.87	4.37	-			2.22	-	-
Pot Cap-1 Maneuver	0	~ 46	0	120	~ 30	0			-	-	0
Stage 1	0	~ 84	0	-	-	0			-	-	0
Stage 2	0	-	0	165	~ 55	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	~ 46	-	-	~ 30	-			-	-	-
Mov Cap-2 Maneuver	-	~ 46	-	-	~ 30	-			-	-	-
Stage 1	-	~ 84	-	-	-	-			-	-	-
Stage 2	-	-	-	-	~ 55	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	$ 719.3	$ 1048.2	
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	46	-	-	30	-	-
HCM Lane V/C Ratio	2.149	-	-	2.7	-	-
HCM Control Delay (s)	$ 719.3	0	$	1048.2	-	-
HCM Lane LOS	F	A	A	F	-	-
HCM 95th %tile Q(veh)	10.2	-	-	9.6	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	86	3	0	0	1	1	63	1684	5	0	0	0
Future Vol, veh/h	86	3	0	0	1	1	63	1684	5	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	96	96	96	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	4	4	4	2	2	2
Mvmt Flow	116	4	0	0	2	2	66	1754	5	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	835	1891	-	-	1889	880	0	0	0
Stage 1	0	0	-	-	1889	-	-	-	-
Stage 2	835	1891	-	-	0	-	-	-	-
Critical Hdwy	6.44	6.54	-	-	6.54	7.14	5.38	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.74	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.82	4.02	-	-	4.02	3.92	3.14	-	-
Pot Cap-1 Maneuver	319	69	0	0	70	249	-	-	-
Stage 1	-	-	0	0	117	-	-	-	-
Stage 2	298	117	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	309	69	-	-	70	249	-	-	-
Mov Cap-2 Maneuver	309	69	-	-	70	-	-	-	-
Stage 1	-	-	-	-	117	-	-	-	-
Stage 2	291	117	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	27.6	39.3	
HCM LOS	D	E	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	277	109
HCM Lane V/C Ratio	-	-	-	0.434	0.037
HCM Control Delay (s)	-	-	-	27.6	39.3
HCM Lane LOS	-	-	-	D	E
HCM 95th %tile Q(veh)	-	-	-	2.1	0.1

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	32	0	0	0	0	0	5	2671	0
Future Vol, veh/h	0	0	0	32	0	0	0	0	0	5	2671	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	53	53	53	92	92	92	95	95	95
Heavy Vehicles, %	2	2	2	6	6	6	2	2	2	2	2	2
Mvmt Flow	0	0	0	60	0	0	0	0	0	5	2812	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	2822	1406	1416	2822	-		0	0	0
Stage 1	-	2822	-	0	0	-		-	-	-
Stage 2	-	0	-	1416	2822	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.62	6.62	-		4.14	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.62	5.62	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.56	4.06	-		2.22	-	-
Pot Cap-1 Maneuver	0	18	129	94	16	0		-	-	0
Stage 1	0	38	-	-	-	0		-	-	0
Stage 2	0	-	-	139	36	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	18	129	94	16	-		-	-	-
Mov Cap-2 Maneuver	-	18	-	94	16	-		-	-	-
Stage 1	-	38	-	-	-	-		-	-	-
Stage 2	-	-	-	139	36	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	95.3	
HCM LOS	A	F	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	94	-	-
HCM Lane V/C Ratio	-	0.642	-	-
HCM Control Delay (s)	0	95.3	-	-
HCM Lane LOS	A	F	-	-
HCM 95th %tile Q(veh)	-	3.1	-	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	10	0	0	22	30	6	1533	12	0	0	0
Future Vol, veh/h	1	10	0	0	22	30	6	1533	12	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	69	69	69	59	59	59	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	14	0	0	37	51	7	1685	13	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	875	1699	-	-	1699	-	0	0	-
Stage 1	0	0	-	-	1699	-	-	-	-
Stage 2	875	1699	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	243	91	0	0	91	0	-	-	0
Stage 1	-	-	0	0	146	0	-	-	0
Stage 2	310	146	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	165	91	-	-	91	-	-	-	-
Mov Cap-2 Maneuver	165	91	-	-	91	-	-	-	-
Stage 1	-	-	-	-	146	-	-	-	-
Stage 2	231	146	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	50.4		
HCM LOS	F	-	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	95	-
HCM Lane V/C Ratio	-	-	0.168	-
HCM Control Delay (s)	-	-	50.4	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX C
Future (2020) Without Project Conditions

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	120	3	16	216	61	0	0	15	35	0	4
Future Vol, veh/h	0	120	3	16	216	61	0	0	15	35	0	4
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	76	76	76	82	82	82	44	44	44	68	68	68
Heavy Vehicles, %	18	18	18	17	17	17	14	14	14	29	29	29
Mvmt Flow	0	158	4	20	263	74	0	0	34	51	0	6

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	339	0	0	162	0	0	332	539	81	421	504	171
Stage 1	-	-	-	-	-	-	160	160	-	342	342	-
Stage 2	-	-	-	-	-	-	172	379	-	79	162	-
Critical Hdwy	4.46	-	-	4.44	-	-	7.78	6.78	7.18	8.08	7.08	7.48
Critical Hdwy Stg 1	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Follow-up Hdwy	2.38	-	-	2.37	-	-	3.64	4.14	3.44	3.79	4.29	3.59
Pot Cap-1 Maneuver	1109	-	-	1311	-	-	568	423	925	457	414	765
Stage 1	-	-	-	-	-	-	792	736	-	577	573	-
Stage 2	-	-	-	-	-	-	779	584	-	847	702	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1107	-	-	1311	-	-	557	416	925	434	407	764
Mov Cap-2 Maneuver	-	-	-	-	-	-	557	416	-	434	407	-
Stage 1	-	-	-	-	-	-	792	736	-	576	563	-
Stage 2	-	-	-	-	-	-	761	574	-	816	702	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.4	9	14.1
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	925	1107	-	-	1311	-	-	454
HCM Lane V/C Ratio	0.037	-	-	-	0.015	-	-	0.126
HCM Control Delay (s)	9	0	-	-	7.8	-	-	14.1
HCM Lane LOS	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.4

Intersection	
Int Delay, s/veh	14.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↰↑	↱
Traffic Vol, veh/h	0	68	47	0	147	0	0	0	0	0	1074	116
Future Vol, veh/h	0	68	47	0	147	0	0	0	0	0	1074	116
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	89	89	89	94	94	94	87	87	87
Heavy Vehicles, %	27	27	27	2	2	2	2	2	2	3	3	3
Mvmt Flow	0	74	51	0	165	0	0	0	0	0	1234	133

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	1234	-	654	1234	-			0	0	0
Stage 1	-	1234	-	0	0	-			-	-	-
Stage 2	-	0	-	654	1234	-			-	-	-
Critical Hdwy	-	7.04	-	7.54	6.54	-			4.16	-	-
Critical Hdwy Stg 1	-	6.04	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-			-	-	-
Follow-up Hdwy	-	4.27	-	3.52	4.02	-			2.23	-	-
Pot Cap-1 Maneuver	0	144	0	352	175	0			-	-	0
Stage 1	0	203	0	-	-	0			-	-	0
Stage 2	0	-	0	422	247	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	144	-	209	175	-			-	-	-
Mov Cap-2 Maneuver	-	144	-	209	175	-			-	-	-
Stage 1	-	203	-	-	-	-			-	-	-
Stage 2	-	-	-	268	247	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	53.8	107.3	0
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	144	-	-	175	-	-
HCM Lane V/C Ratio	0.513	-	-	0.944	-	-
HCM Control Delay (s)	53.8	0	0	107.3	0	-
HCM Lane LOS	F	A	A	F	A	-
HCM 95th %tile Q(veh)	2.5	-	-	7.3	-	-

Intersection	
Int Delay, s/veh	28

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	68	0	0	0	2	2	145	3066	3	0	0	0
Future Vol, veh/h	68	0	0	0	2	2	145	3066	3	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	94	94	94	92	92	92
Heavy Vehicles, %	38	38	38	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	0	0	0	4	4	154	3262	3	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1615	3573	-	-	3572	1633	0	0	0
Stage 1	0	0	-	-	3572	-	-	-	-
Stage 2	1615	3573	-	-	0	-	-	-	-
Critical Hdwy	7.16	7.26	-	-	6.54	7.14	5.34	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	7.46	6.26	-	-	-	-	-	-	-
Follow-up Hdwy	4.18	4.38	-	-	4.02	3.92	3.12	-	-
Pot Cap-1 Maneuver	~ 77	3	0	0	6	77	-	-	-
Stage 1	-	-	0	0	15	-	-	-	-
Stage 2	~ 67	7	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	~ 34	3	-	-	6	77	-	-	-
Mov Cap-2 Maneuver	~ 34	3	-	-	6	-	-	-	-
Stage 1	-	-	-	-	15	-	-	-	-
Stage 2	~ 47	7	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, $	1018.9	$ 603.9	
HCM LOS	F	F	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	34	11
HCM Lane V/C Ratio	-	-	-	2.703	0.727
HCM Control Delay (s)	-	-	-	$ 1018.9	$ 603.9
HCM Lane LOS	-	-	-	F	F
HCM 95th %tile Q(veh)	-	-	-	10.5	1.6

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1336	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1336	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	3	3	3
Mvmt Flow	0	0	0	0	0	0	0	0	0	9	1392	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	1410	696	714	1410	-		0	0	0
Stage 1	-	1410	-	0	0	-		-	-	-
Stage 2	-	0	-	714	1410	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.54	6.54	-		4.16	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.52	4.02	-		2.23	-	-
Pot Cap-1 Maneuver	0	137	384	319	137	0		-	-	0
Stage 1	0	203	-	-	-	0		-	-	0
Stage 2	0	-	-	388	203	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	137	384	319	137	-		-	-	-
Mov Cap-2 Maneuver	-	137	-	319	137	-		-	-	-
Stage 1	-	203	-	-	-	-		-	-	-
Stage 2	-	-	-	388	203	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	
HCM LOS	A	A	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	0	0	-	-
HCM Lane LOS	A	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	9	0	0	0	0	0	3060	22	0	0	0
Future Vol, veh/h	0	9	0	0	0	0	0	3060	22	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	75	75	75	92	92	92	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	12	0	0	0	0	0	3363	24	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1682	3363	-	-	3363	-	0	0	-
Stage 1	0	0	-	-	3363	-	-	-	-
Stage 2	1682	3363	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	62	~ 8	0	0	8	0	-	-	0
Stage 1	-	-	0	0	19	0	-	-	0
Stage 2	98	19	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	62	~ 8	-	-	8	-	-	-	-
Mov Cap-2 Maneuver	62	~ 8	-	-	8	-	-	-	-
Stage 1	-	-	-	-	19	-	-	-	-
Stage 2	98	19	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	$ 1130	0	0
HCM LOS	F	A	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	8	-
HCM Lane V/C Ratio	-	-	1.5	-
HCM Control Delay (s)	0	-	$ 1130	0
HCM Lane LOS	A	-	F	A
HCM 95th %tile Q(veh)	-	-	2.4	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	257	3	4	105	29	3	0	21	47	1	1
Future Vol, veh/h	0	257	3	4	105	29	3	0	21	47	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	84	84	84	82	82	82	51	51	51
Heavy Vehicles, %	4	4	4	32	32	32	2	2	2	4	4	4
Mvmt Flow	0	268	3	5	125	35	4	0	26	92	2	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	160	0	0	271	0	0	344	440	136	287	424	80
Stage 1	-	-	-	-	-	-	270	270	-	153	153	-
Stage 2	-	-	-	-	-	-	74	170	-	134	271	-
Critical Hdwy	4.18	-	-	4.74	-	-	7.54	6.54	6.94	7.58	6.58	6.98
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Follow-up Hdwy	2.24	-	-	2.52	-	-	3.52	4.02	3.32	3.54	4.04	3.34
Pot Cap-1 Maneuver	1402	-	-	1098	-	-	586	510	888	638	516	958
Stage 1	-	-	-	-	-	-	713	685	-	828	765	-
Stage 2	-	-	-	-	-	-	927	757	-	850	679	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1402	-	-	1098	-	-	581	507	888	618	513	958
Mov Cap-2 Maneuver	-	-	-	-	-	-	581	507	-	618	513	-
Stage 1	-	-	-	-	-	-	713	685	-	828	761	-
Stage 2	-	-	-	-	-	-	919	753	-	825	679	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.2	9.5	11.9
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	833	1402	-	-	1098	-	-	620
HCM Lane V/C Ratio	0.035	-	-	-	0.004	-	-	0.155
HCM Control Delay (s)	9.5	0	-	-	8.3	-	-	11.9
HCM Lane LOS	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.5

Intersection	
Int Delay, s/veh	83.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↱↑	↱
Traffic Vol, veh/h	0	89	147	0	67	0	0	0	0	3	2154	109
Future Vol, veh/h	0	89	147	0	67	0	0	0	0	3	2154	109
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	79	79	79	92	92	92	96	96	96
Heavy Vehicles, %	3	3	3	37	37	37	2	2	2	2	2	2
Mvmt Flow	0	102	169	0	85	0	0	0	0	3	2244	114

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	2250	-	1179	2250	-			0	0	0
Stage 1	-	2250	-	0	0	-			-	-	-
Stage 2	-	0	-	1179	2250	-			-	-	-
Critical Hdwy	-	6.56	-	8.24	7.24	-			4.14	-	-
Critical Hdwy Stg 1	-	5.56	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	7.24	6.24	-			-	-	-
Follow-up Hdwy	-	4.03	-	3.87	4.37	-			2.22	-	-
Pot Cap-1 Maneuver	0	~ 41	0	110	~ 26	0			-	-	0
Stage 1	0	~ 76	0	-	-	0			-	-	0
Stage 2	0	-	0	153	~ 49	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	~ 41	-	-	~ 26	-			-	-	-
Mov Cap-2 Maneuver	-	~ 41	-	-	~ 26	-			-	-	-
Stage 1	-	~ 76	-	-	-	-			-	-	-
Stage 2	-	-	-	-	~ 49	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	$ 889.4	$ 1332.3	
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	41	-	-	26	-	-
HCM Lane V/C Ratio	2.495	-	-	3.262	-	-
HCM Control Delay (s)	$ 889.4	0	$	$ 1332.3	-	-
HCM Lane LOS	F	A	A	F	-	-
HCM 95th %tile Q(veh)	11.1	-	-	10.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	3	0	0	1	1	66	1751	5	0	0	0
Future Vol, veh/h	89	3	0	0	1	1	66	1751	5	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	96	96	96	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	4	4	4	2	2	2
Mvmt Flow	120	4	0	0	2	2	69	1824	5	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	869	1967	-	-	1965	915	0	0	0
Stage 1	0	0	-	-	1965	-	-	-	-
Stage 2	869	1967	-	-	0	-	-	-	-
Critical Hdwy	6.44	6.54	-	-	6.54	7.14	5.38	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.74	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.82	4.02	-	-	4.02	3.92	3.14	-	-
Pot Cap-1 Maneuver	305	62	0	0	62	236	-	-	-
Stage 1	-	-	0	0	107	-	-	-	-
Stage 2	284	107	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	295	62	-	-	62	236	-	-	-
Mov Cap-2 Maneuver	295	62	-	-	62	-	-	-	-
Stage 1	-	-	-	-	107	-	-	-	-
Stage 2	276	107	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	30.4	43.3	
HCM LOS	D	E	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	263	98
HCM Lane V/C Ratio	-	-	-	0.473	0.041
HCM Control Delay (s)	-	-	-	30.4	43.3
HCM Lane LOS	-	-	-	D	E
HCM 95th %tile Q(veh)	-	-	-	2.4	0.1

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	0	0	0	33	0	0	0	0	0	5	2778	0
Future Vol, veh/h	0	0	0	33	0	0	0	0	0	5	2778	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	53	53	53	92	92	92	95	95	95
Heavy Vehicles, %	2	2	2	6	6	6	2	2	2	2	2	2
Mvmt Flow	0	0	0	62	0	0	0	0	0	5	2924	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	2934	1462	1472	2934	-		0	0	0
Stage 1	-	2934	-	0	0	-		-	-	-
Stage 2	-	0	-	1472	2934	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.62	6.62	-		4.14	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.62	5.62	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.56	4.06	-		2.22	-	-
Pot Cap-1 Maneuver	0	15	118	85	14	0		-	-	0
Stage 1	0	33	-	-	-	0		-	-	0
Stage 2	0	-	-	128	31	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	15	118	85	14	-		-	-	-
Mov Cap-2 Maneuver	-	15	-	85	14	-		-	-	-
Stage 1	-	33	-	-	-	-		-	-	-
Stage 2	-	-	-	128	31	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	119.8	
HCM LOS	A	F	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	85	-	-
HCM Lane V/C Ratio	-	0.733	-	-
HCM Control Delay (s)	0	119.8	-	-
HCM Lane LOS	A	F	-	-
HCM 95th %tile Q(veh)	-	3.6	-	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	10	0	0	23	31	6	1594	12	0	0	0
Future Vol, veh/h	1	10	0	0	23	31	6	1594	12	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	69	69	69	59	59	59	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	14	0	0	39	53	7	1752	13	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	910	1766	-	-	1766	-	0	0	-
Stage 1	0	0	-	-	1766	-	-	-	-
Stage 2	910	1766	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	230	83	0	0	83	0	-	-	0
Stage 1	-	-	0	0	135	0	-	-	0
Stage 2	296	135	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	145	83	-	-	83	-	-	-	-
Mov Cap-2 Maneuver	145	83	-	-	83	-	-	-	-
Stage 1	-	-	-	-	135	-	-	-	-
Stage 2	211	135	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	56.2		
HCM LOS	F	-	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	86	-
HCM Lane V/C Ratio	-	-	0.185	-
HCM Control Delay (s)	-	-	56.2	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX D
Future (2020) With Project Conditions

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	0	146	3	16	260	61	0	0	15	35	0	4
Future Vol, veh/h	0	146	3	16	260	61	0	0	15	35	0	4
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	76	76	76	82	82	82	44	44	44	68	68	68
Heavy Vehicles, %	32	32	32	28	28	28	14	14	14	29	29	29
Mvmt Flow	0	192	4	20	317	74	0	0	34	51	0	6

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	393	0	0	196	0	0	393	627	98	492	592	198
Stage 1	-	-	-	-	-	-	194	194	-	396	396	-
Stage 2	-	-	-	-	-	-	199	433	-	96	196	-
Critical Hdwy	4.74	-	-	4.66	-	-	7.78	6.78	7.18	8.08	7.08	7.48
Critical Hdwy Stg 1	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Follow-up Hdwy	2.52	-	-	2.48	-	-	3.64	4.14	3.44	3.79	4.29	3.59
Pot Cap-1 Maneuver	974	-	-	1204	-	-	513	375	902	403	365	732
Stage 1	-	-	-	-	-	-	756	711	-	533	539	-
Stage 2	-	-	-	-	-	-	751	551	-	827	676	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	972	-	-	1204	-	-	502	368	902	382	358	731
Mov Cap-2 Maneuver	-	-	-	-	-	-	502	368	-	382	358	-
Stage 1	-	-	-	-	-	-	756	711	-	532	529	-
Stage 2	-	-	-	-	-	-	733	541	-	796	676	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.4	9.1	15.4
HCM LOS			A	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	902	972	-	-	1204	-	-	402
HCM Lane V/C Ratio	0.038	-	-	-	0.016	-	-	0.143
HCM Control Delay (s)	9.1	0	-	-	8	-	-	15.4
HCM Lane LOS	A	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.5

Intersection	
Int Delay, s/veh	30.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↱↑	↱
Traffic Vol, veh/h	0	83	58	0	171	0	0	0	0	0	1074	136
Future Vol, veh/h	0	83	58	0	171	0	0	0	0	0	1074	136
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	89	89	89	94	94	94	87	87	87
Heavy Vehicles, %	40	40	40	16	16	16	2	2	2	5	5	5
Mvmt Flow	0	90	63	0	192	0	0	0	0	0	1234	156

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	1234	-	662	1234	-			0	0	0
Stage 1	-	1234	-	0	0	-			-	-	-
Stage 2	-	0	-	662	1234	-			-	-	-
Critical Hdwy	-	7.3	-	7.82	6.82	-			4.2	-	-
Critical Hdwy Stg 1	-	6.3	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	6.82	5.82	-			-	-	-
Follow-up Hdwy	-	4.4	-	3.66	4.16	-			2.25	-	-
Pot Cap-1 Maneuver	0	130	0	321	~ 157	0			-	-	0
Stage 1	0	183	0	-	-	0			-	-	0
Stage 2	0	-	0	386	221	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	130	-	141	~ 157	-			-	-	-
Mov Cap-2 Maneuver	-	130	-	141	~ 157	-			-	-	-
Stage 1	-	183	-	-	-	-			-	-	-
Stage 2	-	-	-	196	221	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	79.5	201.4	0
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	130	-	-	157	-	-
HCM Lane V/C Ratio	0.694	-	-	1.224	-	-
HCM Control Delay (s)	79.5	0	0	201.4	0	-
HCM Lane LOS	F	A	A	F	A	-
HCM 95th %tile Q(veh)	3.8	-	-	11	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	79.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	83	0	0	0	2	2	169	3066	3	0	0	0
Future Vol, veh/h	83	0	0	0	2	2	169	3066	3	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	94	94	94	92	92	92
Heavy Vehicles, %	50	50	50	2	2	2	3	3	3	2	2	2
Mvmt Flow	112	0	0	0	4	4	180	3262	3	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1667	3625	-	-	3624	1633	0	0	0
Stage 1	0	0	-	-	3624	-	-	-	-
Stage 2	1667	3625	-	-	0	-	-	-	-
Critical Hdwy	7.4	7.5	-	-	6.54	7.14	5.36	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	7.7	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	4.3	4.5	-	-	4.02	3.92	3.13	-	-
Pot Cap-1 Maneuver	~ 63	2	0	0	5	77	-	-	-
Stage 1	-	-	0	0	14	-	-	-	-
Stage 2	~ 55	5	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	~ 20	2	-	-	5	77	-	-	-
Mov Cap-2 Maneuver	~ 20	2	-	-	5	-	-	-	-
Stage 1	-	-	-	-	14	-	-	-	-
Stage 2	~ 37	5	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, $	$ 2458.5	$ 780.8	
HCM LOS	F	F	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	20	9
HCM Lane V/C Ratio	-	-	-	5.608	0.889
HCM Control Delay (s)	-	-	-	$ 2458.5	$ 780.8
HCM Lane LOS	-	-	-	F	F
HCM 95th %tile Q(veh)	-	-	-	14.4	1.7

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1356	0
Future Vol, veh/h	0	0	0	0	0	0	0	0	0	9	1356	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	4	4	4
Mvmt Flow	0	0	0	0	0	0	0	0	0	9	1413	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	1431	707	725	1431	-		0	0	0
Stage 1	-	1431	-	0	0	-		-	-	-
Stage 2	-	0	-	725	1431	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.54	6.54	-		4.18	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.52	4.02	-		2.24	-	-
Pot Cap-1 Maneuver	0	133	378	313	133	0		-	-	0
Stage 1	0	198	-	-	-	0		-	-	0
Stage 2	0	-	-	383	198	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	133	378	313	133	-		-	-	-
Mov Cap-2 Maneuver	-	133	-	313	133	-		-	-	-
Stage 1	-	198	-	-	-	-		-	-	-
Stage 2	-	-	-	383	198	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	
HCM LOS	A	A	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	0	0	-	-
HCM Lane LOS	A	A	-	-
HCM 95th %tile Q(veh)	-	-	-	-

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	9	0	0	0	0	0	3075	22	0	0	0
Future Vol, veh/h	0	9	0	0	0	0	0	3075	22	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	75	75	75	92	92	92	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	12	0	0	0	0	0	3379	24	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1690	3379	-	-	3379	-	0	0	-
Stage 1	0	0	-	-	3379	-	-	-	-
Stage 2	1690	3379	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	61	~ 7	0	0	7	0	-	-	0
Stage 1	-	-	0	0	19	0	-	-	0
Stage 2	97	19	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	61	~ 7	-	-	7	-	-	-	-
Mov Cap-2 Maneuver	61	~ 7	-	-	7	-	-	-	-
Stage 1	-	-	-	-	19	-	-	-	-
Stage 2	97	19	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	$ 1330	0	0
HCM LOS	F	A	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	7	-
HCM Lane V/C Ratio	-	-	1.714	-
HCM Control Delay (s)	0	-	$ 1330	0
HCM Lane LOS	A	-	F	A
HCM 95th %tile Q(veh)	-	-	2.5	-

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	0	280	3	4	118	29	3	0	21	47	1	1
Future Vol, veh/h	0	280	3	4	118	29	3	0	21	47	1	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	84	84	84	82	82	82	51	51	51
Heavy Vehicles, %	12	12	12	37	37	37	2	2	2	4	4	4
Mvmt Flow	0	292	3	5	140	35	4	0	26	92	2	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	175	0	0	295	0	0	375	479	148	314	463	88
Stage 1	-	-	-	-	-	-	294	294	-	168	168	-
Stage 2	-	-	-	-	-	-	81	185	-	146	295	-
Critical Hdwy	4.34	-	-	4.84	-	-	7.54	6.54	6.94	7.58	6.58	6.98
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Follow-up Hdwy	2.32	-	-	2.57	-	-	3.52	4.02	3.32	3.54	4.04	3.34
Pot Cap-1 Maneuver	1329	-	-	1045	-	-	557	484	872	610	490	946
Stage 1	-	-	-	-	-	-	690	668	-	812	754	-
Stage 2	-	-	-	-	-	-	918	746	-	836	663	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1329	-	-	1045	-	-	552	482	872	590	488	946
Mov Cap-2 Maneuver	-	-	-	-	-	-	552	482	-	590	488	-
Stage 1	-	-	-	-	-	-	690	668	-	812	750	-
Stage 2	-	-	-	-	-	-	909	742	-	811	663	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.2	9.6	12.3
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	813	1329	-	-	1045	-	-	592
HCM Lane V/C Ratio	0.036	-	-	-	0.005	-	-	0.162
HCM Control Delay (s)	9.6	0	-	-	8.5	-	-	12.3
HCM Lane LOS	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.6

Intersection	
Int Delay, s/veh	114

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↕↑	↱
Traffic Vol, veh/h	0	98	161	0	72	0	0	0	0	3	2154	117
Future Vol, veh/h	0	98	161	0	72	0	0	0	0	3	2154	117
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	79	79	79	92	92	92	96	96	96
Heavy Vehicles, %	12	12	12	42	42	42	2	2	2	2	2	2
Mvmt Flow	0	113	185	0	91	0	0	0	0	3	2244	122

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	2250	-	1185	2250	-			0	0	0
Stage 1	-	2250	-	0	0	-			-	-	-
Stage 2	-	0	-	1185	2250	-			-	-	-
Critical Hdwy	-	6.74	-	8.34	7.34	-			4.14	-	-
Critical Hdwy Stg 1	-	5.74	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	7.34	6.34	-			-	-	-
Follow-up Hdwy	-	4.12	-	3.92	4.42	-			2.22	-	-
Pot Cap-1 Maneuver	0	~ 36	0	105	~ 24	0			-	-	0
Stage 1	0	~ 67	0	-	-	0			-	-	0
Stage 2	0	-	0	146	~ 46	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	~ 36	-	-	~ 24	-			-	-	-
Mov Cap-2 Maneuver	-	~ 36	-	-	~ 24	-			-	-	-
Stage 1	-	~ 67	-	-	-	-			-	-	-
Stage 2	-	-	-	-	~ 46	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, $	$ 1192.5	$ 1592.2	
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	36	-	-	24	-	-
HCM Lane V/C Ratio	3.129	-	-	3.797	-	-
HCM Control Delay (s)	$ 1192.5	0	$	1592.2	-	-
HCM Lane LOS	F	A	A	F	-	-
HCM 95th %tile Q(veh)	12.9	-	-	11.4	-	-

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	98	3	0	0	1	1	71	1751	5	0	0	0
Future Vol, veh/h	98	3	0	0	1	1	71	1751	5	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	96	96	96	92	92	92
Heavy Vehicles, %	11	11	11	2	2	2	4	4	4	2	2	2
Mvmt Flow	132	4	0	0	2	2	74	1824	5	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	879	1977	-	-	1975	915	0	0	0
Stage 1	0	0	-	-	1975	-	-	-	-
Stage 2	879	1977	-	-	0	-	-	-	-
Critical Hdwy	6.62	6.72	-	-	6.54	7.14	5.38	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.92	5.72	-	-	-	-	-	-	-
Follow-up Hdwy	3.91	4.11	-	-	4.02	3.92	3.14	-	-
Pot Cap-1 Maneuver	284	55	0	0	61	236	-	-	-
Stage 1	-	-	0	0	106	-	-	-	-
Stage 2	264	95	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	275	55	-	-	61	236	-	-	-
Mov Cap-2 Maneuver	275	55	-	-	61	-	-	-	-
Stage 1	-	-	-	-	106	-	-	-	-
Stage 2	257	95	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	36.5	43.7	
HCM LOS	E	E	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	246	97
HCM Lane V/C Ratio	-	-	-	0.555	0.041
HCM Control Delay (s)	-	-	-	36.5	43.7
HCM Lane LOS	-	-	-	E	E
HCM 95th %tile Q(veh)	-	-	-	3.1	0.1

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	0	0	0	33	0	0	0	0	0	5	2786	0
Future Vol, veh/h	0	0	0	33	0	0	0	0	0	5	2786	0
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	53	53	53	92	92	92	95	95	95
Heavy Vehicles, %	2	2	2	6	6	6	2	2	2	2	2	2
Mvmt Flow	0	0	0	62	0	0	0	0	0	5	2933	0

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	2943	1467	1477	2943	-		0	0	0
Stage 1	-	2943	-	0	0	-		-	-	-
Stage 2	-	0	-	1477	2943	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.62	6.62	-		4.14	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.62	5.62	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.56	4.06	-		2.22	-	-
Pot Cap-1 Maneuver	0	15	117	84	14	0		-	-	0
Stage 1	0	33	-	-	-	0		-	-	0
Stage 2	0	-	-	127	31	0		-	-	0
Platoon blocked, %									-	
Mov Cap-1 Maneuver	-	15	117	84	14	-		-	-	-
Mov Cap-2 Maneuver	-	15	-	84	14	-		-	-	-
Stage 1	-	33	-	-	-	-		-	-	-
Stage 2	-	-	-	127	31	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	122.6	
HCM LOS	A	F	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT
Capacity (veh/h)	-	84	-	-
HCM Lane V/C Ratio	-	0.741	-	-
HCM Control Delay (s)	0	122.6	-	-
HCM Lane LOS	A	F	-	-
HCM 95th %tile Q(veh)	-	3.7	-	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	10	0	0	23	31	6	1603	12	0	0	0
Future Vol, veh/h	1	10	0	0	23	31	6	1603	12	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	69	69	69	59	59	59	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	14	0	0	39	53	7	1762	13	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	915	1776	-	-	1776	-	0	0	-
Stage 1	0	0	-	-	1776	-	-	-	-
Stage 2	915	1776	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	228	82	0	0	82	0	-	-	0
Stage 1	-	-	0	0	134	0	-	-	0
Stage 2	294	134	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	143	82	-	-	82	-	-	-	-
Mov Cap-2 Maneuver	143	82	-	-	82	-	-	-	-
Stage 1	-	-	-	-	134	-	-	-	-
Stage 2	208	134	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	56.9		
HCM LOS	F	-	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	85	-
HCM Lane V/C Ratio	-	-	0.188	-
HCM Control Delay (s)	-	-	56.9	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	0.6	-

APPENDIX E
Future (2020) With Project and 2nd Access Conditions

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	56	90	3	16	226	61	0	0	15	35	0	38
Future Vol, veh/h	56	90	3	16	226	61	0	0	15	35	0	38
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	76	76	76	82	82	82	44	44	44	68	68	68
Heavy Vehicles, %	32	32	32	28	28	28	14	14	14	29	29	29
Mvmt Flow	74	118	4	20	276	74	0	0	34	51	0	56

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	352	0	0	122	0	0	446	660	61	562	625	177
Stage 1	-	-	-	-	-	-	268	268	-	355	355	-
Stage 2	-	-	-	-	-	-	178	392	-	207	270	-
Critical Hdwy	4.74	-	-	4.66	-	-	7.78	6.78	7.18	8.08	7.08	7.48
Critical Hdwy Stg 1	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.78	5.78	-	7.08	6.08	-
Follow-up Hdwy	2.52	-	-	2.48	-	-	3.64	4.14	3.44	3.79	4.29	3.59
Pot Cap-1 Maneuver	1014	-	-	1292	-	-	469	358	954	356	348	757
Stage 1	-	-	-	-	-	-	682	657	-	566	565	-
Stage 2	-	-	-	-	-	-	773	576	-	704	622	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1012	-	-	1292	-	-	404	324	954	318	315	756
Mov Cap-2 Maneuver	-	-	-	-	-	-	404	324	-	318	315	-
Stage 1	-	-	-	-	-	-	629	606	-	521	555	-
Stage 2	-	-	-	-	-	-	705	566	-	626	573	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	3.4	0.4	8.9	15.3
HCM LOS			A	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	954	1012	-	-	1292	-	-	455
HCM Lane V/C Ratio	0.036	0.073	-	-	0.015	-	-	0.236
HCM Control Delay (s)	8.9	8.8	0.2	-	7.8	-	-	15.3
HCM Lane LOS	A	A	A	-	A	-	-	C
HCM 95th %tile Q(veh)	0.1	0.2	-	-	0	-	-	0.9

Intersection	
Int Delay, s/veh	29.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↱↑	↱
Traffic Vol, veh/h	0	42	43	0	171	0	0	0	0	0	1089	102
Future Vol, veh/h	0	42	43	0	171	0	0	0	0	0	1089	102
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	89	89	89	94	94	94	87	87	87
Heavy Vehicles, %	40	40	40	16	16	16	2	2	2	5	5	5
Mvmt Flow	0	46	47	0	192	0	0	0	0	0	1252	117

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	1252	-	649	1252	-			0	0	0
Stage 1	-	1252	-	0	0	-			-	-	-
Stage 2	-	0	-	649	1252	-			-	-	-
Critical Hdwy	-	7.3	-	7.82	6.82	-			4.2	-	-
Critical Hdwy Stg 1	-	6.3	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	6.82	5.82	-			-	-	-
Follow-up Hdwy	-	4.4	-	3.66	4.16	-			2.25	-	-
Pot Cap-1 Maneuver	0	126	0	328	~ 153	0			-	-	0
Stage 1	0	179	0	-	-	0			-	-	0
Stage 2	0	-	0	393	216	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	126	-	236	~ 153	-			-	-	-
Mov Cap-2 Maneuver	-	126	-	236	~ 153	-			-	-	-
Stage 1	-	179	-	-	-	-			-	-	-
Stage 2	-	-	-	293	216	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	49	215	0
HCM LOS	E	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	126	-	-	153	-	-
HCM Lane V/C Ratio	0.362	-	-	1.256	-	-
HCM Control Delay (s)	49	0	0	215	0	-
HCM Lane LOS	E	A	A	F	A	-
HCM 95th %tile Q(veh)	1.5	-	-	11.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	21.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	42	0	0	0	2	2	169	3066	3	0	0	0
Future Vol, veh/h	42	0	0	0	2	2	169	3066	3	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	94	94	94	92	92	92
Heavy Vehicles, %	50	50	50	2	2	2	3	3	3	2	2	2
Mvmt Flow	57	0	0	0	4	4	180	3262	3	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1667	3625	-	-	3624	1633	0	0	0
Stage 1	0	0	-	-	3624	-	-	-	-
Stage 2	1667	3625	-	-	0	-	-	-	-
Critical Hdwy	7.4	7.5	-	-	6.54	7.14	5.36	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	7.7	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	4.3	4.5	-	-	4.02	3.92	3.13	-	-
Pot Cap-1 Maneuver	63	2	0	0	5	77	-	-	-
Stage 1	-	-	0	0	14	-	-	-	-
Stage 2	~ 55	5	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	~ 20	2	-	-	5	77	-	-	-
Mov Cap-2 Maneuver	~ 20	2	-	-	5	-	-	-	-
Stage 1	-	-	-	-	14	-	-	-	-
Stage 2	~ 37	5	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, $	1231.6	$ 780.8	
HCM LOS	F	F	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	20	9
HCM Lane V/C Ratio	-	-	-	2.838	0.889
HCM Control Delay (s)	-	-	-	$ 1231.6	$ 780.8
HCM Lane LOS	-	-	-	F	F
HCM 95th %tile Q(veh)	-	-	-	7.5	1.7

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

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	0	41	15	0	0	0	0	0	0	9	1356	34
Future Vol, veh/h	0	41	15	0	0	0	0	0	0	9	1356	34
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	4	4	4
Mvmt Flow	0	45	16	0	0	0	0	0	0	9	1413	35

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	1449	724	747	1466	-			0	0	0
Stage 1	-	1449	-	0	0	-			-	-	-
Stage 2	-	0	-	747	1466	-			-	-	-
Critical Hdwy	-	6.54	6.94	7.54	6.54	-			4.18	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	6.54	5.54	-			-	-	-
Follow-up Hdwy	-	4.02	3.32	3.52	4.02	-			2.24	-	-
Pot Cap-1 Maneuver	0	130	368	301	127	0			-	-	-
Stage 1	0	194	-	-	-	0			-	-	-
Stage 2	0	-	-	371	191	0			-	-	-
Platoon blocked, %										-	-
Mov Cap-1 Maneuver	-	130	368	211	127	-			-	-	-
Mov Cap-2 Maneuver	-	130	-	211	127	-			-	-	-
Stage 1	-	194	-	-	-	-			-	-	-
Stage 2	-	-	-	273	191	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	41.8	0	
HCM LOS	E	A	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	157	-	-	-	-
HCM Lane V/C Ratio	0.388	-	-	-	-
HCM Control Delay (s)	41.8	0	-	-	-
HCM Lane LOS	E	A	-	-	-
HCM 95th %tile Q(veh)	1.7	-	-	-	-

Intersection	
Int Delay, s/veh	18.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	41	9	0	0	0	0	0	3034	22	0	0	0
Future Vol, veh/h	41	9	0	0	0	0	0	3034	22	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	75	75	75	92	92	92	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	55	12	0	0	0	0	0	3334	24	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	1667	3334	-	-	3334	-	0	0	-
Stage 1	0	0	-	-	3334	-	-	-	-
Stage 2	1667	3334	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	63	~ 8	0	0	8	0	-	-	0
Stage 1	-	-	0	0	20	0	-	-	0
Stage 2	100	20	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	63	~ 8	-	-	8	-	-	-	-
Mov Cap-2 Maneuver	63	~ 8	-	-	8	-	-	-	-
Stage 1	-	-	-	-	20	-	-	-	-
Stage 2	100	20	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	$ 928.3	0	0
HCM LOS	F	A	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	28	-
HCM Lane V/C Ratio	-	-	2.381	-
HCM Control Delay (s)	0	-	$ 928.3	0
HCM Lane LOS	A	-	F	A
HCM 95th %tile Q(veh)	-	-	8	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	4.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	191	3	4	118	29	3	0	21	47	1	30
Future Vol, veh/h	89	191	3	4	118	29	3	0	21	47	1	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	84	84	84	82	82	82	51	51	51
Heavy Vehicles, %	12	12	12	37	37	37	2	2	2	4	4	4
Mvmt Flow	93	199	3	5	140	35	4	0	26	92	2	59

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	175	0	0	202	0	0	468	572	101	454	556	88
Stage 1	-	-	-	-	-	-	387	387	-	168	168	-
Stage 2	-	-	-	-	-	-	81	185	-	286	388	-
Critical Hdwy	4.34	-	-	4.84	-	-	7.54	6.54	6.94	7.58	6.58	6.98
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.58	5.58	-
Follow-up Hdwy	2.32	-	-	2.57	-	-	3.52	4.02	3.32	3.54	4.04	3.34
Pot Cap-1 Maneuver	1329	-	-	1146	-	-	478	429	935	485	434	946
Stage 1	-	-	-	-	-	-	608	608	-	812	754	-
Stage 2	-	-	-	-	-	-	918	746	-	692	602	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1329	-	-	1146	-	-	418	393	935	442	398	946
Mov Cap-2 Maneuver	-	-	-	-	-	-	418	393	-	442	398	-
Stage 1	-	-	-	-	-	-	560	560	-	748	751	-
Stage 2	-	-	-	-	-	-	855	743	-	620	554	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.6	0.2	9.6	13.9
HCM LOS			A	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	810	1329	-	-	1146	-	-	555
HCM Lane V/C Ratio	0.036	0.07	-	-	0.004	-	-	0.276
HCM Control Delay (s)	9.6	7.9	0.2	-	8.2	-	-	13.9
HCM Lane LOS	A	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0.2	-	-	0	-	-	1.1

Intersection	
Int Delay, s/veh	76.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑						↱↑	↱
Traffic Vol, veh/h	0	49	121	0	72	0	0	0	0	3	2194	88
Future Vol, veh/h	0	49	121	0	72	0	0	0	0	3	2194	88
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	-	-	Free	-	-	None	-	-	None	-	-	Free
Storage Length	-	-	0	0	-	-	-	-	-	-	-	500
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	79	79	79	92	92	92	96	96	96
Heavy Vehicles, %	12	12	12	42	42	42	2	2	2	2	2	2
Mvmt Flow	0	56	139	0	91	0	0	0	0	3	2285	92

Major/Minor	Minor2			Minor1					Major2		
Conflicting Flow All	-	2291	-	1177	2291	-			0	0	0
Stage 1	-	2291	-	0	0	-			-	-	-
Stage 2	-	0	-	1177	2291	-			-	-	-
Critical Hdwy	-	6.74	-	8.34	7.34	-			4.14	-	-
Critical Hdwy Stg 1	-	5.74	-	-	-	-			-	-	-
Critical Hdwy Stg 2	-	-	-	7.34	6.34	-			-	-	-
Follow-up Hdwy	-	4.12	-	3.92	4.42	-			2.22	-	-
Pot Cap-1 Maneuver	0	~ 34	0	107	~ 23	0			-	-	0
Stage 1	0	64	0	-	-	0			-	-	0
Stage 2	0	-	0	148	~ 43	0			-	-	0
Platoon blocked, %										-	
Mov Cap-1 Maneuver	-	~ 34	-	-	~ 23	-			-	-	-
Mov Cap-2 Maneuver	-	~ 34	-	-	~ 23	-			-	-	-
Stage 1	-	64	-	-	-	-			-	-	-
Stage 2	-	-	-	18	~ 43	-			-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	$ 576	$ 1678.6	
HCM LOS	F	F	

Minor Lane/Major Mvmt	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	34	-	-	23	-	-
HCM Lane V/C Ratio	1.657	-	-	3.963	-	-
HCM Control Delay (s)	$ 576	0	$	1678.6	-	-
HCM Lane LOS	F	A	A	F	-	-
HCM 95th %tile Q(veh)	6.2	-	-	11.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	49	3	0	0	1	1	71	1751	5	0	0	0
Future Vol, veh/h	49	3	0	0	1	1	71	1751	5	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	74	74	74	50	50	50	96	96	96	92	92	92
Heavy Vehicles, %	11	11	11	2	2	2	4	4	4	2	2	2
Mvmt Flow	66	4	0	0	2	2	74	1824	5	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	879	1977	-	-	1975	915	0	0	0
Stage 1	0	0	-	-	1975	-	-	-	-
Stage 2	879	1977	-	-	0	-	-	-	-
Critical Hdwy	6.62	6.72	-	-	6.54	7.14	5.38	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.92	5.72	-	-	-	-	-	-	-
Follow-up Hdwy	3.91	4.11	-	-	4.02	3.92	3.14	-	-
Pot Cap-1 Maneuver	284	55	0	0	61	236	-	-	-
Stage 1	-	-	0	0	106	-	-	-	-
Stage 2	264	95	0	0	-	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	275	55	-	-	61	236	-	-	-
Mov Cap-2 Maneuver	275	55	-	-	61	-	-	-	-
Stage 1	-	-	-	-	106	-	-	-	-
Stage 2	257	95	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	28.4	43.7	
HCM LOS	D	E	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1
Capacity (veh/h)	-	-	-	223	97
HCM Lane V/C Ratio	-	-	-	0.315	0.041
HCM Control Delay (s)	-	-	-	28.4	43.7
HCM Lane LOS	-	-	-	D	E
HCM 95th %tile Q(veh)	-	-	-	1.3	0.1

Intersection	
Int Delay, s/veh	55.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	49	40	33	0	0	0	0	0	5	2786	29
Future Vol, veh/h	0	49	40	33	0	0	0	0	0	5	2786	29
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	-	-	-	-	-	-	-	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	53	53	53	92	92	92	95	95	95
Heavy Vehicles, %	2	2	2	6	6	6	2	2	2	2	2	2
Mvmt Flow	0	53	43	62	0	0	0	0	0	5	2933	31

Major/Minor	Minor2			Minor1				Major2		
Conflicting Flow All	-	2959	1482	1503	2974	-		0	0	0
Stage 1	-	2959	-	0	0	-		-	-	-
Stage 2	-	0	-	1503	2974	-		-	-	-
Critical Hdwy	-	6.54	6.94	7.62	6.62	-		4.14	-	-
Critical Hdwy Stg 1	-	5.54	-	-	-	-		-	-	-
Critical Hdwy Stg 2	-	-	-	6.62	5.62	-		-	-	-
Follow-up Hdwy	-	4.02	3.32	3.56	4.06	-		2.22	-	-
Pot Cap-1 Maneuver	0	~ 14	114	81	13	0		-	-	-
Stage 1	0	~ 32	-	-	-	0		-	-	-
Stage 2	0	-	-	122	30	0		-	-	-
Platoon blocked, %									-	-
Mov Cap-1 Maneuver	-	~ 14	114	-	13	-		-	-	-
Mov Cap-2 Maneuver	-	~ 14	-	-	13	-		-	-	-
Stage 1	-	~ 32	-	-	-	-		-	-	-
Stage 2	-	-	-	-	30	-		-	-	-

Approach	EB	WB	SB
HCM Control Delay, $	1786.6		
HCM LOS	F	-	

Minor Lane/Major Mvmt	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	23	-	-	-	-
HCM Lane V/C Ratio	4.206	-	-	-	-
HCM Control Delay (s)	$ 1786.6	-	-	-	-
HCM Lane LOS	F	-	-	-	-
HCM 95th %tile Q(veh)	12.2	-	-	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	49	10	0	0	23	31	6	1554	12	0	0	0
Future Vol, veh/h	49	10	0	0	23	31	6	1554	12	0	0	0
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	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Free	-	-	Free	-	-	None
Storage Length	-	-	-	-	-	-	-	-	500	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	16965	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	69	69	69	59	59	59	91	91	91	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	71	14	0	0	39	53	7	1708	13	0	0	0

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	888	1722	-	-	1722	-	0	0	-
Stage 1	0	0	-	-	1722	-	-	-	-
Stage 2	888	1722	-	-	0	-	-	-	-
Critical Hdwy	7.54	6.54	-	-	6.54	-	4.14	-	-
Critical Hdwy Stg 1	-	-	-	-	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	-	-	4.02	-	2.22	-	-
Pot Cap-1 Maneuver	238	88	0	0	88	0	-	-	0
Stage 1	-	-	0	0	142	0	-	-	0
Stage 2	305	142	0	0	-	0	-	-	0
Platoon blocked, %								-	
Mov Cap-1 Maneuver	155	88	-	-	88	-	-	-	-
Mov Cap-2 Maneuver	155	88	-	-	88	-	-	-	-
Stage 1	-	-	-	-	142	-	-	-	-
Stage 2	221	142	-	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	67.3		
HCM LOS	F	-	

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	WBLn1
Capacity (veh/h)	-	-	137	-
HCM Lane V/C Ratio	-	-	0.624	-
HCM Control Delay (s)	-	-	67.3	-
HCM Lane LOS	-	-	F	-
HCM 95th %tile Q(veh)	-	-	3.3	-

Appendix H

“Need for the Project” Documentation

This page intentionally blank.

COUNTY OF HAWAI'I STATE OF HAWAI'I

RESOLUTION NO. 28 03 DRAFT 2

RESOLUTION TO SET FORTH THE GOALS AND POLICIES OF THE COUNTY OF HAWAI`I ON THE SUBJECT OF SOLID WASTE REDUCTION AND DIVERSION FROM THE LANDFILLS

WHEREAS, on November 20, 2002, the Hawai'i County Council adopted Resolution 238-02, which authorized the acceptance of the Update to the Integrated Solid Waste Management Plan; and

WHEREAS, the county's comparative approach to waste management is to strive to maximize the life of the West Hawai'i landfill as well as increase the life of the South Hilo landfill, the county must begin diverting as much solid waste as possible from both landfills and work as a one-island county system, emphasizing public convenience; and

WHEREAS, the approach chosen by the county, detailed in the Update of the Integrated Solid Waste Management Plan, describes the strategies and courses of action to reach 80% reduction of the solid waste stream prior to landfill disposal by striving to develop various waste reduction technologies and maximizing a recycling plan to promote 100% community participation; and

WHEREAS, in Hawai`i Revised Statutes §342G-2, the State of Hawai`i has guided the state and each county to "consider the following solid waste management practices and processing methods in their order of priority:

(1) Source reduction;
(2) Recycling and bioconversion, including composting; and
(3) Landfilling and incineration;" and

WHEREAS, in Hawai`i Revised Statutes §342G-3, the State of Hawai`i has adopted a goal of fifty per cent reduction of the solid waste stream prior to disposal through source reduction, recycling, and bioconversion. HRS also states that "Nothing in this chapter shall be construed to restrict a county from setting waste reduction goals higher than those of the State."; and

NOW, THEREFORE, BE IT RESOLVED that the County of Hawai`i now sets its goal at 50% diversion of Solid Waste from any landfill within 5 years from the date of this resolution.

BE IT FURTHER RESOLVED that the County of Hawai`i now further sets its goal at 80% diversion of Solid Waste from any landfill with 10 years from the date of this resolution.

BE IT FURTHER RESOLVED that copies of this resolution be transmitted to the Honorable Linda Lingle, Governor, State of Hawai'i; Chiyome Fukino, M.D., Director, State Department of Health; Harry Kim, Mayor; County of Hawai'i; and Barbara Bell, Director, Department of Environmental Management, County of Hawai'i.

Dated at Hilo, Hawai'i, this 23rd day of January, 2003.

INTRODUCED BY:

COUNCIL MEMBER, COUNTY OF HAWAI'I

COUNTY COUNCIL
County of Hawai'i
Hilo, Hawai'i

I hereby certify that the foregoing RESOLUTION was by The vote indicated to the right hereof adopted by the COUNCIL of the County of Hawai'i on January 23, 2003.

ATTEST:

ROLL CALL VOTE

	AYES	NOES	ABS	EX
ARAKAKI	X			
CHUNG			X	
ELARIONOFF	X			
HOLSCHUH	X			
JACOBSON	X			
LEITHEAD-TODD	X			
REYNOLDS	X			
SAFARIK	X			
TYLER	X			
	8	0	1	0

Reference: C-65.1/P-Council

COUNTY CLERK CHAIRMAN & PRESIDING OFFICER RESOLUTION NO. 28 03 (Draft 2)

COUNTY OF HAWAI'I STATE OF HAWAI'I

RESOLUTION NO. 356 07

A RESOLUTION TO EMBRACE AND ADOPT THE PRINCIPLES OF ZERO WASTE AS A LONG -TERM GOAL FOR HAWAI'I COUNTY.

WHEREAS, according to the August 2001 "Waste Composition Study, South Hilo Lanfill", approximately 67,000 tons of waste was deposited at the South Hilo Landfill in 2000; and

WHEREAS, the department of environmental management secured an extention of time for the closure of the South Hilo Landfill by implementing sliver-filling techniques that have added some years to the landfill's life span; and

WHEREAS, the Council of the County of Hawai'i recognizes the need to increase efforts that will divert materials from the landfill; and

WHEREAS, the Zero Waste philosophy promotes the highest and best use of materials to eliminate waste and pollution by emphasizing a closed-loop system of production and consumption, moving in logical increments toward the goal of zero waste through the core principles of:

- Improving "downstream" reuse/recycle of end-of-life products and materials to ensure their highest and best use;

- Pursuing "upstream" re-design strategies to reduce the volume and toxicity of discarded products and materials, and promote low-impact or reduced-consumption lifestyles;

- Fostering and supporting the use of discarded products and materials to stimulate and drive local economic and workforce development; and

WHEREAS, strategies to reach zero waste can help promote the over-arching goal of each generation leaving a reduced ecological footprint on the earth; now, therefore,

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAI'I that through its legislation, policies, and actions that Hawai'i County does embrace and will adopt the Zero Waste philosophy of solid waste management; and

WHEREAS, strategies to reach zero waste can help promote the over-arching goal of each generation leaving a reduced ecological footprint on the earth; now, therefore,

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAI'I that through its legislation, policies, and actions that Hawai'i County shall embrace and adopt the Zero Waste philosophy of solid waste management and that the Council and the department of environmental management will take necesssary steps to incorporate the Zero Waste philosophy into the Integrated Solid Waste Management Plan; and

BE IT FINALLY RESOLVED that the Clerk of the County of Hawai'i transmit copies of this resolution to the director of the department of environmental management and to the Mayor of Hawai'i County.

Dated at Kona, Hawai'i, this 19th day of December 2007

INTRODUCED BY:

COUNCIL MEMBER, COUNTY OF HAWAI'I

COUNTY COUNCIL
County of Hawai'i
Hilo, Hawai'i

I hereby certify that the foregoing RESOLUTION was by the vote indicated to the right hereof adopted by the COUNCIL of the County of Hawai'i on December 19, 2007.

ATTEST:

COUNTY CLERK CHAIRMAN & PRESIDING OFFICER

ROLL CALL VOTE

	AYES	NOES	ABS	EX
FORD	X			
HIGA	X			
HOFFMANN	X			
IKEDA	X			
JACOBSON	X			
NAEOLE	X			
PILAGO	X			
YAGONG			X	
YOSHIMOTO	X			
	8	0	1	0

Reference: C- 707.2/EMC - 10

RESOLUTION NO. 356 07

(DRAFT 2)

COUNTY OF HAWAI'I STATE OF HAWAI'I

RESOLUTION NO. 826 08

(DRAFT 2)

A RESOLUTION URGING THE DIRECTOR OF THE DEPARTMENT OF ENVIRONMENTAL MANAGEMENT TO DEVELOP AN ORDINANCE AND IMPLEMENT A PLAN TO PROHIBIT FOOD, PAPER, AND COMPOSTABLE ORGANICS FROM HAWAI'I COUNTY LANDFILLS BY 2012.

WHEREAS, landfilling food and paper is greatly contributing to global warming; and

WHEREAS, more than 100 tons of biodegradable materials, including paper products, food scraps and yard trimmings, are landfilled in the County of Hawai'i every day. These materials amount to approximately half of our island's discarded resources, and when buried in a landfill, they decompose without oxygen and generate methane, an efficient atmospheric heat-trapping gas and a major factor in climate change; and

WHEREAS, methane is understood to be 72 times more potent than carbon dioxide (CO2) in causing climate changes over a 20-year period, the amount of time scientists have determined is left before the planet reaches the "tipping point" on irreversible climate change. Landfills are the number one source of human-caused methane in the United States and emit the greenhouse gas equivalent of 20 percent of our country's coal-fired power plants every year; and

WHEREAS, commercial farming and shortsighted land use policies favoring energy-intensive pesticides, fertilizers, and irrigation water have resulted in dramatic increases in greenhouse gases discharged into the atmosphere for more than 50 years. These practices have contributed to one-third of the increase in atmospheric CO2, while causing erosion, sedimentation, water pollution, and the progressive stripping of organic matter, beneficial microbes, carbon, and other essential nutrients from our soils; and

WHEREAS, healthy soils are capable of holding twice the carbon stocks of plants. Release of soil bound carbon through tilling, unsustainable and other short sighted farming practices cause soils to contribute to, rather than protect against, global warming. These unsustainable methods also compromise the ability of using soil to grow food locally, nutritiously, and sustainably; and

WHEREAS, Hawai'i currently imports 90 percent of its food and urgently requires the healthier soils that can be produced through diverting organic materials from the landfill and returning the nutrients and organic matter back to farmland to grow its own. This is a critical component of re-creating a more sustainable society on our island; and

WHEREAS, the quickest and cheapest way to immediately reduce our community's greenhouse gas emissions and improve the health of soils on the island is to divert compostable organics from our landfills; and

WHEREAS, this resolution is in keeping with Resolution 356-07, Draft 2; "EMBRACING AND ADOPTING THE PRINCIPLES OF ZERO WASTE AS A LONG TERM GOAL FOR HAWAI'I COUNTY", adopted on December 19, 2007; and

WHEREAS, we agree to phase these materials out of our landfills by 2012, and ask that Department of Environmental Management staff come back with a plan on how to best accomplish this and how to work with local agencies to encourage the use of compostable organics to sustain the health of our soils; now, therefore,

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAI'I that food, paper, and compostable organics shall be banned from Hawai'i County landfills by 2012 and that the Department of Environmental Management is urged to develop a plan to accomplish this policy and to present it to the Hawai'i County Council within 6 months of passage of this resolution.

BE IT FURTHER RESOLVED that the County Clerk shall forward a copy of this resolution to the Director of the Department of Environmental Management to develop a strategic plan to achieve the goals in accordance with the terms of this resolution.

Dated at Kona, Hawai'i, this 23rd day of January, 2009.

INTRODUCED BY:

Brenda Ford

COUNCIL MEMBER, COUNTY OF HAWAI'I

COUNTY COUNCIL
County of Hawai'i
Hilo, Hawai'i

I hereby certify that the foregoing RESOLUTION was by the vote indicated to the right hereof adopted by the COUNCIL of the County of Hawai'i on January 23, 2009.

ATTEST:

COUNTY CLERK

CHAIRMAN & PRESIDING OFFICER

ROLL CALL VOTE

	AYES	NOES	ABS	EX
FORD	X			
HIGA	X			
HOFFMANN	X			
IKEDA	X			
JACOBSON	X			
NAEOLE	X			
PILAGO	X			
YAGONG	X			
YOSHIMOTO	X			
	9	0	0	0

Reference: C-91.1/EMC-21

RESOLUTION NO. 826 08

(DRAFT 2)