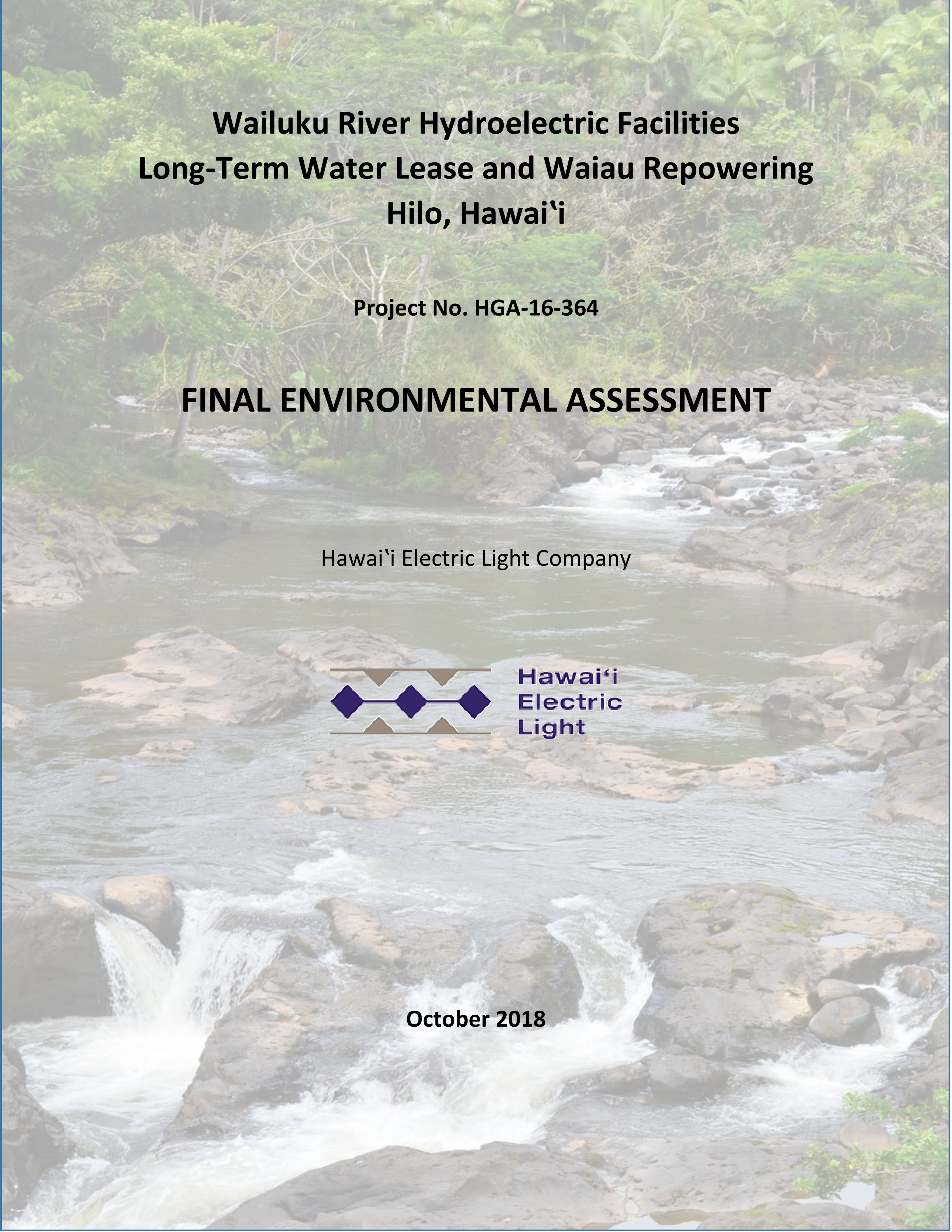

Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Repowering
Hilo, Hawaiʻi

Project No. HGA-16-364

FINAL ENVIRONMENTAL ASSESSMENT

Hawaiʻi Electric Light Company

Hawaiʻi Electric Light

October 2018

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Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Repowering
Hilo, Hawai‘i

Project No. HGA-16-364

Prepared for:

Hawai‘i Electric Light

1200 Kīlauea Avenue
Hilo, Hawai‘i 96720

Prepared by:

SSFM International

99 Aupuni Street, Suite 202
Hilo, Hawai‘i 96720

October 2018

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Project Summary

Project Name	Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering
Location	Hilo, Hawaiʻi
District	South Hilo
Project Site Tax Map Key	(3) 2-6-009:025 (Waiau Hydroplant and Penstock) (3) 2-6-007:001 (Puʻuʻeo Hydroplant) (3) 2-6-029:044 (Puʻuʻeo Penstock)
Landowner	Hawaii Electric Light Company
Project Site Existing Uses	Hydropower Generation
State Land Uses	(3) 2-6-009:025 (Agricultural and Conservation) (3) 2-6-007:001 (Urban) (3) 2-6-029:044 (Conservation)
County of Hawaiʻi Zoning	(3) 2-6-009:025 (A-20a and Open) (3) 2-6-007:001 (RM1) (3) 2-6-029:044 (A-20a)
County of Hawaiʻi Land Use Pattern Allocation Guide (LUPAG)	(3) 2-6-009:025 (Important Agricultural Lands [IAL] and Conservation) (3) 2-6-007:001 (Medium Density Urban) (3) 2-6-029:044 (Conservation)
Proposed Action	Hawaiʻi Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawaiʻi. HELCO is currently diverting and using water from the Wailuku River pursuant to Revocable Permit No. S-7463 issued by the Board of Land and Natural Resources (BLNR). On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR work with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the BLNR (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puʻuʻeo hydroelectric facilities located alongside the Wailuku River in Hilo. In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant.
Anticipated Impacts	No long-term impacts to any resource, as discussed in **Chapter 3: Environmental Setting, Potential Impacts, and Minimization and Mitigation Measures**, are anticipated with implementation of the Proposed Action. Any impacts would be during the construction phase and would be short-term and temporary. The Proposed Action would have beneficial impacts associated with the generation of renewable energy and would further help to achieve the State of Hawaiʻi's goal of 100% renewable energy by 2045.

Applicant	Hawaiʽi Electric Light Company, Inc. (HELCO) 1200 Kilauea Avenue Hilo, Hawaiʽi 96720 (808) 935-1171
HRS Chapter 343 Approving Agency	Department of Land and Natural Resources (DLNR)
~~Anticipated~~ Determination	Finding of No Significant Impact (FONSI)
Project Site Permits/ Approvals Required	• HPUC Approval to Commit Funds • Long-Term Lease of Water Rights • National Pollutant Discharge Elimination System (NPDES) Individual Permit • Community Noise Permit/Community Noise Variance • Historic Preservation Review
EA Preparer	SSFM International 99 Aupuni Street, Suite 202 Hilo, Hawaiʻi 96720 Contact: Jennifer Scheffel (808) 356-1273
Individuals, Community Groups, and Agencies Consulted	See **Chapter 6: Agencies and Organizations Consulted**

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Appendix C Cultural Impact Assessment

Appendix D Socioeconomic Impact Assessment

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Acronyms

°F	degrees Fahrenheit
%	percent
BLNR	Board of Land and Natural Resources
BMPs	Best Management Practices
CAA	Clean Air Act
CFR	Code of Federal Regulations
CFS	cubic feet per second
CO	carbon monoxide
CSRL	California Soil Resource Lab
CWA	Clean Water Act
CWB	Clean Water Branch
dB	decibel
dBA	decibels A-weighted
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
DOH	State of Hawaiʽi Department of Health
DWS	State of Hawaiʽi Department of Water Supply
EA	Environmental Assessment
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
HAR	Hawaiʽi Administrative Rules
HDFS	High Definition Fish Survey
HELCO	Hawaiʽi Electric Light Company
HPUC	Hawaiʽi Public Utilities Commission
HRS	Hawaiʽi Revised Statutes
IAL	Important Agricultural Lands
IPaC	Information for Planning and Conservation
kW	kilowatt
LSB	Land Study Bureau
LUPAG	Land Use Pattern Allocation Guide
m^2	square meters
mgd	million gallons per day
MKWA	Mauna Kea Watershed Alliance
MWh	megawatt-hour
MWh/yr	megawatt-hour per year
$\mu g/m^3$	microgram per cubic meter
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide

NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
O_3	ozone
OEQC	Office of Environmental Quality Control
PM_{10}	particulate matter less than 10 microns
$PM_{2.5}$	particulate matter less than 2.5 microns
ppm	parts per million
ROW	right-of-way
SDWB	Safe Drinking Water Branch
SHPD	State Historic Preservation Division
SO_2	sulfur dioxide
SWPP	*State Water Projects Plan, Hawai`i Water Plan*
USDA-NRCS	U.S. Department of Agriculture – Natural Resource Conservation Service
USDA-SCS	U.S. Department of Agriculture – Soil Conservation Service
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRPP	*Water Resource Protection Plan, Hawai`i Water Plan*
WUDP	*Hawai`i County Water Use and Development Plan*

CHAPTER 1: PROJECT DESCRIPTION

1.1 Introduction

Hawaiʽi Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawaiʽi. HELCO is currently diverting and using water from the Wailuku River for hydroelectric production at their Waiau and Puʽuʽeo Plants pursuant to Revocable Permit No. S-7463 issued by the Board of Land and Natural Resources (BLNR). On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR work with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the BLNR (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puʽuʽeo Plants located alongside the Wailuku River in Hilo. In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant.

This Environmental Assessment (EA) has been prepared pursuant to the requirements of Hawaiʽi Revised Statutes (HRS) Section 171-58, Minerals and Water Rights, and HRS Chapter 343, Environmental Impact Statements.

1.2 Purpose and Need for the Proposed Action

Purpose of the Project

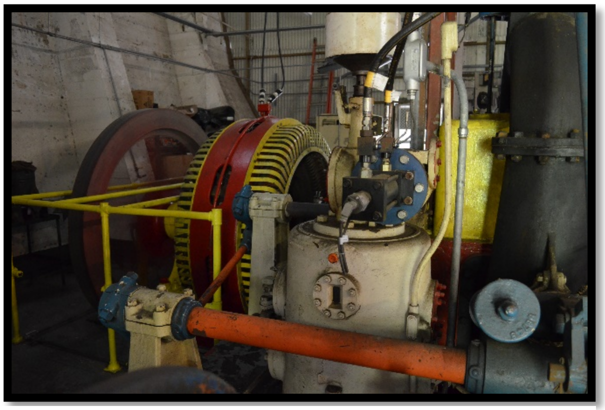
The purpose of the proposed project is to continue to operate the two hydropower projects on the Wailuku River: the Waiau Plant and the Puʽuʽeo Plant. Renewable energy generated by hydropower projects reduces imports of oil for conventional diesel electric power generation. The continued operation of HELCO's Wailuku River hydroelectric plants and increased capacity of the Waiau Plant would further help to achieve the State of Hawaiʽi's goal of 100% renewable energy by 2045.

Need for the Long-Term Water Lease

HELCO is currently diverting and using water from the Wailuku River to power its Waiau and Puʽuʽeo hydroelectric plants under an existing Revocable Permit No. S-7463, which must be renewed each year. However, under Act 126, Session Laws of Hawaiʽi 2016, HELCO would only be able to get its Revocable Permit renewed through 2019. The long-term water lease is needed to ensure continued operation of the Waiau and Puʽuʽeo Plants for the next 65 years.

Need for Waiau Plant Repowering

In 2010, HELCO commissioned Christensen Associates, Inc., to inspect and evaluate the Waiau Plant and determine options available to extend the service life of the plant and maximize the renewable resources. Results of the inspection revealed that the Waiau Plant, which has been in operation since the 1920s, has already exceeded its nominal economic life and that the age and condition of the generating equipment, as shown in the following photos, are such that the plant is now due for either major rehabilitation or repowering of the existing generating units. The plant's generation appears to be impaired by a combination of plant maintenance outages, low plant generation efficiency due to the old design and condition of the equipment, and suboptimal operation of the headworks. Measures have already been implemented to extend the service life of the headworks and penstock; therefore, the repowering of the generators and replacement of a 300-foot section of penstock are the only items that are in need of attention. On July 29, 2016, HELCO filed their application with the Hawaiʿi Public Utilities Commission (HPUC) for the expenditure of funds to upgrade the Waiau Plant (HELCO, 2016a).



Generator Unit 2

Penstock

Need for an Easement from the Department of Hawaiian Home Lands

The diversion structure for the Waiau Plant has a small section that encroaches on lands managed by the Department of Hawaiian Home Lands (DHHL), as shown in **Figure 1-1**. This structure has been in place since prior to October 1964. HELCO has requested an easement from DHHL to bring the structure into conformance with State land use law.

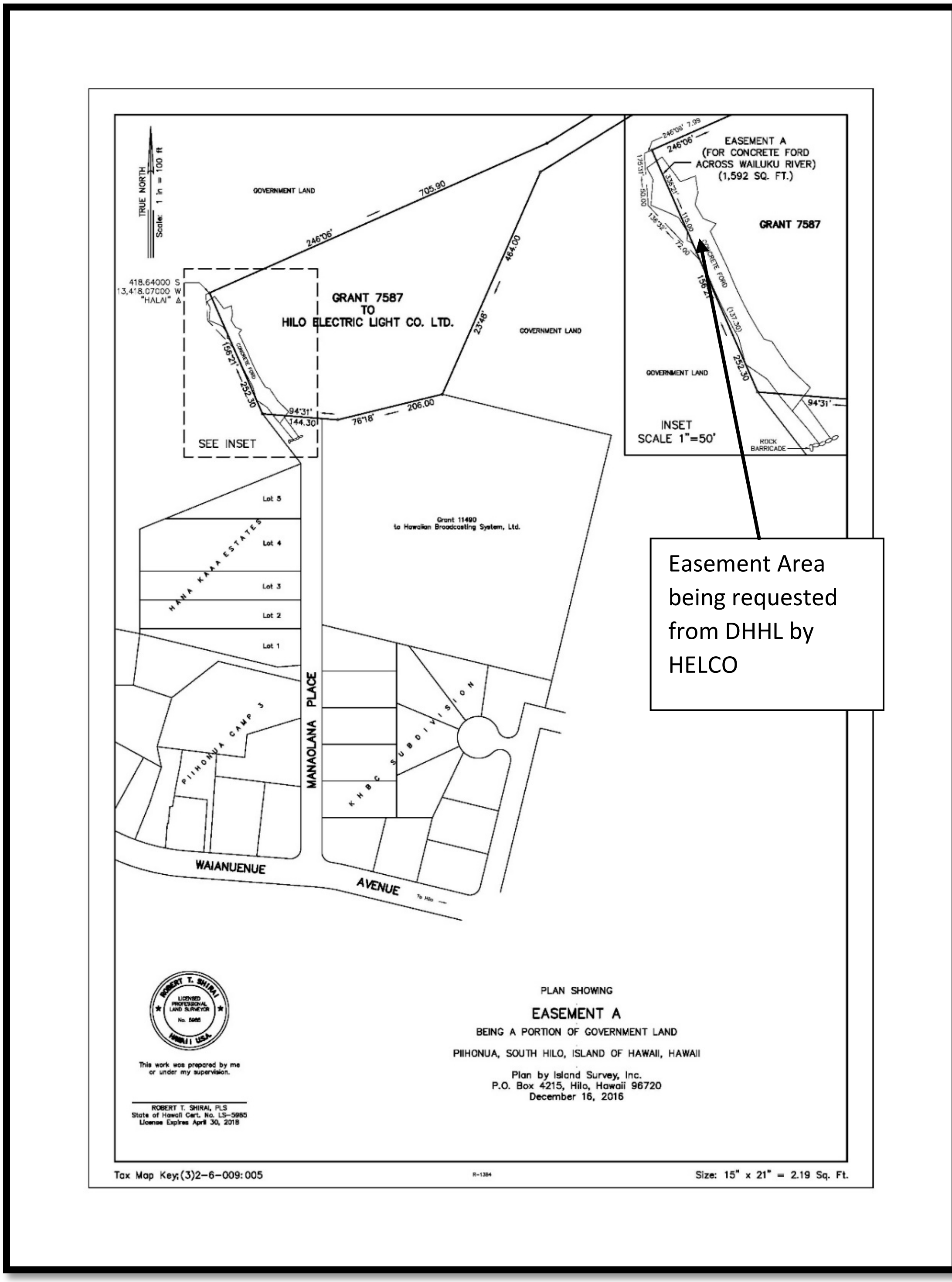
1.3 Project Location and Site Characteristics

HELCO operates two small hydroelectric projects on the Wailuku River near Hilo, Hawaiʿi: the Waiau Plant and the Puʿuʿeo Plant.

As shown in **Figure 1-2**, the Waiau Plant powerhouse is located at the confluence of the Wailuku River and Waiau Stream on a bluff overlooking Kaimukanaka Falls (TMK (3) 2-6-009:025). The stream diversion and intake structure are located immediately upstream of Peʿepeʿe Falls approximately 0.94 mile from the powerhouse at an elevation of approximately 855 feet. The stream diversion is formed by a low concrete sill across lava flows in the streambed that diverts water into an inlet in the north bank of the river. An 800-foot-long concrete-lined channel carries water from the inlet to a concrete intake structure at the mouth of the penstock. The intake canal has a sediment sluice valve downstream of the entrance which is used to flush sand and gravel out of the upper section of the channel and to drain the channel for

Waiau Intake Canal and Overflow Spillway maintenance operations. There is an overflow spillway section in the canal to prevent overcharging of the canal and overtopping further downstream. The diversion structure is located on TMK (3) 2-6-009:025 with a small portion of the structure located on TMK (3) 2-6-9:005. The 4,961-foot-long buried penstock is buried on the north side of the river in what used to be sugar plantation but is now forest.

Figure 1-1. Waiau Diversion Structure Encroachment



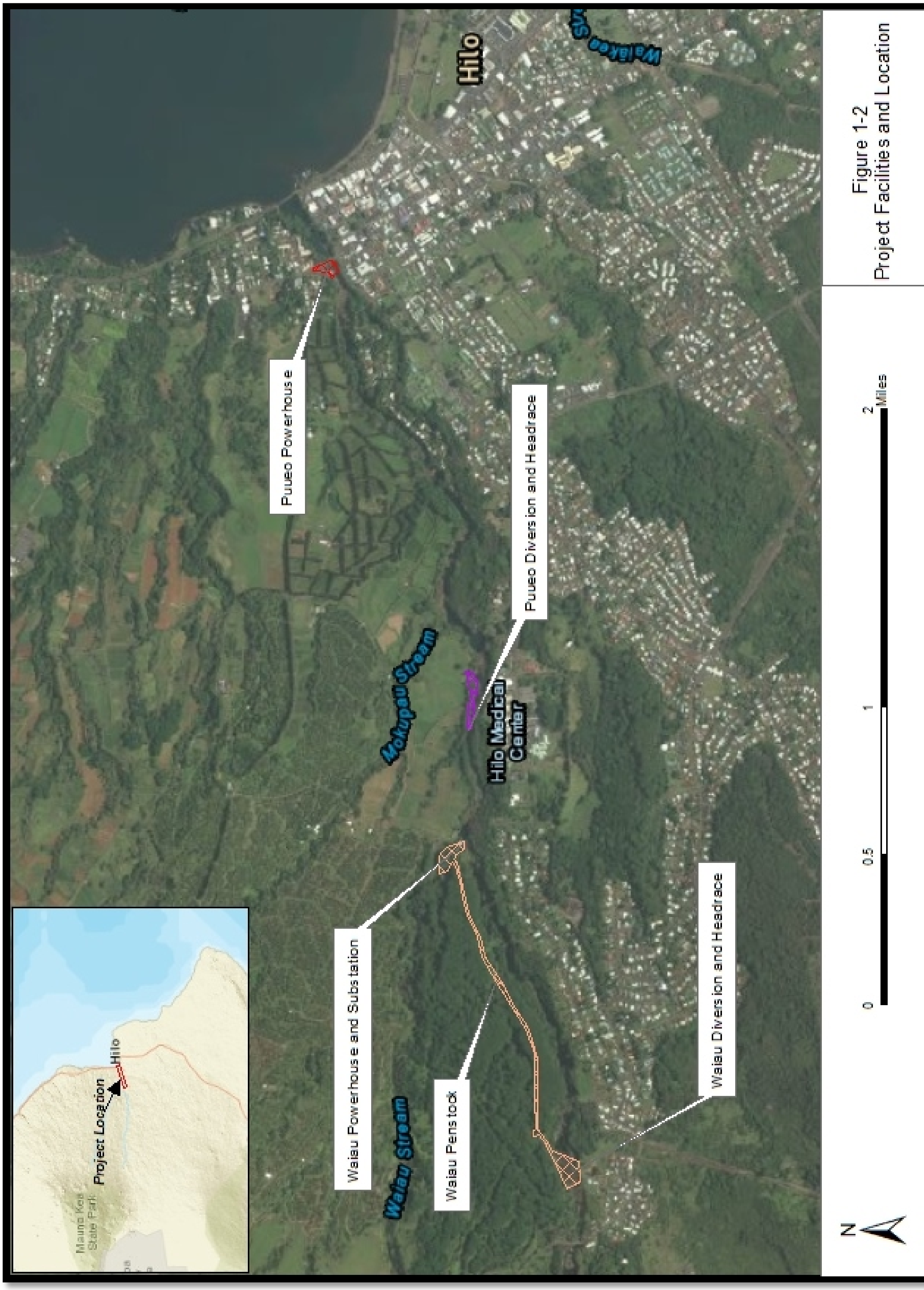


Figure 1-2
Project Facilities and Location

The Waiau Plant powerhouse is located in a forested area adjacent to the Wailuku River. The substation is located on the same parcel as the Waiau Plant powerhouse adjacent to the driveway and parking area. Adjacent land uses include agriculture to the north of the powerhouse and residential across the river on the south side of the powerhouse. The stream diversion and intake structures are located in a natural, forested river environment. Adjacent land uses include forested open space on the north side of the river and forested open space and residential on the south side of the river. All of the facilities for the Waiau Plant are on lands owned by HELCO.

Waiau Powerhouse

Puʻuʻeo Intake Canal

The Puʻuʻeo Plant powerhouse is located just upstream of the Wainaku Avenue Bridge near the mouth of the Wailuku River at Hilo Bay (see Figure 1-1) on parcel (3) 2-6-007:001. The stream diversion and intake structure are located just upstream of Rainbow Falls approximately 1.36 miles from the powerhouse at an elevation of approximately 446 feet (TMK (3) 2-6-029:044). The intake is located on the north side of the river and is formed by a low concrete weir across the lava-flow streambed which diverts water into an unlined channel that leads 470 feet downstream to the headworks. The headworks consist of a 144-feet-long tunnel and 240-feet-long lined channel, as per the as-built drawings. The intake channel has an elevated skimmer headwall and a side channel spillway for discharging surplus water. There is a 7,205-foot-long buried penstock that traverses agricultural fields on the north side of the river.

The Puʻuʻeo Hydro Plant powerhouse is located in an urban area. The stream diversion and intake structures are located in a natural, forested river environment. Adjacent land uses include agricultural land north of the river and the Hilo Medical Center and Yukio Okutsu State Veterans Home south of the river. The diversion, intake structure, and penstock for the Puʻuʻeo Plant are located on privately-owned lands for which access easements have been obtained. The Puʻuʻeo powerhouse is on lands owned by HELCO.

Puʻuʻeo Powerhouse

HELCO's use of water for both plants is registered with the DLNR in compliance with HRS Chapter 174C, State Water Code. HELCO submits monthly reports on usage.

1.4 Project Schedule and Construction Costs

HELCO plans to place orders for major equipment (e.g., turbine, generator, switchgear, transformer) in the 3rd quarter of 2017. The equipment is estimated to take approximately 15 to 18 months to arrive. Construction would begin in early 2019 and would take approximately 9 months to complete. HELCO anticipates that the project would be completed in 2019.

Construction of the Proposed Action would cost approximately $6,200,000 and would be funded by HELCO. HELCO filed their application with the HPUC on July 29, 2016 for approval to commit funds in excess of $2,500,000. The application was approved by HPUC in Decision and Order No. 34868 on October 16, 2017.

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**.

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

Permit or Approval	Description	Regulation(s)	Administrative Authority
HPUC Approval to Commit Funds	Approval to commit funds in excess of $2,500,000 for Item H0002550, the Waiau Hydro Repowering Project. Application filed July 29, 2016.	• Section 6-61-74, Rules of Practice and Procedure before the Public Utilities Commission • Hawaii Administrative Rules (HAR), Chapter 61 • HPUC General Order No. 7, Paragraph 2.3(g)(2), as modified by D&O 21002	HPUC
Long-Term Lease of Water Rights	Long-term (65-year) lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puʽuʽeo hydroelectric facilities located alongside the Wailuku River in Hilo. Application submitted August 16, 2016.	• HRS Section 171-58 • Act 216 (amendment to HRS Section 171-58)	BLNR
Easement	Easement from DHHL to resolve encroachment of Waiau diversion structure on DHHL property.		DHHL-Land Management Division

Permit or Approval	Description	Regulation(s)	Administrative Authority
National Pollutant Discharge Elimination System (NPDES) Permit	NPDES Individual Permit required for stormwater discharge associated with construction activities. The Wailuku River is classified as a Class I water at Rainbow Falls.	• Clean Water Act, Section 401 • HAR Section 11-55	DOH-Clean Water Branch (CWB)
NPDES, Hydrostatic Test Permit	NPDES Individual Permit required for discharges of hydrotesting waters.	• HAR Section 11-55	DOH-CWB
NPDES, Dewatering Permit	NPDES Individual Permit required for discharges associated with construction activity dewatering.	• HAR Section 11-55	DOH-CWB
Community Noise Permit/Community Noise Variance	Required for construction projects exceeding 78 decibels (dBA) or has a total cost of more than $250,000.	• HRS Chapter 342F • HAR Title 11, Chapter 46	DOH-Indoor and Radiological Health Branch
Historic Preservation Review	Required for projects that may affect historic property or a burial site.	• HRS Chapter 6E	DLNR, State Historic Preservation Division (SHPD)

1.6 Anticipated Findings and Determinations

As per HAR Section 11-200, the approving agency, the DLNR, will issue its determination in a Notice of Determination letter to the Office of Environmental Quality Control (OEQC).

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CHAPTER 2: PROPOSED ACTION AND ALTERNATIVES

2.1 No-Action Alternative

Under the No-Action Alternative, HELCO would continue to operate its Waiau and Puʽuʽeo Plants under the Revocable Permit. Given the age and condition of the Waiau Plant, this is essentially a "run to failure" option. However, under Action 126, Session Laws of Hawaiʽi 2016, HELCO would only be able to get its Revocable Permit renewed through 2019. In other words, the water may stop before the Waiau Plant "runs to failure."

It is expected that more leaks in the 300 feet of penstock closest to the Waiau powerhouse would occur and would need to be repaired. The number of leaks would increase exponentially over time. Ultimately, the existing penstock at the Waiau Plant would be weakened to the point where it could suffer structural failure. This course of action has a high risk that failure of the penstock may cause risk to human life, subsidence or erosion of adjacent land, and may cause a long outage at the Waiau Plant that would have associated costs of generating replacement energy.

2.2 Proposed Action

The Proposed Action consists of three distinct components: (1) application for a long-term water use lease for the Waiau and Puʽuʽeo Plants on the Wailuku River, (2) repowering of the Waiau Plant, and (3) application for an easement for the Waiau diversion structure encroachment on state land.

Long-Term Water Lease

As described in Section 1.1, HELCO has requested a long-term water lease to replace the existing revocable permit authorizing the non-consumptive use of water from the Wailuku River for its two Wailuku River hydroelectric facilities. The proposed use of the leased water would be to utilize water from the Wailuku River to operate the Waiau and Puʽuʽeo hydro generators. At the beginning of the process, river water is diverted into a canal. At Pu'u'eo, level controls automatically maintain a minimum water level within the canal to ensure natural river flow past the diversion is maintained. At the Waiau plant, the canal water level is maintained manually by HELCO operators. As part of the repowering of the Waiau Plant, discussed in Section 2.2.2, automatic water level controls similar to those in operation at the Puʽuʽeo Plant would be installed.

After passing through the canal, diverted water enters a penstock where it is piped to the powerhouse. Once at the powerhouse, the water is passed through a hydroelectric turbine, then released back into the river via an open-channel tailrace[1]. The existing stream diversions are in working condition and no additional improvements are proposed to divert water from the stream. Under the repowering plan before the PUC, the maximum amount of water diverted during high flow conditions for the Waiau

[1] Flume or channel leading away from a waterwheel or turbine.

diversion would increase from 55 cubic feet per second (CFS) to 100 CFS. The maximum amount for Pu'u'eo at high flow conditions is 130 CFS.

Repowering of the Waiau Plant

HELCO's Waiau Plant is a "run-of-the-river" hydroelectric plant served by a diversion and intake structure located on the Wailuku River near Hilo on Hawaiʻi Island, just upstream of Peʻepeʻe Falls, and a 4,888-foot-long buried steel penstock[2] to transport water from the diversion to the plant.

The Waiau Plant was constructed in 1920 with a single 750 kilowatt (kW) horizontal-axis hydraulic Pelton turbine generator, referred as Unit 1. In 1928, a second Pelton 350 kW unit, referred to as Unit 2, was relocated from the Puʻuʻeo Plant to the Waiau Plant.

The repowering component of the Proposed Action would include the following:

1. Repowering of Unit 2
2. Rehabilitation of Unit 1
3. Penstock Replacement
4. Powerhouse Modifications
5. Substation Modifications

Annual energy generation was estimated to be 10,214 MWh/yr at a levelized lifecycle energy production cost of $94/MWh.

Repowering of Unit 2

The smaller and older 350 kW Unit 2 would be replaced by a larger, new turbine-generator. The turbine would either be a horizontal-axis Pelton or a Turgo impulse turbine. The size will be constrained by the size of the penstock, but it is estimated that the capacity will be 1,500 kW.

Rehabilitation of Unit 1

The existing 750 kW Unit 1 would be refurbished by rewinding the generator with more efficient coils and refurbishment of the Pelton water wheel (buckets and nozzle) to increase capacity and restore useful life. As a result of this refurbishment, the capacity of the unit would be increased from 750 kW to 800 kW. All work would be within the existing powerhouse.

Penstock Replacement

The last 300-foot section of riveted, 38-inch-diameter penstock immediately before the powerhouse would be removed due to its poor condition and replaced with 45-inch-diameter welded steel pipe. The existing penstock would be removed and the new penstock would be installed in the same location.

[2] A penstock is a sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydroelectric turbines.

Construction activities would be within a 20-foot right-of-way (ROW) on HELCO and Department of Hawaiian Home Lands (DHHL) property.

Powerhouse Modifications

Powerhouse modifications would be required to accommodate the new turbine. In addition to modifications to the interior of the powerhouse, there would be exterior modifications associated with the penstock and the tailrace. The penstock will include a new bifurcated section with block valves in concrete boxes immediately outside the mauka entrance to the powerhouse. The majority of the facility would be below grade. The makai tailrace will be removed and rebuilt to accommodate the additional water discharged from the new turbine. The tailrace will be an open concrete channel that will be above grade.

Substation Modifications

The substation adjacent to the Waiau Plant would require modifications to account for the additional energy being generated by the Waiau Plant. Specifically, a new generator would be installed and the existing transformer would be replaced with a new, larger transformer. If it is determined that the existing transformer contains polychlorinated biphenyls (PCBs), it would be disposed of in compliance with 40 Code of Federal Regulations (CFR) 761.60. The overall footprint of the substation would be approximately 800 to 1000 square feet and would remain within the HELCO property boundary.

Easement from DHHL

The Waiau diversion structure encroaches onto state lands managed by the DHHL. Specifically, the encroachment involves approximately 1,600 square feet of a roadway across the Wailuku River that accesses the diversion structure for the Waiau Plant into adjacent DHHL property. HELCO is currently consulting with DHHL’s Land Management Division to resolve the encroachment by obtaining an easement.

2.3 Alternatives Considered But Not Carried Forward

In addition to the Proposed Action and No-Action Alternative, other potential alternatives were considered. The following sections briefly summarize these alternative actions that were examined but eliminated from further consideration.

Long-Term Water Lease

There are two alternatives that could be considered in lieu of the long-term water lease. The first alternative would be to continue operations and the diversion of water under the Revocable Permit until it is no longer renewed. This alternative is the No-Action Alternative and is discussed in **Section 2.1**, above. The second alternative would be to discontinue the diversion of water and stop operations of the Waiau and Puʻuʻeo Plants. This alternative was not carried forward because it does not meet the purpose of the project, which is to continue to operate both hydropower projects on the Wailuku River and help the state achieve its goal of 100% renewable energy by 2045.

Repowering of the Waiau Plant

There are four alternatives that were considered with regard to the Waiau Plant, but they were not carried forward for various reasons as described below.

Alternative 1 – Retirement and Decommissioning of the Waiau Plant

Alternative 1 would involve the retirement and decommissioning of the Waiau Plant. Many of the major components of the Waiau Plant have significant remaining service life. Retiring and decommissioning the facility would result in HELCO and its customers foregoing the remaining benefits available from the investment. In addition, Alternative 1 does not meet the purpose of the project, which is to continue to operate both hydropower projects on the Wailuku River and help the state achieve its goal of 100% renewable energy by 2045.

Alternative 2 – Option Rehabilitate Units 1 and 2

Alternative 2 would include the rehabilitation of both of the existing units at the Waiau Plant. Existing generating equipment would be fully inspected and tested to determine the scope of the rehabilitation of the units that would be implemented during plant outages. This option has lower overall costs than other rehabilitation options and does not utilize any additional hydraulic capacity in the waterway. Annual energy generation was estimated to be 6,220 MWh/yr at a levelized lifecycle energy production cost of $124/MWh. Alternative 2 was not carried forward because it does not increase energy generation enough to compensate for the cost.

Alternative 3 – Repower Units 1 and 2 with a Single Unit

Alternative 3 would retire the existing units and replace them with a single, larger turbine-generator. The replacement of Units 1 and 2 with a single, larger unit would require interior modifications to the powerhouse, modifications to the existing substation, and replacement of 300 feet of riveted penstock adjacent to the powerhouse. The new single unit would be approximately 1,533 kW and would produce 8,058 MWh/yr at a levelized production cost of $112/MWh. Alternative 3 was not carried forward because it does not increase energy generation enough to compensate for the cost.

Alternative 4 – Add Third Unit and Rehabilitate Units 1 and 2

Alternative 4 would maximize electric power production available from the existing headworks and penstock by adding a new unit and rehabilitating the existing units. This alternative would require a 30-foot by 40-foot addition to the existing powerhouse to accommodate the third unit. It would also require modifications to the existing substation and replacement of 300 feet of riveted penstock adjacent to the powerhouse. The estimated capacity of the new unit would be approximately 2,200 kW. This alternative would produce 12,823 MWh/yr at a levelized production cost of $74/MWh. Although Alternative 4 has the highest energy generation and lowest levelized production cost, it was not carried forward because of the extensive work required to the powerhouse exterior and the potential cost risk that permitting delays could impose.

Easement from DHHL

The only alternative to obtaining an easement from DHHL would be to remove the part of the structure that is encroaching upon DHHL land. However, the encroachment is part of the diversion structure and is made out of concrete and masonry weirs built on lava bedrock. To remove the portion of the diversion structure encroaching onto DHHL land is not feasible and would cause a significant environmental impact.

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CHAPTER 3: ENVIRONMENTAL SETTING, POTENTIAL IMPACTS, AND MINIMIZATION AND MITIGATION MEASURES

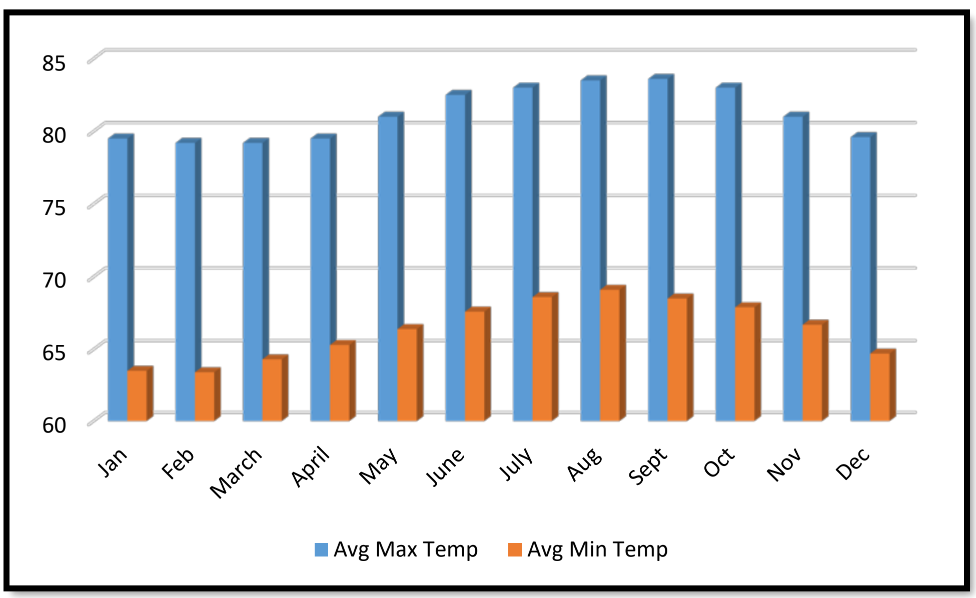
3.1 Climate and Air Quality

Climate

The Proposed Action is located on the north side of Hilo, Hawaiʻi. Hilo features a tropical rainforest climate with substantial rainfall throughout the year. Temperature and rainfall in Hilo varies 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, Hawaiʻi has a relatively uniform day length and temperature.

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 83.6°F, respectively. The coolest months are February and March with an average high temperature of 79.2°F. Hilo receives approximately 126.6 inches of annual rainfall (WRCC, 2016). The Waiau Plant site has an average annual temperature of 70.6°F; the Puueo Plant site, which is located at a lower elevation, has an average annual temperature of 72.7°F (UH-Mānoa, 2014).

Figure 3-1. Average Low and High Temperatures in Hilo, Hawaiʻi



Hilo is located on the east side of Hawaiʻi Island and receives approximately 127 inches of rain annually. The mean annual rainfall at the Waiau Plant is approximately 169.4 inches. The mean annual rainfall at the Puʻuʻeo Plant is approximately 145.4 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 Hawaiʽi 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 Hawaiʽi AAQS are in some cases considerably more stringent than the comparable National Ambient Air Quality Standards (NAAQS). In particular, the Hawaiʽi 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 largest sources of air pollution in the immediate project area are most likely associated with agricultural operations and automobile traffic using the roadway network in the project area. Emissions from these sources consist primarily of particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides. Volcanic emissions from Kilauea Volcano also affect the air quality at times of “Kona” or southerly wind conditions.

The DOH operates a network of air quality monitoring stations at various locations around the state, including a station in Hilo located near the Hilo Medical Center. This station monitors $PM_{2.5}$ and SO_2. In 2015, the highest concentration of $PM_{2.5}$ was 24.8 $\mu g/m^3$, and the 98th percentile was 17.1 $\mu g/m^3$. The annual average was 5.0 $\mu g/m^3$, and there were no occurrences of 24-hour concentrations greater than 35 $\mu g/m^3$ (the federal standard). The highest concentration of SO_2 in 2015 was 0.640 ppm, and the 99th percentile was 0.236 ppm. There were 15 instances of one-hour averages greater than 0.075 ppm (the federal standard). These values are mostly attributed to volcanic emissions. Volcanic eruptions are considered natural events; therefore, the USEPA may exclude exceedances of the one-hour NAAQS from attainment determinations (DOH, 2016). The State of Hawaiʽi is in attainment with the NAAQS for all pollutants regulated by the USEPA.

In addition to the NAAQS and the State AAQS, the DOH regulates fugitive dust. HAR Section 11-60.1-33, Fugitive Dust, states that no person shall cause or permit visible fugitive dust to become airborne without taking reasonable precautions, and no person shall cause or permit the discharge of visible fugitive dust beyond the property lot line on which the fugitive dust originates (DOH, 2014). This rule applies to construction projects and would therefore be applicable to the Proposed Action.

Table 3-1. State of Hawaiʻi 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})	µg/m³	Annual 24 Hours	- 150[a]	- 150[a]	50 150[b]
Particulate Matter <2.5 microns ($PM_{2.5}$)	µg/m³	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	µg/m³	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.

Potential Impacts

Construction

The long-term water lease would not require any construction activities; therefore, there would not be any short-term impacts to the existing air quality.

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 Waiau Plant 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 the removal and replacement of the partially buried penstock.

Because levels of criteria pollutants in Hawaiʽi 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.

Under the No-Action Alternative, no construction activities would occur and no additional emission sources would be added; therefore, there would be no impact to the existing air quality.

Operation

The long-term water lease would ensure continued operation of the Waiau and Puʽuʽeo Plants for the next 65 years. Hydropower can have a beneficial effect on air quality by reducing fossil-fueled energy generation and the associated air emissions.

Hydroelectric power production does not create noxious emissions. Repowering of the Waiau Plant would increase the capacity to 2,075 kW from the existing 1,100 kW. The estimated annual output would be approximately 10,200 MWh. This increase in the generation of renewable energy for the next 65 years would decrease the required generation of electricity from fossil fuel sources. By displacing fossil fuel power generation, the repowered Waiau Plant would have a beneficial impact on air quality elsewhere in Hawaiʽi.

Under the No-Action Alternative, the Waiau and Puʽuʽeo Plants would continue their existing operations for a very limited time period until the Revocable Permit is no longer renewed (i.e., up to 2019). The current beneficial impacts to air quality from operation of the two plants would continue until they are no longer in service.

Minimization and Mitigation Measures

A dust control plan would be developed and implemented to minimize fugitive dust during construction, to be approved by the DOH. The plan would include some or all of the following measures:

- Watering of active work areas and project access roads, as needed
- 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

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

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 Hawaiʽi 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.

As discussed in **Section 4.3, County of Hawaiʽi Zoning**, the Waiau Plant is in zone A-20a, Agriculture, which is Class C. The Puʽuʽeo Plant is located in zone RM-1, Multiple Family Residential, which is Class B.

Existing Noise Environment

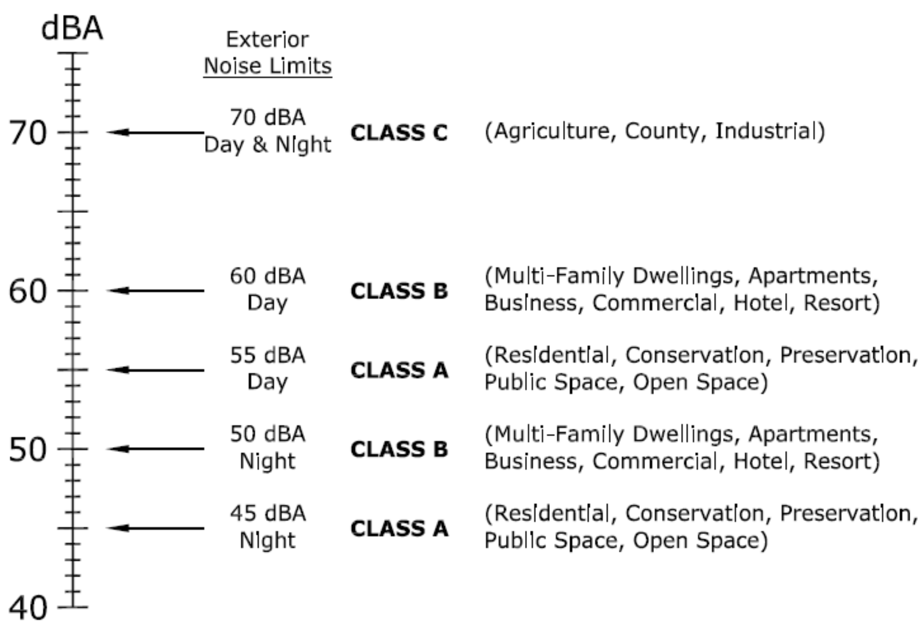
Waiau Plant

The Waiau Plant is located in a forested area along the Wailuku River. There are no adjacent noise producers to the project site, which creates a very quiet noise environment. Noise in the area is limited to the sound of the river, wind blowing through the trees, birds, and other fauna (e.g., coqui frogs). Noise from the current operations is limited to inside the powerhouse.

There is one house located approximately 175 feet northeast of the powerhouse. Additionally, as stated in **Section 1.3**, there is a residential area south of the river. Within this residential neighborhood, the closest house to the Waiau Plant is approximately 575 feet away and is separated from the Waiau Plant by a forested area that is approximately 400 feet wide.

Figure 3-2. Hawaiʻi Maximum Permissible Sound Levels for Various

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)



Puʻuʻeo Plant

The Puʻuʻeo Plant is located in a built environment. Existing noise in the area is consistent with that associated with a mixed-use environment and consists of motorists on the adjacent roads, human activities, birds, wind blowing through the trees, and the sound of the Wailuku River. Noise from the current operations is limited to inside the powerhouse.

There are several small apartment complexes to the east of the powerhouse on the opposite side of Wainaku Avenue. A residential neighborhood lies to the west of the substation. There is a commercial district across the Wailuku River to the south of the Puʻuʻeo Plant.

Potential Impacts

Construction

Noise generated during construction of the Proposed Action would be short-term and limited to the areas of construction at the Waiau Plant and penstock. Noise would be generated by construction equipment employed to implement the Proposed Action. Construction equipment would include excavators, trucks, and other heavy equipment. Earthmoving equipment (e.g., bulldozers and diesel-powered trucks) would probably be the loudest equipment used during construction and would only be used at the Waiau Plant. Typical noise emission levels for construction equipment are provided in **Table 3-2**.

Table 3-2. Typical Noise Emission Levels for Construction Equipment

Type of Equipment	Noise Level at 50 feet (dBA)
Air Compressor	81
Backhoe	80
Bulldozer	82
Chain Saw	85
Concrete/Grout Pumps	82
Crawler Service Crane (100-ton)	83
Dump Truck	88
Excavator	85
Front End Loader	80
Generator	81
Jackhammer (compressed air)	85
Lift Booms	85
Pick-Up Truck	55
Power-Actuated Hammer	88
Water Pump	76
Water Truck	55

Source: FHWA, 2015.

No normal-working-hour noise-sensitive uses (i.e., schools and hospitals) are present near the Waiau Plant. It is not expected that construction noise would exceed acceptable levels at the nearby residence due to topography, vegetation, and the existing noise environment.

Under the No-Action Alternative, no construction activities would occur, and there would be no change to the existing noise environment. Therefore, no impacts from noise are anticipated under the No-Action Alternative.

Operation

The long-term water lease would allow continued diversion of water from the Wailuku River in two locations: immediately upstream of Peʻepeʻe Falls and upstream of Rainbow Falls. Since the long-term water lease would allow continued operation of the existing diversion facilities, the noise environment would remain the same as at present. Therefore, there would be no noise impacts associated with the diversion of water under the long-term water lease.

Operation of the repowered Waiau Plant would generate some noise when placed into service. However, there would not be a substantial increase in noise at or adjacent to the Waiau Plant over existing levels. Some of the new equipment may attenuate some of the existing noise as aging equipment and facilities are replaced.

No significant substation noise is anticipated. The modifications to the substation would replace some of the aging equipment, which could attenuate some of the existing noise.

Under the No-Action Alternative, the Waiau and Puʻuʻeo Plants would continue diverting water from the Wailuku River under the Revocable Permit until such time it is no longer renewed, as well as continue their existing operations. The existing noise produced from the two plants and associated substation would remain as-is.

Minimization and Mitigation Measures

Noise generated from construction activities and the use of machinery would be minimized by requiring contractors to adhere to state and county noise regulations. To reduce noise exposure to nearby residences, 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.

No minimization or mitigation measures are proposed for noise created during plant operations since it would be confined to the powerhouse.

3.3 Geology and Soils

Geology

The Wailuku River is the approximate boundary between the lava flows from Mauna Kea and those from Mauna Loa (Buchanan-Banks, J.M., 1993a). Formations to the north of the river are those of Mauna Kea's volcano series, while the area to the south consists of Mauna Loa volcano formations, all of which date back to the Pleistocene Age.

Mauna Kea's Hamakua volcanic series is a permeable basalt with an overlying Pahala ash layer up to 25 feet thick. The surface is less permeable than normal for exposed basalts. As a result, stream flow in the area is substantial, and flow in the Wailuku River averages several hundred million gallons per day. Slopes on the Mauna Kea surface are moderately steep, averaging 5 to 10%.

South and east of the Wailuku River, the surface rocks consist of the Kaʻu volcanic series of Mauna Loa, an extremely permeable basalt that is too recent in origin to have formed a deep soil and saprolite layer. There are patches of Pahala ash on some older Mauna Loa lavas near the Wailuku River, but are insignificant in contrast to the wide extent of bare Kaʻu lava over the remainder of the area. The Kaʻu series erupted from Mauna Loa after the main deposition of Pahala ash and is only about 25 feet thick in the Hilo region. Beneath the ash is the initial Mauna Loa basalt formation, the Kahuku series, which is also very permeable. The result of permeable surface and subsurface formations is a lack of appreciable surface runoff and the occurrence of high infiltration and subsurface flow rates. The Kaʻu volcanics also have low slopes in the Hilo region, averaging 0.5 to 5%.

As shown in **Figure 3-3**, the Waiau Plant is located within the Hāmākua volcanic series. The portion of the penstock to be replaced is located within the Hāmākua volcanic series and tephra deposits.

Soils

Soils in the project area are part of the Hilo Series. The Hilo Series consists of well-drained silty clay loams. These soils are formed in a series of volcanic ash layers that give them a banded appearance. They range in elevation from near sea level to 800 feet and have gently sloping to steep slopes. Permeability of Hilo Series soils is rapid, runoff is slow to moderate, and the erosion hazard is slight to moderate (USDA-SCS, 1973). The Waiau Plant, substation, and portion of the penstock to be replaced is located on Kaiwiki silty clay loam, 0 to 10 percent slopes. **Figure 3-4** identifies soils in the project area.

Potential Impacts

Construction

Effects on geology and soils from construction of the Proposed Action would be limited to the potential for disturbed soils in the construction area for the penstock replacement, Waiau powerhouse modifications, and substation modifications to be eroded as a result of being carried away by storm water runoff or wind and the potential for contaminants to be present that could be imparted to soils. Contaminants in soils have the potential to be transported in normal runoff flows to receiving waters, be leached into groundwater, or pose a direct health risk to people living, working, or playing in or near the soil area.

Operation

Under the Proposed Action, the 300-foot section of riveted, 38-inch-diameter penstock immediately before the powerhouse would be replaced, which would minimize the potential for leaks and associated impacts due to erosion. Therefore, operation of the Proposed Action would have less than significant impacts to geology and soils.

Under the No-Action Alternative, the Waiau and Puʻuʻeo Plants would continue their existing operations. The last 300-foot section of riveted, 38-inch-diameter penstock immediately before the powerhouse would not be replaced and would continue to deteriorate and develop leaks. Leakage from the pipeline may form deep sinkholes, or it may cause erosion or subsidence of adjacent land. Due to the age and condition of this section of penstock, it is also likely that it would completely fail. Failure of the pipeline would cause major erosion and land subsidence. The degree of damage in such an event would be affected by the time taken to detect the leak and shut down flow. However, the flow would need to be shut off slowly to avoid negative pressures and possible collapse of the pipeline shell due to vacuum. The No-Action Alternative would potentially have significant impacts to geology and soils.

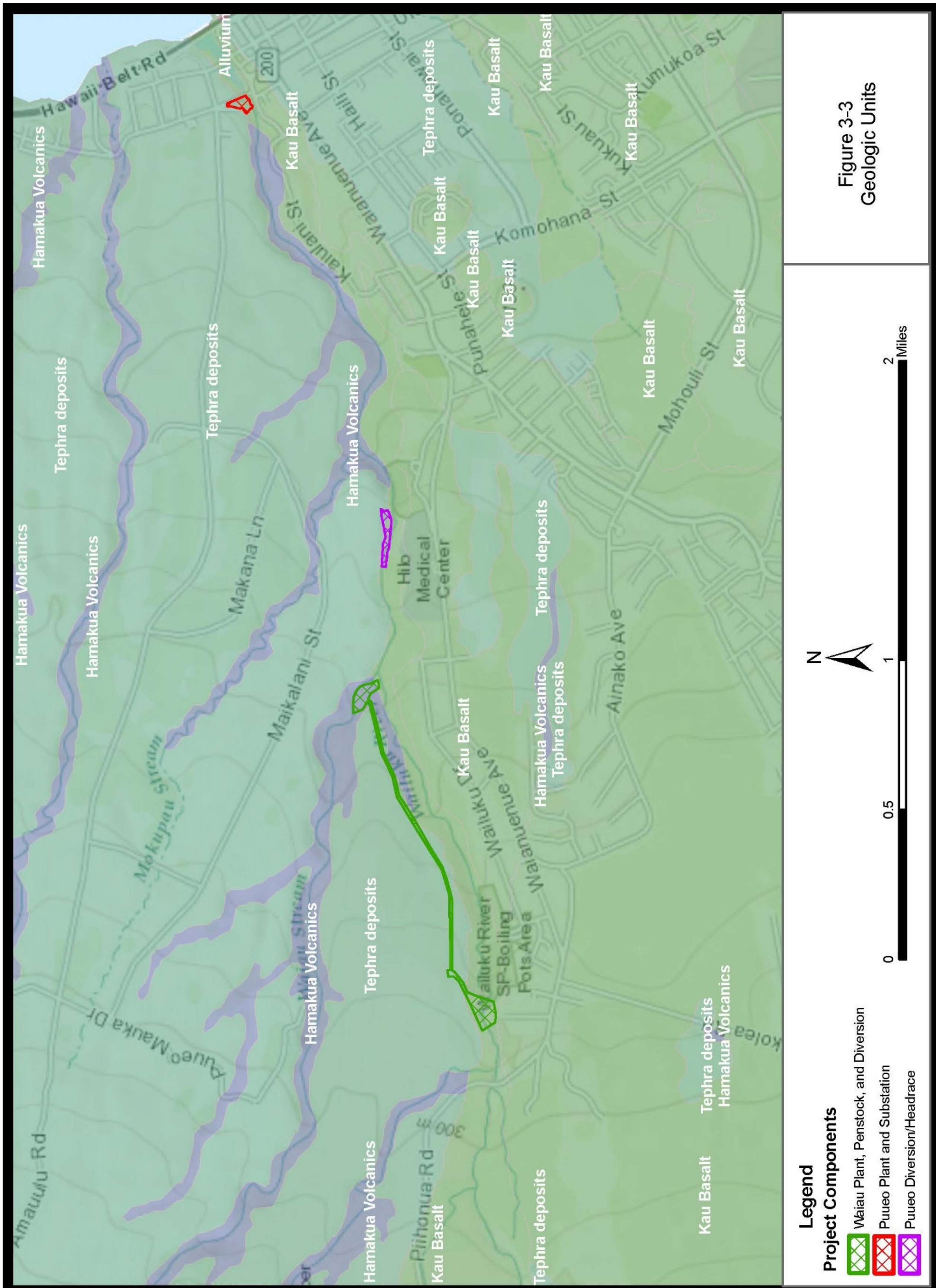


Figure 3-3
Geologic Units

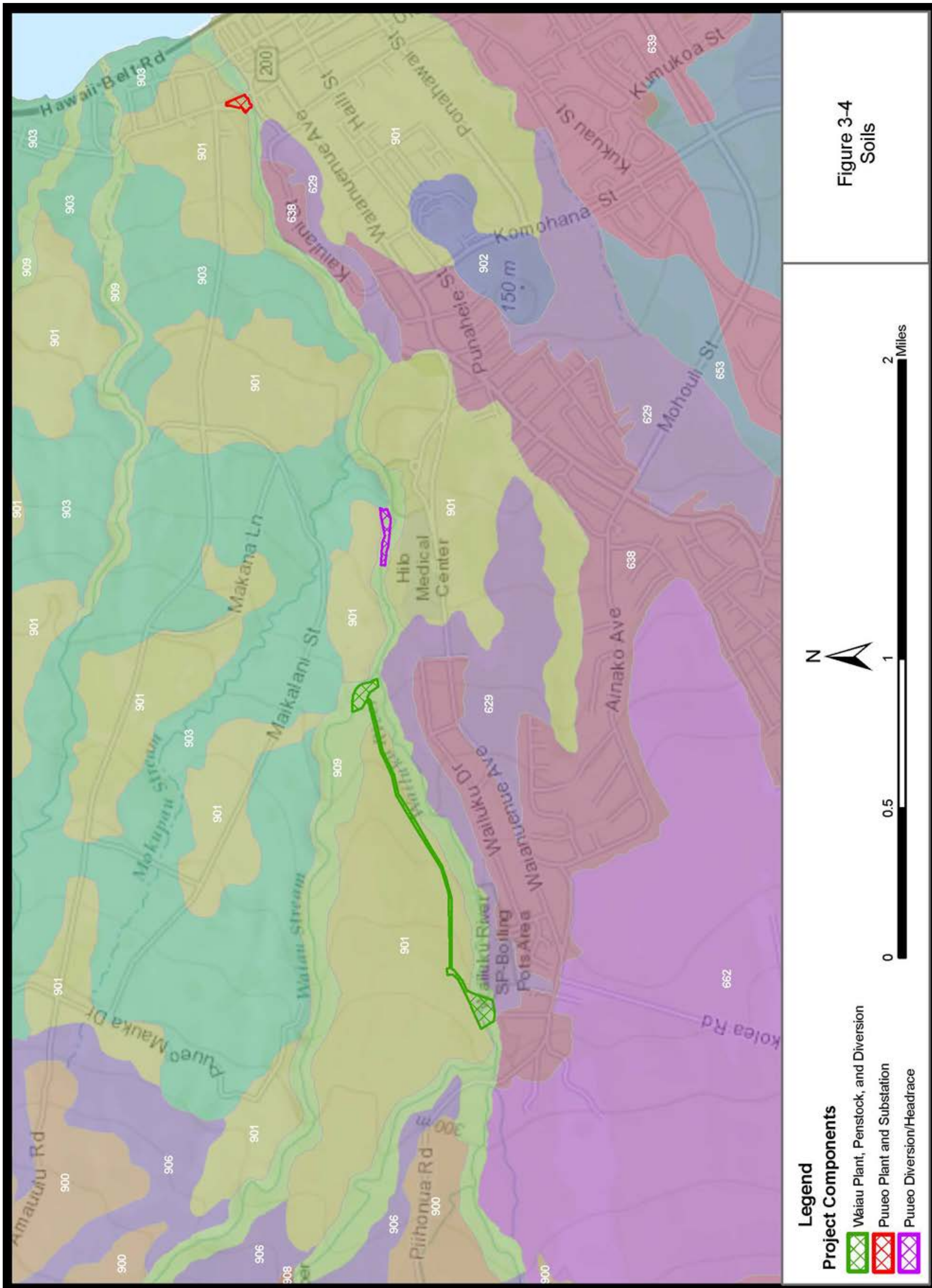


Figure 3-4
Soils

Minimization and Mitigation Measures

HELCO would obtain a NPDES Individual Permit for stormwater discharge associated with construction activities. As part of the permit process, HELCO 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 of 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 and would be inspected and maintained throughout the construction period.

3.4 Natural Hazards

Natural hazards that may occur in and affect the proposed project area include floods, tsunami, hurricanes, earthquakes, and volcanic eruptions.

Floods

Updated flood maps for the Hawaiʽi County are currently in the preliminary phase. Therefore, for this EA we are using the 1988 Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM).

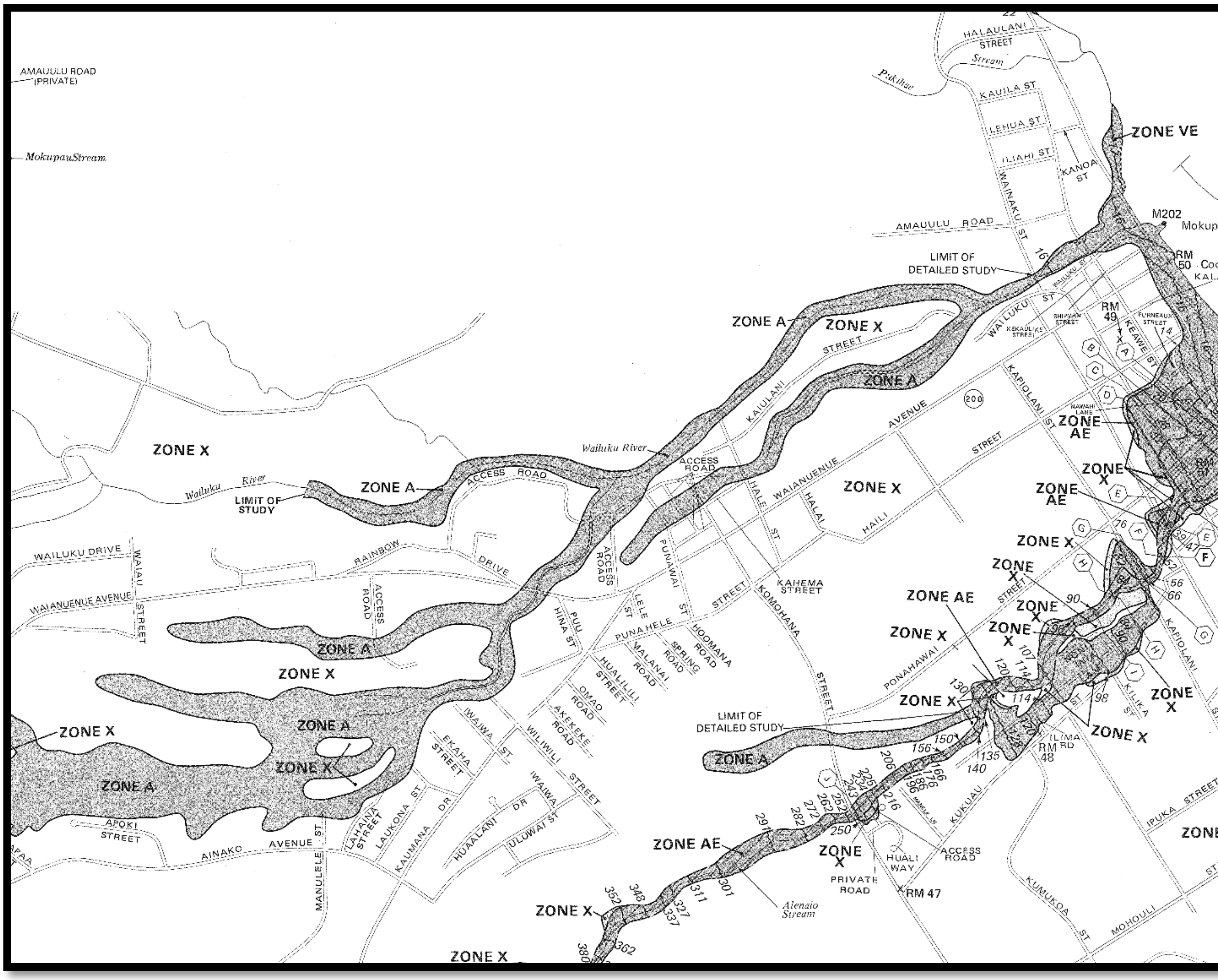
The FEMA FIRM flood zone designations include the following:

- A – Areas of 100-year flood, base flood elevations not determined
- AE – Areas of 100-year flood, base flood elevation determined
- XS – Areas of 500-year flood; areas of 100-year flood with average depths of less than one foot or within the drainage area less that one square mile, and areas protected by levees from 100-year flood
- X – Areas determined to be outside the 500-year floodplain
- D – Areas in which flood hazard is undetermined
- VE – Areas of 100-year coastal flood with velocity (wave action), base flood elevations determined (Coastal High Hazard District)

As shown in **Figure 3-5**, the facilities associated with the Waiau Plant are beyond the limits of the study (FEMA, 1988). However, periodic flooding has been a problem for the Waiau powerhouse. There are two types of floods that occur: (1) river flooding caused by Waiau Stream overtopping its west bank and flooding the powerhouse, and (2) local flooding caused by storm water running down the slope in front of the powerhouse and into the building.

The Puʽuʽeo Plant is located on the border of Zones A and X (see **Figure 3-5**).

Figure 3-5. FEMA Flood Zones



Source: FEMA, 1988

Hurricanes

The Hawaiian Islands are seasonally affected by Pacific hurricanes from June through the November. On average, there are between four and five tropical cyclones observed in the Central Pacific every year. The state has been affected by significant hurricanes over the years. These include Hiki (1950), Nina (1957), Dot (1959), Iwa (1982), Iniki (1992), and Iselle (2014) (HNN, 2016a). In addition to damaging winds and heavy rains, hurricanes cause heavy surf and wave action that can damage beach areas. According to a report presented at the International Union of Conservation of Nature World Conservation Congress, global climate change could mean that Hawaiʻi may experience more frequent and more severe hurricanes in the future (HNN, 2016).

Tsunami

A tsunami involves the generation of a series of destructive ocean waves that can affect all shorelines. These waves can occur at any time with limited or no warning, and are most commonly generated by earthquakes in marine and coastal regions (NOAA, 2017). As shown in **Figure 3-6**, none of the project components are located within the tsunami evacuation zone.

Earthquakes

As a series of islands formed by volcanoes, the Islands of Hawaiʽi are very seismically active. Most of the earthquakes in Hawaiʽi occur on the Big Island and are associated with volcanic activity. However, other earthquakes are caused by the weight of the Hawaiian Islands on the Pacific lithosphere. **Figure 3-7** shows the earthquakes on the Big Island during the month of January 2017.

Volcanic Eruption

As described in **Section 3.3**, the Wailuku River is the approximate boundary between the lava flows from Mauna Kea and those from Mauna Loa. Therefore, the facilities associated with the proposed project are located in two lava zones. As shown in **Figure 3-8**, the Waiau Plant and diversion structure for the Puʽuʽeo Plant are located in Lava Zone 8; the Puʽuʽeo Plant and diversion structure for the Waiau Plant are located in Lava Zone 3.

Lava Zone 8 is the older part of the dormant volcano Mauna Kea. Only a few percent of the land in Lava Zone 8 has been covered by lava in the past 10,000 years. Lava Zone 3 is at a greater distance from recently active vents and/or topography makes it less likely that lava flows will cover these areas. One to five percent of Zone 3 has been covered with lava since 1800, and 15 to 75 percent has been covered within the last 750 years (Wright, et.al., 1992).

Potential Impacts

Construction

Construction at the Waiau Plant would not create conditions that would exacerbate natural hazards. The County of Hawaiʽi Civil Defense directs and coordinates the County's emergency preparedness and response program to ensure prompt and effective action when natural or man-caused disaster threatens or occurs anywhere in the County of Hawaiʽi. Construction personnel would respond to any emergency messages or alerts, as appropriate, to ensure their safety during construction.

Operation

The existing Waiau and Puʽuʽeo powerhouses and associated facilities have been operational for over 100 years without significant damage from natural hazards. These facilities were built to withstand their natural environment, and it is expected that they will continue to do so.

Both facilities are unmanned. The only time personnel visit the facilities is for inspections and/or maintenance. Personnel would respond to any emergency messages or alerts, as appropriate, to ensure their safety during these visits to the facilities.

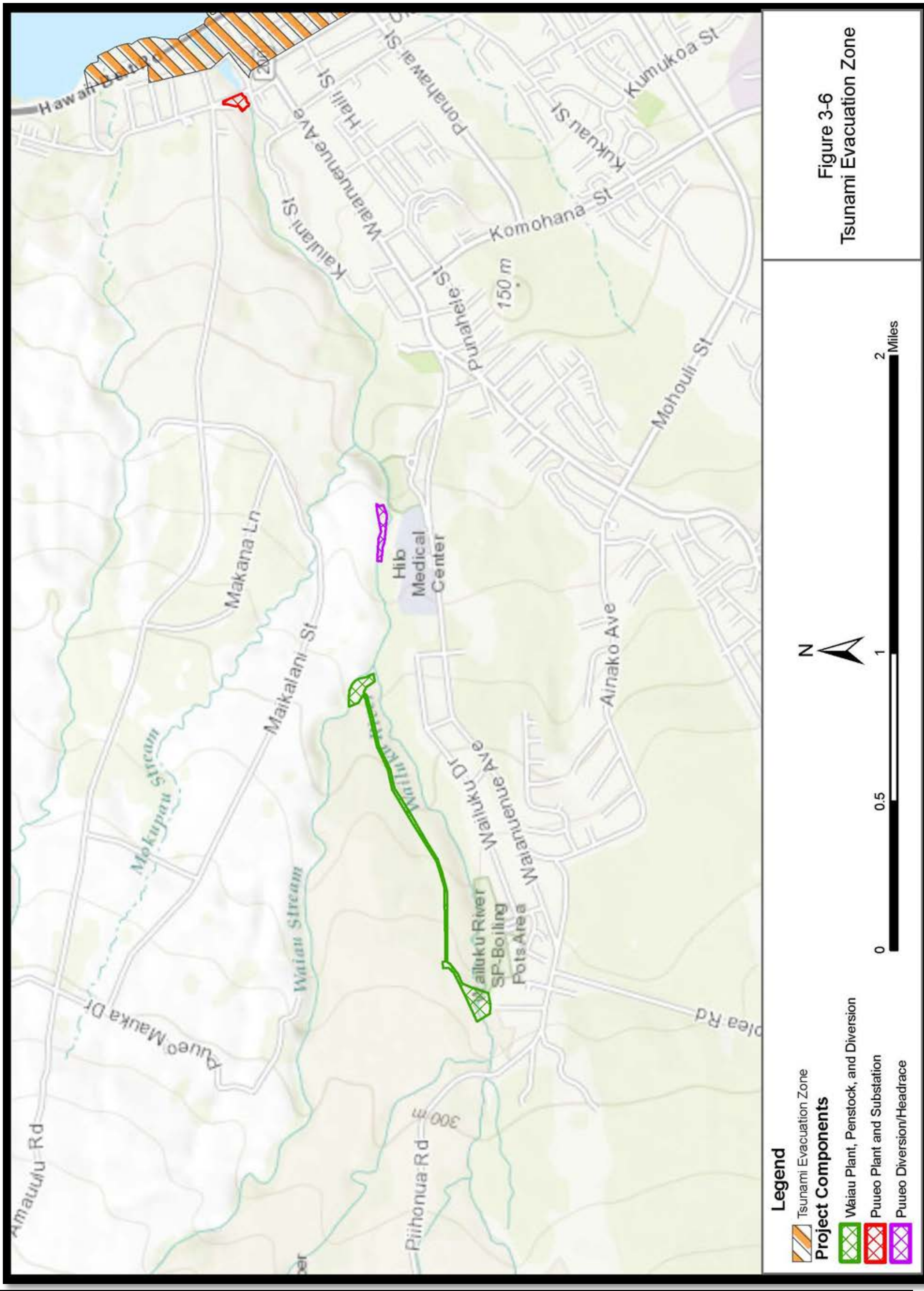
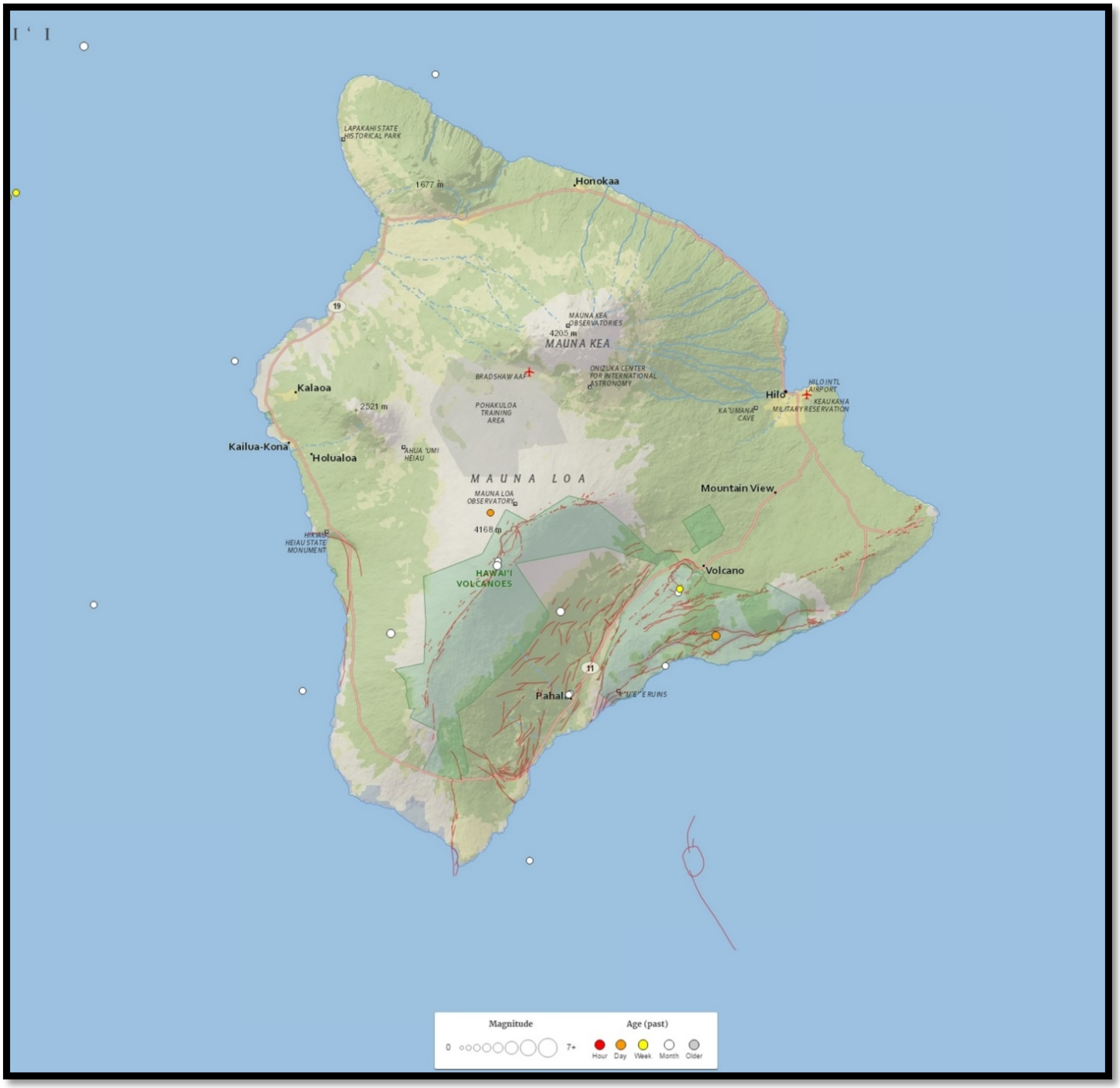


Figure 3-6
Tsunami Evacuation Zone
Legend
Tsunami Evacuation Zone
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2
Miles
Kumukoa St
Kukuau St
Ponahawai St
Haili St
Waianuenue Ave
Kaiulani St
Komohana St
150 m
Punahele St
Mohouli St
Hilo Medical Center
Makana Ln
Maikalani St
Ainako Ave
Wailuku Dr
Waianuenue Ave
Wailuku River SP-Boiling Pots Area
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m

Figure 3-7. Big Island Earthquakes, January 2017



Source: USGS, 2017a

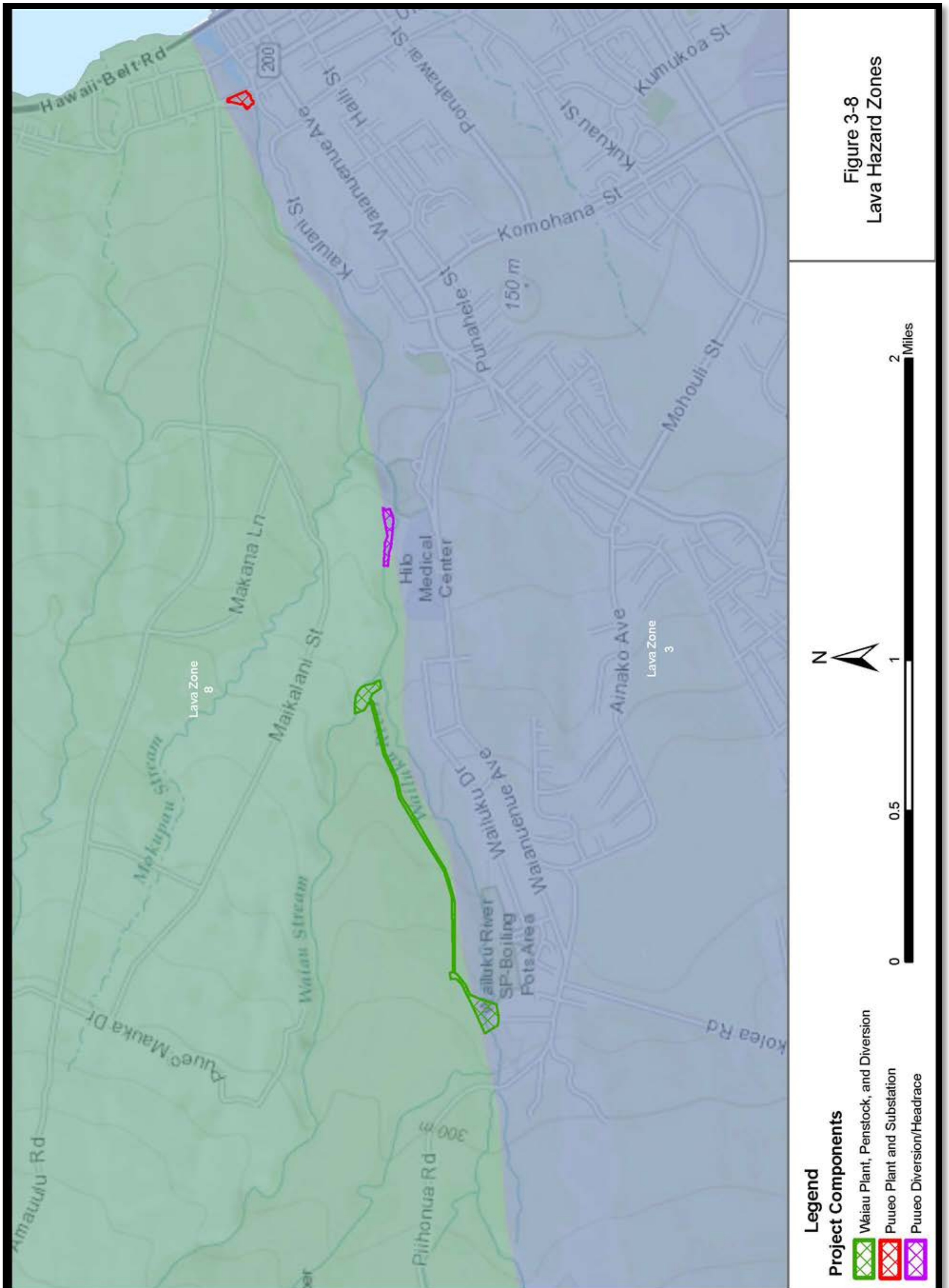


Figure 3-8
Lava Hazard Zones

Minimization and Mitigation Measures

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

3.5 Water Resources

Groundwater

Groundwater in Hawaiʽi occurs in volcanic rock aquifers. In these aquifers, freshwater commonly occurs as a body of water called a freshwater lens that floats on saltwater and is separated from the saltwater by a zone of transition that contains brackish water (Miller, et.al., 1999). As shown in **Figure 3-9**, the Proposed Action is located at the intersection of two aquifer sectors: East Mauna Kea and Northeast Mauna Loa. Aquifer systems that underlie the facilities of the Proposed Action include the Onomea aquifer system (State Code 80204) and the Hilo aquifer system (State Code 80401). Aquifers in the Onomea aquifer system are perched on ash beds and dense lava flows. The Hilo aquifer system consists of a voluminous basal lens that extends at least four miles inland of the coast, beyond which high-level water has been encountered (Mink and Lau, 1993).

Surface Waters

The Proposed Action is located in the Wailuku River watershed (see **Figure 3-10**). The Wailuku River watershed is 252.2 square miles with a maximum elevation of 13,779 feet (DLNR, 2008).

The Waiau Plant is located at the confluence of the Wailuku River and Waiau Stream. The Wailuku River is the longest river in Hawaiʽi (approximately 28 miles long). The river lies mostly along the divide between the Mauna Kea and Mauna Loa lava flows. Its headwaters are at approximately 10,800 feet elevation on Mauna Kea, and it descends steeply from the mountain to Hilo Bay. The Wailuku River is impaired with nitrates and nitrites and is listed on the 2014 303(d) Impaired Waterbody List (USEPA, 2014). Waiau Stream is not listed on the 303(d) Impaired Waterbody List.

The Puʽuʽeo Plant is located on the Wailuku River immediately upstream from where it drains into Hilo Bay. Hilo Bay is listed on the 2014 303(d) Impaired Waterbody List for total nitrogen, nitrates and nitrites, total phosphorus, and turbidity (USEPA, 2014).

Wetlands

There are no wetlands identified on the National Wetland Inventory (NWI) maps (see **Figure 3-11**) in the project area (USFWS, 2016). Streams that are identified on the NWI maps are discussed above.

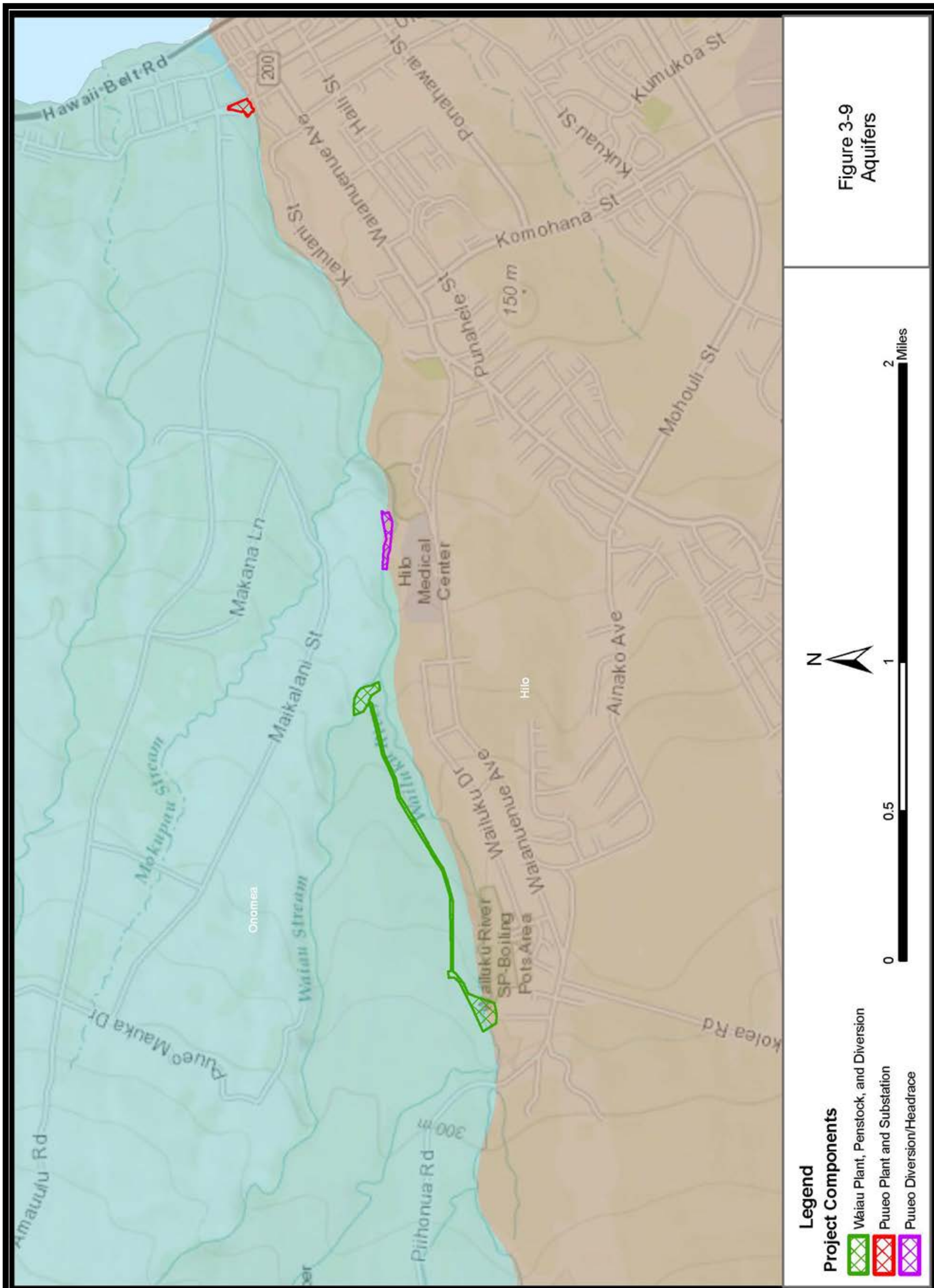


Figure 3-9
Aquifers
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
0
0.5
1
2
Miles
N
Hawaii Belt Rd
Kaiulani St
Waianuenue Ave
Haili St
Ponahawai St
Kukuau St
Kumukoa St
Komohana St
Punahele St
150 m
Mohouli St
Hilo Medical Center
Ainako Ave
Hilo
Makana Ln
Maikalani St
Mokupau Stream
Onomea
Waiau Stream
Wailuku Dr
Waianuenue Ave
Wailuku River SP-Boiling Pots Area
Kolea Rd
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m
200

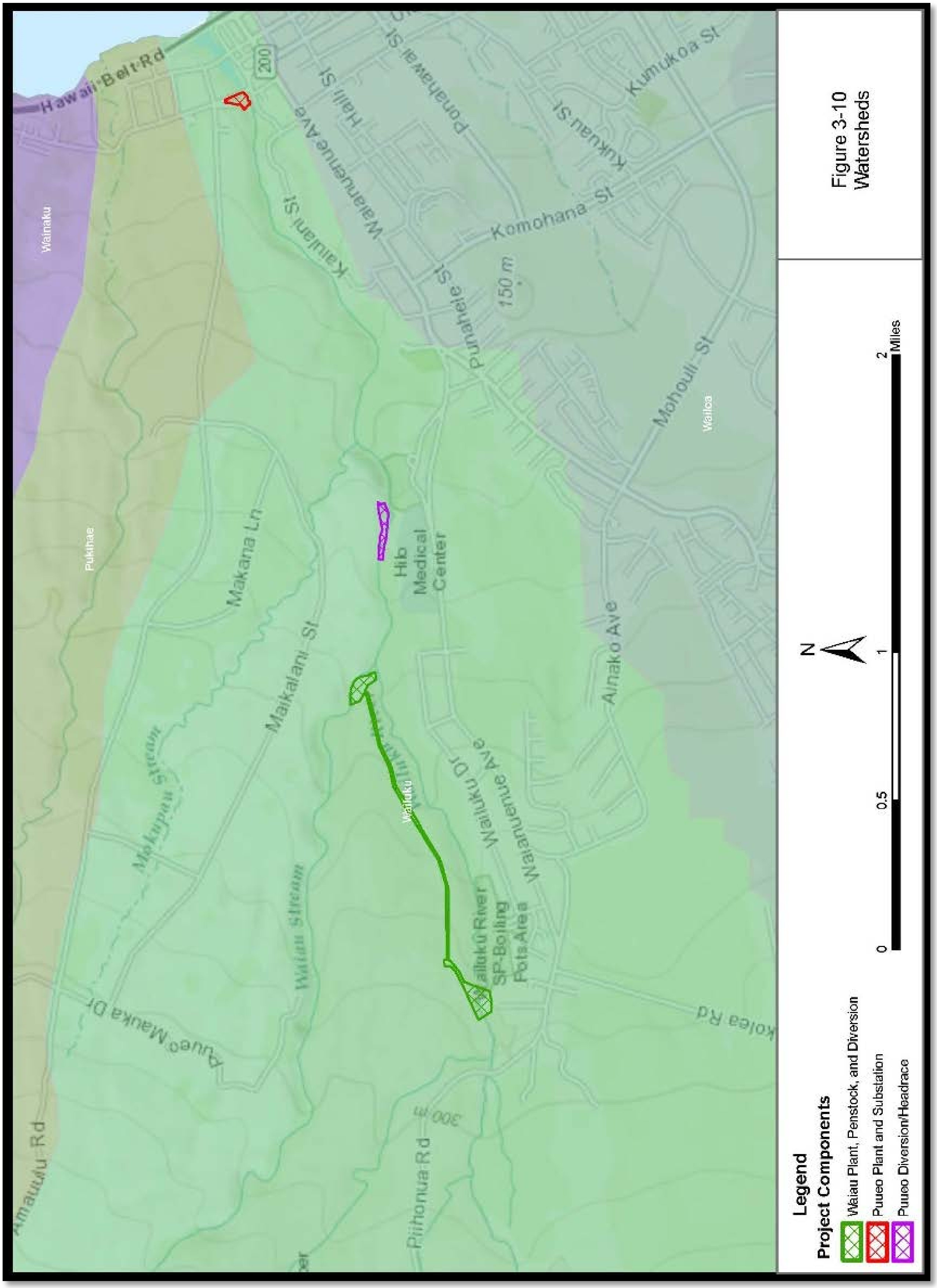


Figure 3-10
Watersheds
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2
Miles
Wainaku
Pukihae
Wailuku
Wailoa
Hawaii Belt Rd
Komohana St
Kukuau St
Kumukoa St
Ponahawai St
Haili St
Waianuenue Ave
Kaiulani St
Punahele St
Mohouli St
Ainako Ave
Makana Ln
Maikalani St
Hilo Medical Center
Wailuku Dr
Wailuku River SP-Boiling Pots Area
Kolea Rd
Piihonua Rd
Amauulu Rd
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
150 m
300 m
200

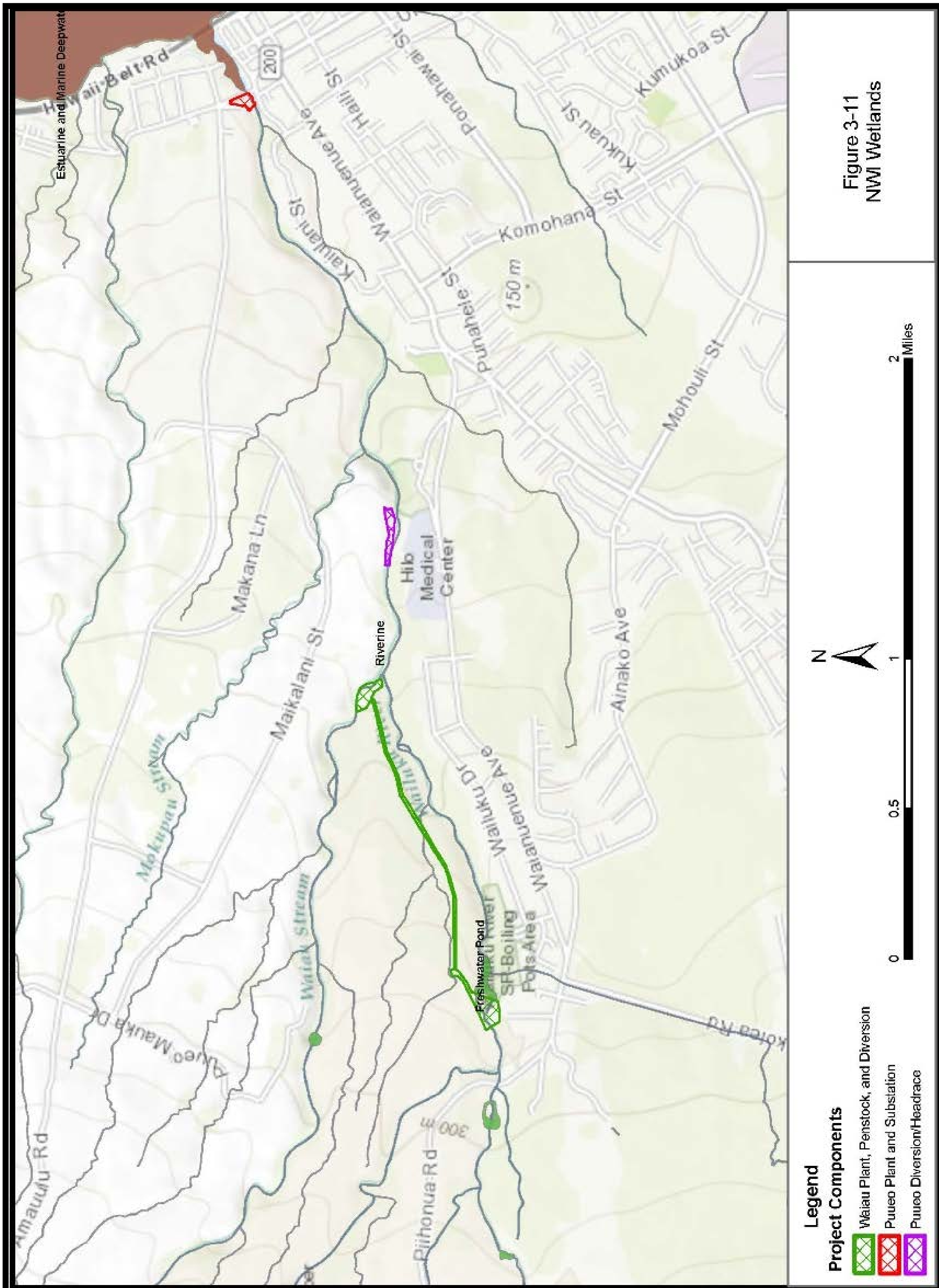


Figure 3-11
NWI Wetlands

Potential Impacts

Construction

Construction plans and specifications would include BMPs to minimize erosion on the project site during and after construction, as well as measures to contain runoff on site during construction. Temporary erosion control measures would be used during construction to prevent soil loss and to minimize surface runoff into adjacent areas and the Wailuku River. Therefore, impacts to water resources during construction would be less than significant.

Operation

The Proposed Action would result in an increase in the diversion of water from the Wailuku River during periods of high flow. However, this is a non-consumptive use and all water is returned to the channel at the Waiau powerhouse. Additionally, river is drawn through the diversion into a level-controlled canal. In other words, the diversion structure is a high flow diversion (i.e., only diverts water when the stream reaches a certain amount of flow), and the low flows always stay in the stream. This ensures that natural river flow past the diversion is maintained. Operation of the hydroelectric facilities would not cause water pollution as no foreign objects or chemicals are introduced to the water during its passage through the penstock or turbine. Additionally, there is no heat removal or addition to the water as it passes through the plant. HELCO has no plans to make any changes to the existing systems that would create a potential for temperature, chemical, or foreign object introduction into the river water and is committed to maintaining that policy for the duration of the project. ~~All other~~ Operation activities associated with the Proposed Action would be the same as current operations; therefore, there would be no impact to water resources from operation of the Proposed Action.

Minimization and Mitigation Measures

HELCO would obtain a NPDES Individual Permit for stormwater discharge associated with construction activities. As part of the permit process, HELCO would prepare a construction site BMP plan that would include an erosion and sediment control plan, a site-specific plan to minimize erosion of 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 and would be inspected and maintained throughout the construction period.

HRS 171-58 requires the lessee and the DLNR to develop, or include a covenant to develop, a watershed management plan. ~~HELCO does not own or control watershed lands on which to implement any watershed management plan.~~ HELCO met with the Forestry Manager for the DLNR-Division of Forestry and Wildlife (DOFAW) and a representative from the Mauna Kea Watershed Alliance (MKWA) on November 1, 2017 to discuss ways in which HELCO can participate in or contribute to watershed management plans.

MKWA brings together major landowners on Mauna Kea around a shared interest to protect the ʻāina by working together to manage threats that occur across common land ownership boundaries, pooling limited resources to achieve conservation goals, and promoting collaboration in protecting vital resources across large landscapes. MKWA consists of landholding partners, including the Department of Land and Natural Resources, the Department of Hawaiian Home Lands, Kamehameha Schools, Hakalau Forest

National Wildlife Refuge and Kuka`iau Ranch, and several affiliate partners. The vision of the MKWA is to protect and enhance watershed ecosystems, biodiversity and resources through responsible management, while promoting economic sustainability and providing recreational, subsistence, educational and research opportunities.

MKWA has developed a draft Mauna Kea Watershed Management Plan that establishes management goals and objectives, and recommends specific actions to implement these goals and objectives, to the benefit of Mauna Kea's unique watershed resources. The area addressed by the Management Plan encompasses over 525,000 acres of land above the 2,000 foot elevation contour on the slopes of Mauna Kea, reaching from Hilo to just south of Waipi`o Valley. Within the Management Plan area there are approximately 85 perennial streams, including the Wailuku River which drains the largest area on the windward side of Mauna Kea and which powers HELCO's Waiau and Pu`u`ea hydropower plants.

MKWA and DOFAW indicated that they would welcome a long-term relationship between MKWA and HELCO and discussed general and specific ways in which HELCO could potentially assist MKWA in meeting its goals and objectives. In comments on the Draft EA, DOFAW has agreed to "work directly with HELCO to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed." DOFAW's comment letter is included in **Appendix A-2**.

3.6 Biological Resources

Flora and Fauna

The natural vegetation in the vicinity of the Waiau Plant and penstock was lowland rain forest dominated by *ʽōhiʽa* and *koa*. These original vegetation communities, however, have been destroyed by farming and sugar cane cultivation. Currently, vegetation in the vicinity is dominated by non-native species, including *Albizia*. The Puʽuʽeo Plant is located in an urban area with very little vegetation.

Wide-ranging terrestrial vertebrates listed as threatened or endangered may be present in the vicinity of the Waiau Plant and penstock and may overfly, roost, nest, or utilize resources here. These include the endangered Hawaiian hawk and the endangered Hawaiian hoary bat. These species are discussed below.

Special Status Species

A query of the USFWS's Information for Planning and Conservation (IPaC) database revealed that there are no federally-listed threatened or endangered species identified in the project area.

Plants

The DLNR-DOFAW Threatened and Endangered Plant Species maps (1992) show that the diversion and a portion of the penstock for the Waiau Plant are in an area with a high concentration of threatened and endangered plant species. The Waiau Plant, substation, portion of the penstock that would be replaced, and the diversion structure for the Puʽuʽeo Plant are located in an area with a medium concentration of threatened and endangered plant species. The Puʽuʽeo Plant is located in an area with little or no threatened and endangered plant species.

Birds

The Hawaiian hawk is endemic to Hawaiʻi but is currently restricted to the Big Island. It breeds in stands of native *ʻōhiʻa* trees, and the nesting season extends from March through September. Although they depend on native forests for nesting, they use a broad range of habitats for foraging, including papaya and macadamia nut orchards and forests dominated by native and introduced vegetation (USFWS, 2012).

Six migratory Birds of Conservation Concern were identified in the IPaC database (USFWS, 2016a). The Birds of Conservation Concern designation is applied to "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973" (USFWS, 2015). These birds are identified in **Table 3-3**.

Mammals

The endangered Hawaiian hoary bat (*Lashiurus cinereus semotus)*, or ʻopeʻapeʻa, as it is known locally, is the only native terrestrial mammal species that is still extant within the Hawaiian islands (USFWS, 1998). Hawaiian hoary bats forage in open, wooded, and linear habitats over a wide range of vegetation types. These mammals are insectivores and are regularly observed foraging over streams, reservoirs, and wetlands (USDA-NRCS, 2009; USFWS, 1998). Hawaiian hoary bats generally roost in trees greater than 16 feet tall with dense canopy foliage or in subcanopy when canopy is sparse, with open access for launching into flight (Gorresen et.al, 2013; USDA-NRCS, 2009).

Aquatic Habitat and Biota

Habitat Assessment

The Hawaiian Stream Habitat Evaluation Procedure (HSHEP) model was utilized to evaluate the quantity and quality of the aquatic habitat in the Wailuku River. The HSHEP model for the Wailuku River was developed using published information for species distributions at the watershed, reach scale, and site scales and combined with local data from habitat and biotic surveys. The final HSHEP model combines the information at the site, stream segment, and watershed scales to predict changes in habitat as a result of diverting water for operation of the hydroelectric plants.

Current instream habitat conditions were excellent in the areas surveyed. There were a range of substrates with very little substrate embedded by fine sediment. Substrates include bedrock substrate, boulder and cobble substrate, gravel and boulder substrate, and sand and small gravel substrate. Rocks are covered with a fine layer of filamentous green algae except in the swiftest cascade areas.

Although the stream habitat conditions in the study area are suitable for native species, there is a lack of diversity and abundance of such species, as described below.

Table 3-3. Migratory Birds of Conservation Concern that Potentially Occur within the Project Area

Common Name	Scientific Name	Species Description
ʽApapane	*Himatione sanguinea*	A small, crimson, primarily nectarivorous Hawaiian honeycreeper. A year-round resident, they occur in native forests above 4,100 feet in elevation on the island of Hawaiʽi.[1]
Bar-tailed godwit	*Limosa lapponica*	A large shorebird that breeds in Alaska and migrates along the Pacific Coast and through the Hawaiian Islands. During migration, they occur along coasts, especially around estuaries and along sheltered shorelines.[2]
Christmas shearwater	*Puffinus nativitatis*	Medium-sized, nocturnal birds that breed in low numbers on small islands throughout the central Pacific. They arrive at breeding grounds in late February and depart after their chicks fledge by November.[3]
Hawaiʽi ʽelepaio	*Chasiempis sandwichensis*	Small, adaptable monarch flycatcher endemic to the island of Hawaiʽi. They occur in most forested areas above 2,000 feet in elevation.[4]
Tahiti petrel	*Pseudobulweria rostrate*	Seabird that breeds on islands in the tropical South Pacific. Has been sighted in southeastern Hawaiian waters.[5]
Tristram's storm petrel	*Oceanodroma tristrami*	Medium-sized storm-petrel that breeds on the Northwestern Hawaiian Islands. Outside of the breeding season, they range across the subtropical central and western Pacific Ocean.[6]

Sources: USFWS, 2016a
[1] DLNR, 2005a
[2] Mitch Waite Group, 2016
[3] USFWS, 2016c
[4] DLNR, 2005b
[5] Spear, et.al., 1999
[6] USFWS, 2016d

Aquatic Surveys

Aquatic surveys using the High Definition Fish Survey (HDFS) approach were completed in January 2017. HDFS uses pole-mounted, high definition, underwater video cameras to capture images of fish or other aquatic animals at a specific location. The underwater cameras are geo-referenced so that specific time and place information is recorded in conjunction with all video observations. Surveys were conducted in two areas of the Wailuku River: (1) upstream of the waterfall above Piʻihonau Bridge, and (2) downstream near the low-water bridge crossing at the Waiau diversion structure.

The first survey site, upstream of the Piʻihonau Bridge, was characterized by a large cascade down the center left of the river prior to flowing over the waterfall and smaller riffles in pools on the right-hand side. The survey area encompassed approximately 98 square meters (m^2) in a total of 52 sample locations. Green swordtails (*Xiphophorus hellerii)* were the most common species observed. Three native shrimp, ʻŌpae kalaʻole (*Atyoida bisulcata)*, were observed clinging to bedrock near swift flows. Instream habitat appeared good throughout the survey area, but stream animals were present at low densities (PAEC, 2017).

The second survey site located immediately upstream of the Waiau diversion structure was characterized by a cascade on the right side of the river and pools and runs on the left side. The survey area encompassed approximately 253 m^2 in a total of 116 sample locations. Green swordtails were the most observed species. In general, densities of most species were at least double that of the first site; however, the native shrimp ʻŌpae kalaʻole was not observed.

Table 3-4 identifies all species observed, habitat, and number observed for both sites.

Table 3-4. Aquatic Species Observed during High Definition Fish Survey

Site	Habitat Type	# Sampled	Area Sampled	Number Observed						
				White Cloud Mountain Minnow	Green Swordtail	Guppy	Dojo	Crayfish	Atyid Shrimp	Bullfrog Tadpole
1	Pool	15	39	2	10	1	0	0	0	0
1	Run	22	35.6	1	4	0	0	0	3	0
1	Riffle	8	6.9	0	0	0	0	0	0	0
1	Cascade	7	16.2	0	0	0	0	0	0	0
2	Pool	54	129.8	13	101	58	4	3	0	2
2	Run	32	75.6	3	32	7	0	2	0	0
2	Riffle	12	22.8	0	0	0	0	0	0	0
2	Cascade	18	24.7	0	1	0	0	0	0	0

Source: PAEC, 2017

Although there was appropriate habitat for native stream gobies at both sites, none were observed during the surveys. It is believed that the primary lack of native species in the study area is their inability to migrate upstream past Rainbow Falls. Rainbow Falls is a natural feature on the Wailuku River and stream segments above the falls are unlikely to have substantial populations of native species.

The complete survey report, *An Assessment of the Environmental Impact of the HELCO Wailuku Hydroelectric Plants on Native Stream Animals with Respect to Instream Habitat, Barriers to Migration, and Entrainment using the GIS Model-based Hawaiian Stream Habitat Evaluation Procedure* is included as **Appendix B** to this EA.

Potential Impacts

Construction

Construction activities at the Waiau Plant would have short-term impacts on biological resources. The noise and concentrated human activity in the normally undisturbed area along the Wailuku River would temporarily disrupt the habitat for the various species of birds and mammals that are known to exist in the area. Wildlife is expected to retreat from the area while construction is taking place but return after the project is in operation. Construction would also result in the removal of vegetation over the 300 feet of penstock to be replaced. The approximately 50 feet of penstock closest to the powerhouse in is a landscaped area. Vegetation in the area of the remaining 250 feet of penstock to be replaced is mostly non-native species. Therefore, it is expected that construction at the Waiau Plant would have less than significant impacts on terrestrial flora and fauna.

Impacts to the endangered Hawaiian hoary bat could occur due to vegetation removal, which may occur as part of the penstock replacement and/or substation expansion. During clearing, grubbing, or tree trimming/cutting, the removal of tall, woody vegetation can temporarily displace bats using the vegetation for roosting. As bats use multiple roosts within their home territories, this disturbance from the removal of vegetation is likely to be minimal. However, during the pupping season from about June 1st to September 15th each year, female bats carrying pups may be less able to rapidly vacate a roost site when the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage, and very small pups may be unable to flee a tree that is being felled. Impacts to the endangered Hawaiian hoary bat would be minimized to the extent practicable, as described below in **Minimization and Mitigation Measures**.

Impacts to the endangered Hawaiian hawk could occur due to vegetation removal, which may occur as part of the penstock replacement and/or substation expansion. Hawaiian hawks only breed on the Island of Hawaiʻi, and they next from March through September. Impacts to the endangered Hawaiian hawk would be minimized to the extent practicable, as described below in **Minimization and Mitigation Measures**.

Impacts to seabirds could occur from the use of nighttime lighting during construction and/or operation. Artificial lighting can adversely impact seabirds that may pass through the area at night causing disorientation which could result in collision with manmade objects or grounding of birds. Impacts to seabirds would be minimized to the extent practicable, as described below in **Minimization and Mitigation Measures**.

Aquatic species may be impacted by increased turbidity and sedimentation from the replacement of the penstock. Construction plans and specifications would include BMPs to minimize erosion on the project site during and after construction, as well as measures to contain runoff on site during construction. Temporary erosion control measures would be used during construction to prevent soil loss and to minimize surface runoff into adjacent areas and the Wailuku River. Therefore, impacts to aquatic species during construction would be less than significant.

Operation

The Waiau and Puʻuʻeo Plants have been in operation for over 100 years. Therefore, there would be no change from current conditions to terrestrial biological resources during operation of these plants. Under current operations, both diversion structures have a "trash rack" grate that allows water to flow through but keeps anything larger than just under two inches out of the penstock. Although it is possible that smaller flora and fauna may go through the grate, there has been no evidence of such an event. The canal leading to the penstock has spillway notches that allow excess water and any flora/fauna species to be spilled back to the river during high flows. During low flows, the water velocity in the area of the canal leading to the penstock entrance is low. Crayfish and guppies have been observed in the canal at the penstock entrance, but they were not getting sucked into the penstock.

Operations of the repowered Waiau Plant would divert more water from the Wailuku River during periods of high flow than current operations. While stream diversion in other Hawaiian streams can result in a dewatered stream bed, the conditions within the Wailuku River near the Waiau Plant are relatively unique. The Wailuku River is a large river by Hawaiian standards with extensive deep pools, runs, and cascades. With consistent flows in the river, the presence of large deep pools provide stream animals a refuge even during times of drought. The diversion structure for the Waiau Plant will utilize level controls that automatically maintain a minimum water level within the canal to ensure natural river flow past the diversion is maintained. Additionally, the diversion structures for the Waiau and Puʻuʻeo Plants are upstream of Rainbow Falls where there is little diversity or abundance of native biota. Therefore, the increased intake of water for the Waiau Plant repowering would have less than significant impacts on aquatic habitat or biota, and there would be no change of impacts associated with the Puʻuʻeo diversion structure.

Minimization and Mitigation Measures

To minimize impacts to the endangered Hawaiian hoary bat, no trees taller than 15 feet would be trimmed or removed between June 1st and September 15th when juvenile Hawaiian hoary bats that are not capable of flying may be roosting in the trees. In addition, the Proposed Action would not include the use of barbed wire.

To minimize impacts to the endangered Hawaiian hawk, all trees to be cut would be inspected to ensure that no Hawaiian hawk nests are present.

To minimize impact to seabirds that may pass through the area at night, all nighttime lighting, if required during construction and/or operation, would be fully shielded.

HELCO would obtain a NPDES Individual Permit for stormwater discharge associated with construction activities. As part of the permit process, HELCO would prepare a construction site BMP plan that would include an erosion and sediment control plan, a site-specific plan to minimize erosion of 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 and would be inspected and maintained throughout the construction period.

3.7 Cultural Resources

Cultural Practices and Traditional Uses

The *Cultural Impact Assessment for the Renewal of Hawai`i Electric Light's Wailuku River Water Lease* (CIA) (ASM Affiliates, 2017) identifies several cultural resources that are significant (see **Appendix C**). The assessment included research and a collection of legendary and historical references to the Puʻuʻeo and Piʻihonua Ahupuaʻa, the Wailuku River, and the greater Hilo District. The assessment also contained consultations with community members with genealogical ties and/or long-standing residency relationships to the area as a whole.

The following cultural practices were identified within the Pu`u`eo and Pi`ihonua Ahupua`a and the vicinity of the project area:

- Cultivation of Plant Resources – The Wailuku River was an important source of food and fiber. Hawaiians planted and cultivated native *`ahiu* (wild) cultigens like *kalo*, *mai`a*, and *olona* located in flats along the embankments of the Wailuku River. Pu`u`eo also means "hill" (pu`u) "full of food" (`eo) referring to the bounty of agricultural resources produced on its fertile slopes (Pukui and Elbert 1986:42, 358).
- Marine Resource Gathering – Hilo Bay is noted as having an abundance of marine resources and was a valuable resource to Native Hawaiians who are considered traditionally as expert fishermen. Hilo Bay, along with extensive spring-fed fishponds and waterfowl and wetland and dryland agricultural resources in the area, sustained the population of the *moku* of Hilo during pre- and post-contact years.
- Fresh Water Resource – The Wailuku River is classified as a perennial stream and is the main feature of the Wailuku River watershed. The sheer scale of the Wailuku River and the abundance of fresh water it brings down from the upper elevations impacts the communities within North and South Hilo Districts. It is a vital source of *wai,* or fresh water, which is not only necessary for survival but also carries cultural significance for the Hawaiian people. The concept of *kānāwai* (law, rule, ordinance, to learn from experience) is said to originate from the customary practice of sharing water between neighbors especially to nourish crops for traditional irrigated fields that were built along the water system. It was a customary practice for Hawaiian farmers to take only what water they needed, and to ensure those located below them had access to an ample and clean supply of water. *Wai* was not only valued for its life-giving properties, but also its purifying properties. The continuous mauka to makai flow of fresh water provided fresh drinking water, supplied water to irrigated fields and fishponds, recharged ground water supplies, and sustained productive estuaries and fisheries by transporting nutrients from the uplands to the sea (Sproat 2009). Because a flowing river was considered a vital artery for both the land and man, great care was paid to maintaining clean rivers. To that end, domestic duties involving the use of water were dispersed along the length of the river. For instance, "there was a place for bathing *(ʻauʻau)* low down in the stream; a place up farther along the stream for washing utensils or soaking calabashes; still farther up were dams for *ʻauwai* (irrigation ditch); and above the dams was the place where drinking water was taken" (Handy et al 1983:61). Because of the high degree of dependency on fresh water to furnish and satisfy life's needs, fresh water was a public trust resource that was considered inalienable.
- Fresh Water Fishing – Review of historical sources revealed very little regarding traditional fishing practices or historic fishing in the Wailuku River. However, today one might find people perched

on the riverbank pole fishing makai of the current study area within the mouth of the Wailuku River. Thus, it is likely that people similarly fished along the river in earlier times. The only direct reference to the Wailuku River in an account on fishing was found in a December 1887 article titled “The Fish Question” in the *Planters’ Monthly* (1887:542-543). This article described the attempt of fresh water fish raising in Wailuku River. The article mentioned residents coming together to stock trout eggs on a regular plan in Hilo, hatch, and distribute the fish in Wailuku and Wainaku streams in order to conduct sport fishing of trout.

- Sacred River – The Wailuku River is of particular cultural and spiritual importance to the Hawaiian people, and is well documented in *mo`olelo* (stories, tales, and myths) passed through generations. The river is associated with many legendary places along the length of the river such as Waiānuenue (Rainbow Falls), Peʻepeʻe (Boiling Pots), and its connection to various significant persons in the Hawaiian culture.

A review of the culture-historical background material and as expressed by all consulted parties in the CIA notes that the Wailuku River as a whole should be considered a traditional cultural property, as defined by the National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service, as it is associated with traditional *mo`olelo* linked with various Hawaiian *akua* (deities), *kupua* (cultural heroes), and *mo`o* (guardians of fresh water sources). The Wailuku is arguably one of the most storied rivers on Hawai`i Island and these *mo`olelo* are the contributing element that makes Wailuku a culturally significant place.

Archaeological and Historic Resources

The Waiau Plant and penstock are located in an area that has been previously disturbed by the construction of the facility. During a site visit with SHPD on March 3, 2017, SHPD concurred that no archaeological studies would be required for the Proposed Action.

Potential Impacts

Construction

The long-term water lease would not require any construction activities; therefore, would not be any impacts to cultural and traditional uses.

Repowering of the generators and replacement of a 300-ft section of the Waiau Plant penstock are the only items that are in need of short-term construction. This construction would not disturb archaeological or historic sites, sacred sites, or traditional cultural uses as all work would be at the existing powerhouse and the new penstock would be installed in the same location. There would be no work conducted along the river embankments; therefore, there impacts to wild cultigens such as kalo, maiʻa, and olana are not expected.

Under the No-Action Alternative, no construction activities would occur; therefore, there would be no impact to cultural practices.

Operation

HELCO is currently diverting and using water from the Wailuku River to power its Waiau and Puʻuʻeo hydroelectric plants under an existing Revocable Permit No. S-7463. Under a proposed long-term water lease, continued use of the Waiau and Puʿuʿeo power plants would be in operation for the next 65 years. Operations of the repowered Waiau Plant would be able to take on more water during high flows. No modifications to the diversion works are required as part of the Proposed Action; rather, the Waiau diversion will be able to divert water up to its current capacity for the repowered Waiau Plant. If stream flows are low, the diversion would not divert water. Therefore, the proposed project is not anticipated to have any impacts toward marine resource gathering and fresh water fishing. Therefore, no significant cultural impacts would occur.

Minimization and Mitigation Measures

In fulfilling their mission to empower our customers and communities with affordable, reliable, clean energy, the Hawaiian Electric Companies are also committed to being good stewards of the environment, and take this responsibility very seriously.

Hawaiian Electric Companies, including HELCO, have been long-time supporters of The Nature Conservancy and have also supported many nonprofit community and environmental-related organizations on Hawaiʻi Island through corporate contributions and employee volunteer projects.

HELCO will continue to support environment and non-profit community organizations as part of standard practice and to be good stewards to the environment and community. HELCO also commits to working with local farmers to relocate any wild cultigens should they be encountered during construction or operation of the Proposed Action.

3.8 Socioeconomics

Population and Demographics

A Socioeconomic Impact Assessment Report was prepared for the Proposed Action. This document is included with this Draft EA as **Appendix D**. The following summarizes the findings of that report.

In 2015, there were 196,428 residents living in the County of Hawaiʻi. The *de facto* population (i.e., all persons, including residents and visitors) present in the County at a given point in time, was approximately 220,342. Hawaiʻi County's current resident population lives in approximately 64,200 households, with an average household size of 3.01 persons. The number of households has increased by more than 22 percent over the past decade. Overall, the County of Hawaiʻi is forecast to continue increasing its population and households through 2026.

The County of Hawaiʻi's current labor force includes 90,595 persons age 16 or older. An estimated 90.4 percent of the labor force was employed (81,575 workers).The labor force has grown at an average annual rate of 1.7 percent over the previous decade. In 2016, there were an estimated 103,000 jobs in Hawaiʻi County. The average annual growth rate for jobs ranged from 1.6 to 1.9 percent since 1990, and was expected to remain at that level for the next several decades.

The population of Hilo has not changed much in the past 15+ years and actually decreased between 2010 and 2015. The local growth was 3,202 persons, approximately 213 persons per year over the 15 year period from 2000 to 2015. There is a forecasted 7.3% increase over the next three years to 2020 with an additional forecasted increase of 9.7% by 2025 bringing the Hilo city population up to around 50,000 persons. Hilo's recorded growth was 1,154 additional homes, approximately 77 per year over the 15 year period from 2000 to 2015. There is an additional 967 households forecasted for 2020 and 1,811 households by 2025. To accommodate the projected forecasted increases there will need to be an additional 1,500 to 2,000 homes/residences built in Hilo over the next 8 years. This translates to ~250 additional homes being built annually on average at a rate that is over three times the previous fifteen-year average.

The Puʻuʻeo Ahupuaʻa neighborhood in Hilo is relevant to this project is several ways. Not only are both the Waiau and Puʻuʻeo Plants and the proposed project sites located within its boundaries, but the natural waterways and the pipelines that feed the facilities are as well. The Puʻuʻeo Ahupuaʻa neighborhood has a total area of 4.759 square miles and a population of 14,388. It has a population density of 3,023 people per square mile compared to Hilo as a whole with a population density of 836 people per square mile. It is the area of Hilo that will experience the most direct impacts from the physical construction processes over the envisioned eight-month timeframe of the project.

Potential Impacts

Construction

Construction at the Waiau Plant and replacement of the penstock would not increase the population of the area. Direct construction jobs would result in overall short-term positive economic activity by stimulating indirect and induced employment within other industries on the island. Direct construction jobs for the project is estimated to require 10 to 15 construction workers during peak construction phases during an estimated 9 month period. This translates to approximately 7.5% of the cumulative projected earnings generated by the project for Hawaiʻi County going toward direct jobs for the construction of the project with remaining 92.5% of the direct, indirect, and induced earnings going to jobs not involved with the physical construction processes. The estimated construction cost of the project is $6.2 million. In total, the project would produce 77 jobs over two years, with an estimated earnings impact of $4.2 million, and an increase in state tax revenue of $700,000 and Hawai'i County taxes of $21,000.

Operation

The projected increase in the population and households will continue to drive the need for more electricity in homes as well as businesses throughout the County. The continued operation of HELCO's Wailuku River hydroelectric plants will enable the contribution to the electrical grid to continue. The repowering of the Waiau Plant is expected to produce about 10,000 MWH/year and this potential energy production would service 1,700 500 KWH/month/residential-customers (2%) of HELCO's 85,029 overall customers. It will benefit the community and 100% of HELCO customers as part of the HELCO grid in reducing the cost of energy production while increasing Hawaii County's renewable energy percentage toward achieving the Hawaii Clean Energy Initiative 2045 goals.

The No-Action Alternative would have no impact on area demographics or economic conditions. Given the age and condition of the Waiau Plant and penstock, a "run to failure" option is a risk to human life, subsidence or erosion of adjacent land, and may cause a long outage at the Waiau Plant that would have associated costs of generating replacement energy.

Minimization and Mitigation Measures

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

3.9 Public Facilities and Services

Parks and Recreational Areas

Wailuku River State Park is located along the Wailuku River between the Waiau and Puʽuʽeo Plants. There are two separate park areas that offer scenic viewpoints: Boiling Pots and Rainbow Falls. Both park sections are accessed via Waiānuenue Avenue. Activities at Wailuku River State Park are generally limited to sightseeing, although both park areas include basic facilities, such as restrooms, water fountains, and trash cans.

There are no other parks or recreation areas within the project vicinity.

Solid Waste Disposal

The County currently maintains two landfill sites: the South Hilo Sanitary Landfill and the West Hawaiʽi Sanitary Landfill. There are 21 solid waste transfer sites throughout the island.

Emergency Services

Fire, police, and emergency medical services (EMS) are provided by the County of Hawaiʽi.

Police

Hawaiʽi County has eight districts with one main police station per district. There are also four substations across the island. The project site is located in the South Hilo District, which is serviced by the Hilo Station of the Hawaiʽi Police Department. The Hilo Station is located at 349 Kapiʽolani Street in Hilo approximately 3.25 miles east-southeast of the Waiau Plant.

Fire

There are currently 20 regular fire stations, 22 volunteer fire stations, and 1 federal fire station located on the Island of Hawaiʽi. The regular fire stations provide 24 hour firefighting and emergency medical services. Fire protection for the project area is provided by the Central Fire Station of the Hawaiʽi Fire Department. The Hilo Station is located at 466 Kinoʽole Street in Hilo approximately 3.0 miles east of the Waiau Plant. The Central Station contains one Fire Engine, one Medical Unit, one Tanker, and the Assistant Fire Chief.

Medical

The Waiau Plant is located on the north side of the Wailuku River in a rural area. The nearest medical facility, the Hilo Medical Center, is across the river at 1190 Waianuenue Avenue. The County has contracted with the DOH for emergency ambulance services. All fire department personnel who provide basic and advanced life support services are licensed or certified.

Potential Impacts

Parks and Recreation Areas

All construction associated with the Proposed Action would occur at the Waiau Plant, which is not visible from the Boiling Pots or Rainbow Falls lookouts. Therefore, there would be no impact to parks and recreation areas from construction of the Proposed Action.

Although the Proposed Action would result in an increase in the diversion of water from the Wailuku River during periods of high flow for operation of the Waiau Hydroelectric Plant, the diversion is a non-consumptive use and all water is returned to the channel at the Waiau Plant upstream of Boiling Pots and Rainbow Falls. The diversion structure for the Puʻuʻeo Hydroelectric Plant is located upstream of Rainbow Falls; however, there would not be an increase in the amount of water diverted. Additionally, water from the river is drawn through the diversion into a level-controlled canal where the level control maintains a minimum water level within the canal to ensure natural river flow past the diversion is maintained. Therefore, there would be no impact to parks and recreation areas from operation of the Proposed Action.

Under the No-Action Alternative, there would be no construction and the current operations at the Waiau and Puʻuʻeo Plants would continue. Therefore, there would be no impacts to park and recreation facilities associated with the No-Action Alternative.

Solid Waste Disposal

Construction debris would be disposed of at the Hilo Sanitary Landfill, which has a special section for large metal waste. Construction debris would include the generator that is replaced, 300 feet of penstock, the existing substation components, and the existing circuit breakers in the powerhouse. The transformers at the substation have been replaced within the last 10 years; therefore, there would be no PCBs associated with the transformers. The circuit breakers in the powerhouse are 90+ years old and it is unknown if they contain PCBs or other hazardous materials. The circuit breakers would be tested to make a hazardous waste determination in accordance with HAR, Section 11-262-11.

Emergency Services

Due to the remote location of construction associated with the Proposed Action, there would be no impact to emergency vehicle access during construction. It is not anticipated that construction activities would result in an increase in calls for fire, police or medical services. However, if an incident were to occur during construction that required fire, police, or medical attention, it is anticipated that the level of demand could be met by the existing fire, police, and emergency medical services force.

The County of Hawaiʻi Police Department has stated that they do not anticipate any significant impact to traffic or public safety from the Proposed Action. The Waiau and Puʻuʻeo Plants are remotely load controlled and monitored from HELCO's Kanoelehua Operations Control Center; therefore, the Proposed Action would not result in an increase in calls for fire, police, or medical services.

Under the No-Action Alternative, there would be no construction and no change to existing operations; therefore, there would be no impacts on emergency services.

Minimization and Mitigation Measures

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

3.10 Transportation and Traffic

Existing Transportation System

Access to the Waiau Plant, including the diversion and intake, is from Maikalani Street through a locked gate that does not allow public access. A short road leads from the gate past an existing lay-down area where the step-up transformers are located at a turnaround area before the powerhouse. There is no vehicle access to the door of the powerhouse. The last 100 feet between the end of the road and the powerhouse is a steep 25% grade that is covered with grass with a set of concrete steps on the left side.

The Puʽuʽeo Plant's diversion and intake is accessible via gravel roads through agricultural fields on the north side of the Wailuku River. The Puʽuʽeo Plant powerhouse is accessed by Wainaku Avenue.

Potential Impacts

Construction

There would be a temporary increase of traffic on local streets as construction materials are brought to the staging area and project site, as well as during the transport of construction debris. There would also be a slight increase in traffic as construction workers travel to and from the project site. These impacts would be temporary and are expected to be minimal.

Under the No-Action Alternative, no construction activities would occur and there would be no impacts to the existing transportation system.

Operation

The Waiau and Puʽuʽeo Plants are unstaffed. Therefore, upon completion of construction, traffic in the vicinity of the project would go back to pre-existing conditions.

The No-Action Alternative would continue the existing operations at the Waiau and Puʽuʽeo plants. There would be no impact to the existing transportation system.

Minimization and Mitigation Measures

The contractor would be required to keep all construction vehicles in proper operating condition and ensure that material loads are properly secured to prevent dust, debris, leakage, or other adverse conditions from affecting public roadways.

The contractor would be required to obtain a permit from the State Department of Transportation to transport oversized and/or overweight materials and equipment on State highways.

All construction materials and equipment would be transferred to and from the project staging area and project site during off-peak traffic hours (8:30 a.m. to 3:30 p.m.) to minimize potential disruption to traffic on the local streets.

3.11 Visual Resources

Existing Scenic and Visual Environment

The Waiau and Puʻuʻeo Hydropower Plants are located on the Wailuku River. The Waiau Plant is located immediately upstream of two scenic points: Boiling Pots and Rainbow Falls. The powerhouse, however, is not visible from either of these areas.

Potential Impacts

Construction

All construction would occur at the Waiau Plant, which is not visible from public areas. Therefore, there would be no impact to visual resources.

Operation

The existing Waiau and Puʻuʻeo powerhouses have been in existence for nearly a century and are a part of the historical landscape. The Proposed Action would allow for continued operations at these facilities. ~~the existing Waiau and Puʻuʻeo plants~~. Flows in the river would remain continuous and uninterrupted since the stream diversion structure does not divert low flows. After powering the turbines, the water is returned to the river. Therefore, the natural character of the river is maintained. There would be no impact to visual resources associated with the continued operation of the existing powerhouses or the continued diversion of water.

The No-Action Alternative would continue the existing operations at the Waiau and Puʻuʻeo plants. There would be no impact to visual resources.

Minimization and Mitigation Measures

There would be no impact to the existing and scenic environment. Therefore, no minimization or mitigation measures are proposed or warranted.

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 involves the repowering of an existing facility and the extension of an existing non-consumptive water lease. There would be no impacts from continued operation of the facility. All potential impacts from repowering the Waiau Plant would be short-term and temporary during construction. Therefore, the Proposed Action would not have cumulative impacts.

3.13 Irretrievable and Irreversible Commitment of Resources

The Proposed Action includes a long-term water lease for a non-consumptive use of water from the Wailuku River. Since the use would be non-consumptive, there is not an irretrievable and irreversible commitment of the water resource. Implementation of the Proposed Action would not result in the irretrievable and irreversible commitment of resources other than the financial resources, fuel, and other consumable materials required for construction.

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CHAPTER 4: RELATIONSHIP TO STATE AND COUNTY LAND USE PLANS AND POLICIES

4.1 State Planning Documents

The Hawaiʽi State Plan

The Hawaiʽi State Plan, HRS Chapter 226, provides goals, objectives, policies, and priorities for the State. The Hawaiʽi 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 226-11. *Objectives and policies for the physical environment – land-based, shoreline, and marine resources.*

- *(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:*
  - *(1) Prudent use of Hawaiʽi's land-based, shoreline, and marine resources.*
  - *(2) Effective protection of Hawaiʽi'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 Hawaiʽi's natural resources.*
  - *(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.*
  - *(3) Take into account the physical attributes of areas when planning and designing activities and facilities.*
  - *(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.*
  - *(5) Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.*
  - *(8) Pursue compatible relationships among activities, facilities, and natural resources.*

Discussion: The Proposed Action is located on the Wailuku River and would include an increase in the amount of water diverted for the Waiau Plant during periods of high flow. However, this is a non-consumptive use, no additives are use, and all water is returned to the channel at the Waiau powerhouse. Additionally, river water is drawn through the diversion into a level-controlled canal. Level control maintains a minimum water level within the canal to ensure natural river flow past the diversion is maintained. Therefore, the Proposed Action is consistent with the objectives and policies for land-based, shoreline, and marine resources.

Section 226-12. *Objectives and policies for the physical environment – scenic, natural beauty, and historic resources.*

(a) *Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai'i's scenic assets, natural beauty, and multi-cultural/historical resources.*
(b) *To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to:*
    (1) *Promote the preservation and restoration of significant natural and historic resources.*
    (4) *Protect those special areas, structures, and elements that are an integral and functional part of Hawai'i's ethnic and cultural heritage.*

Discussion: The Proposed Action would allow for the continued use of two existing hydropower plants. Neither of these plants are visible from any scenic area. Additionally, neither of the plants are considered an integral and functional part of Hawai'i's ethnic and cultural heritage. Therefore, the Proposed Action is consistent with the objectives and policies for scenic, natural beauty, and historic resources.

Section 226-18. *Objectives and policies for facility systems – energy.*

(a) *Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:*
    (1) *Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;*
    (2) *Increased energy security and self-sufficiency through the reduction and ultimate elimination of Hawai'i's dependence on imported fossil fuels for electrical generation and ground transportation;*
    (3) *Greater diversification of energy generation in the face of threats to Hawai'i's energy supplies and systems;*
    (4) *Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use; and*
    (5) *Utility models that make the social and financial interests of Hawai'i's utility customers a priority.*
(b) *To achieve the energy objectives, it shall be the policy of this State to ensure the short- and long-term provision of adequate, reasonably priced, and dependable energy services to accommodate demand.*
(c) *To further achieve the energy objectives, it shall be the policy of this State to:*
    1. *Support research and development as well as promote the use of renewable energy sources.*

Discussion: The Proposed Action includes the continued operation of two hydropower projects on the Wailuku River. As a renewable energy project, the Proposed Action reduces imports of oil for conventional diesel electric power generation. The continued operation of HELCO's Wailuku River hydroelectric plants and increased capacity of the Waiau Plant would further help to achieve the State of Hawai'i's goal of 100% renewable energy by 2045.

Section 226-109. *Climate change adaptation priority guidelines.*

Priority guidelines to prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; energy; higher education; health; historic preservation; water resources; the built environment, such as housing, recreation, transportation; and the economy shall:

(1) Ensure that Hawaiʽi's people are educated, informed, and aware of the impacts climate change may have on their communities;

(2) Encourage community stewardship groups and local stakeholders to participate in planning and implementation of climate change policies;

(3) Invest in continued monitoring and research of Hawaiʽi's climate and the impacts of climate change on the State;

(4) Consider native Hawaiian traditional knowledge and practices in planning for the impacts of climate change;

(5) Encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change;

(6) Explore adaptation strategies that moderate harm or exploit beneficial opportunities in response to actual or expected climate change impacts to the natural and built environments;

(7) Promote sector resilience in areas such as water, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and evaluation of adaptation options;

(8) Foster cross-jurisdictional collaboration between County, State, and Federal agencies and partnerships between government and private entities and other nongovernmental entities, including nonprofit entities;

(9) Use management and implementation approaches that encourage the continual collection, evaluation, and integration of new information and strategies into new and existing practices, policies, and plans; and

(10)Encourage planning and management of the natural and built environments that effectively integrate climate change policy.

Discussion: The purpose of the Proposed Action is to continue to operate the two hydropower projects on the Wailuku River: the Waiau Plant and the Puʽuʽeo Plant. Renewable energy generated by hydropower projects reduces imports of oil for conventional diesel electric power generation. The continued operation of HELCO's Wailuku River hydroelectric plants and increased capacity of the Waiau Plant would further help to achieve the State of Hawaiʽi's goal of 100% renewable energy by 2045.

State Land Use Law

Hawaiʽi was the first of the fifty States to have a State Land Use Law (originally adopted in 1961) and a State Plan. Today, Hawaiʽi 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: As shown in **Figure 4-1**, the location of diversion and intake for both the Waiau and Puʽuʽeo Plants is designated Conservation. The Waiau and Puʽuʽeo powerhouse locations are designated Agricultural and Urban, respectively. The penstocks for both are located in lands designated Agricultural.

Permitted uses in the Agricultural land use district is dependent on the agricultural land productivity rating as determined by the Land Study Bureau (LSB). The LSB assigns a rating of A to E to agricultural land, with A being the most productive land and E being the least productive land. As shown in **Figure 4-2**, the project facilities are located in areas with a LSB rating of C and E. As per HRS 205-2, permissible uses do not include hydropower plants. However, the Waiau Plant and the penstocks for the Waiau and Puʽuʽeo Plants were constructed and put into operation prior to the adoption of the State Land Use Law. Therefore, as per HRS 205-8, these facilities are an allowed nonconforming use.

The Urban land use district permits "any and all uses permitted by the counties".

Permitted uses within the Conservation District are dependent on the Resource subzone. As shown in **Figure 4-3**, the diversion structures for the Waiau and Puʽuʽeo Plants are located in the Resource subzone of the Conservation District. Power generation from renewable resources, including hydropower, is a permissible use in the Resource subzone of the Conservation District.

Hawaiʽi Water Plan

The Hawaiʽi Water Plan consists of the following five components: (1) State Water Projects Plan, (2) Water Resource Protection Plan, (3) Water Quality Plan, (4) Agricultural Water Use and Development Plan, and (5) County Water Use and Development Plans. These plans provide the overall guidance and direction for assessing water needs and water quality in Hawaiʽi.

Of these plans, only one has been recently updated: the *State Water Projects Plan Update, Hawaiʽi Water Plan, Department of Hawaiian Home Lands* (SWPP) (DLNR, 2017). The SWPP provides "a framework for planning and implementation of water development programs to meet projected water demands for State Projects." The 2017 SWPP updates the 2003 SWPP but only includes DHHL projects. An inventory of proposed DHHL projects and their future water requirements over a 20-year planning horizon (between 2012 and 2031) was completed based on a prioritization of high, medium, and low.

There is one DHHL tract in the vicinity of the Proposed Action: Lower Piʽihonua. The potable water requirement is from Residential and Sub Ag land use areas and will continue to be supplied by the Department of Water Supply's (DWS) Hilo Water System. Future (2031) non-potable water demand for the Lower Piʽihonua tract is an estimated 4.9674 mgd. As per the SWPP, there is no "strategy" for meeting this demand as it is expected that ambient rainfall would meet the non-potable water demand for Lower Piʽihonua. The Proposed Action would have no impact on the future water demand of Lower Piʽihonua.

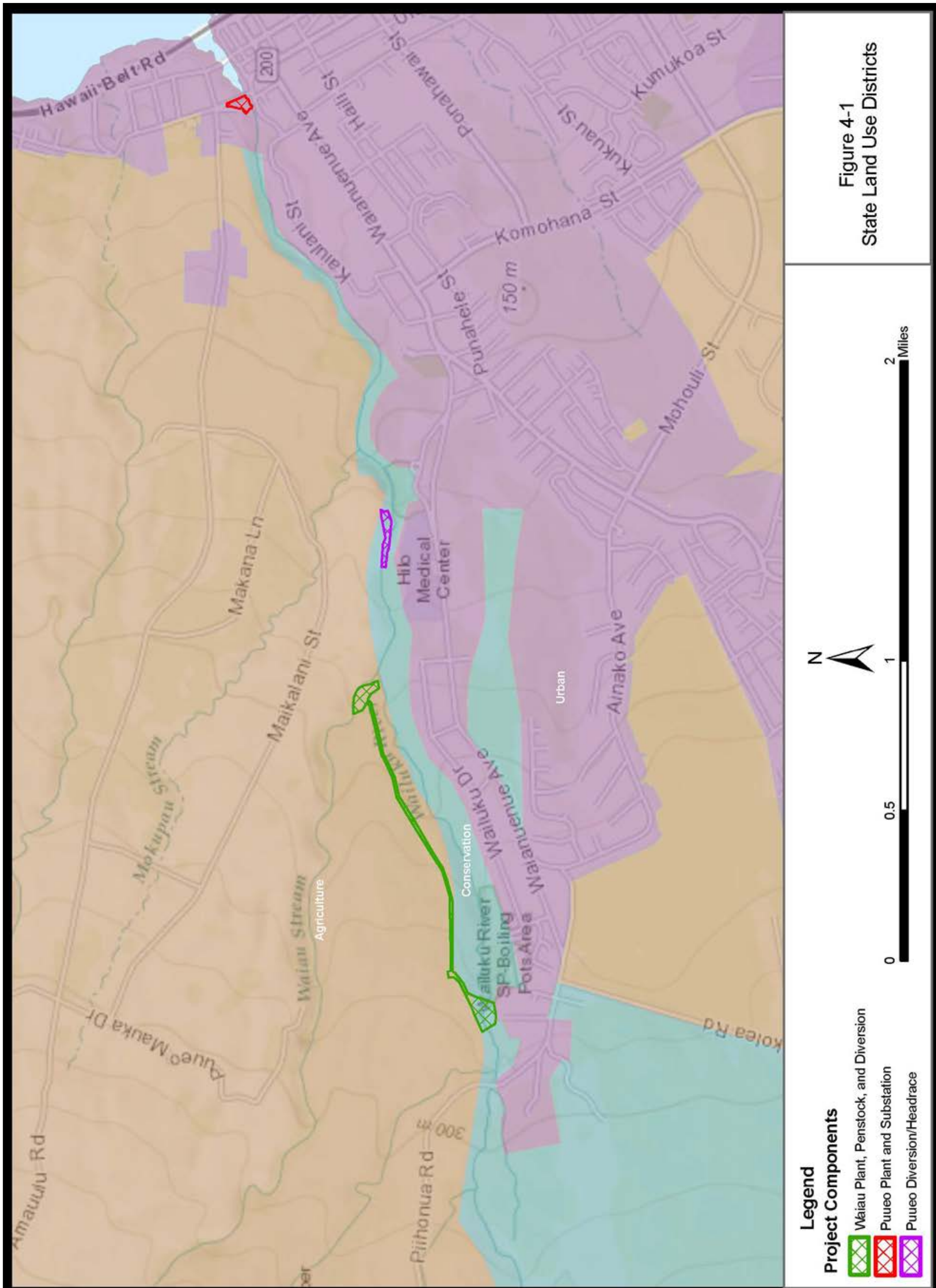
Figure 4-1
State Land Use Districts
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2
Miles
Urban
Conservation
Agriculture
Hawaii Belt Rd
Kaiulani St
Waianuenue Ave
Haili St
Ponahawai St
Kukuau St
Kumukoa St
Komohana St
Punahele St
150 m
Mohouli St
Hilo Medical Center
Ainako Ave
Wailuku Dr
Waianuenue Ave
Wailuku River SP-Boiling Pots Area
Makana Ln
Maikalani St
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m

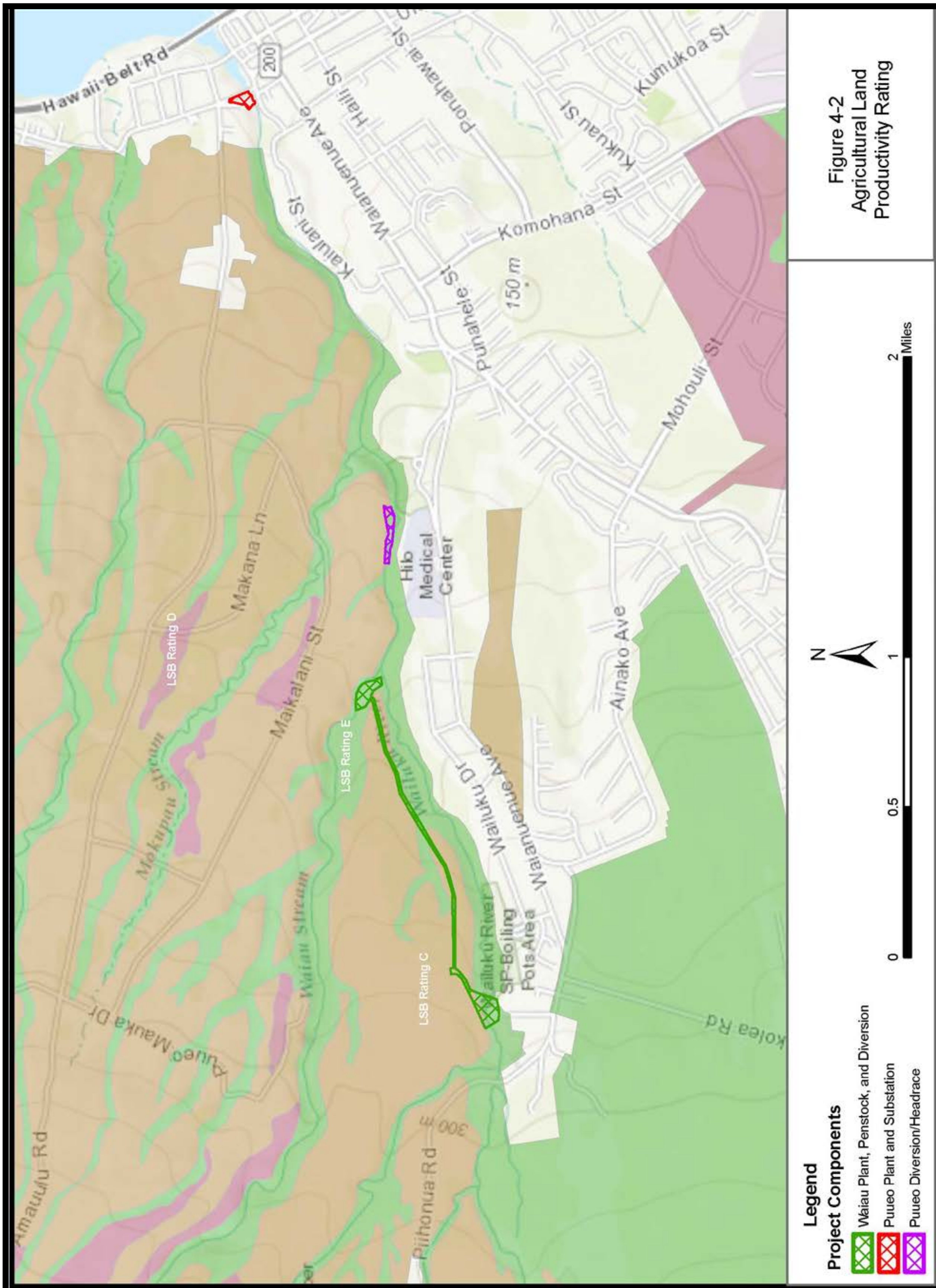
Figure 4-2
Agricultural Land
Productivity Rating
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2
Miles
LSB Rating C
LSB Rating D
LSB Rating E
Hawaii Belt Rd
200
Kaiulani St
Waianuenue Ave
Haili St
Ponahawai St
Kukuau St
Kumukoa St
Komohana St
Punahele St
150 m
Mohouli St
Hilo Medical Center
Ainako Ave
Wailuku Dr
Wailuku River
SP-Boiling Pots Area
Makana Ln
Maikalani St
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m
Kolea Rd

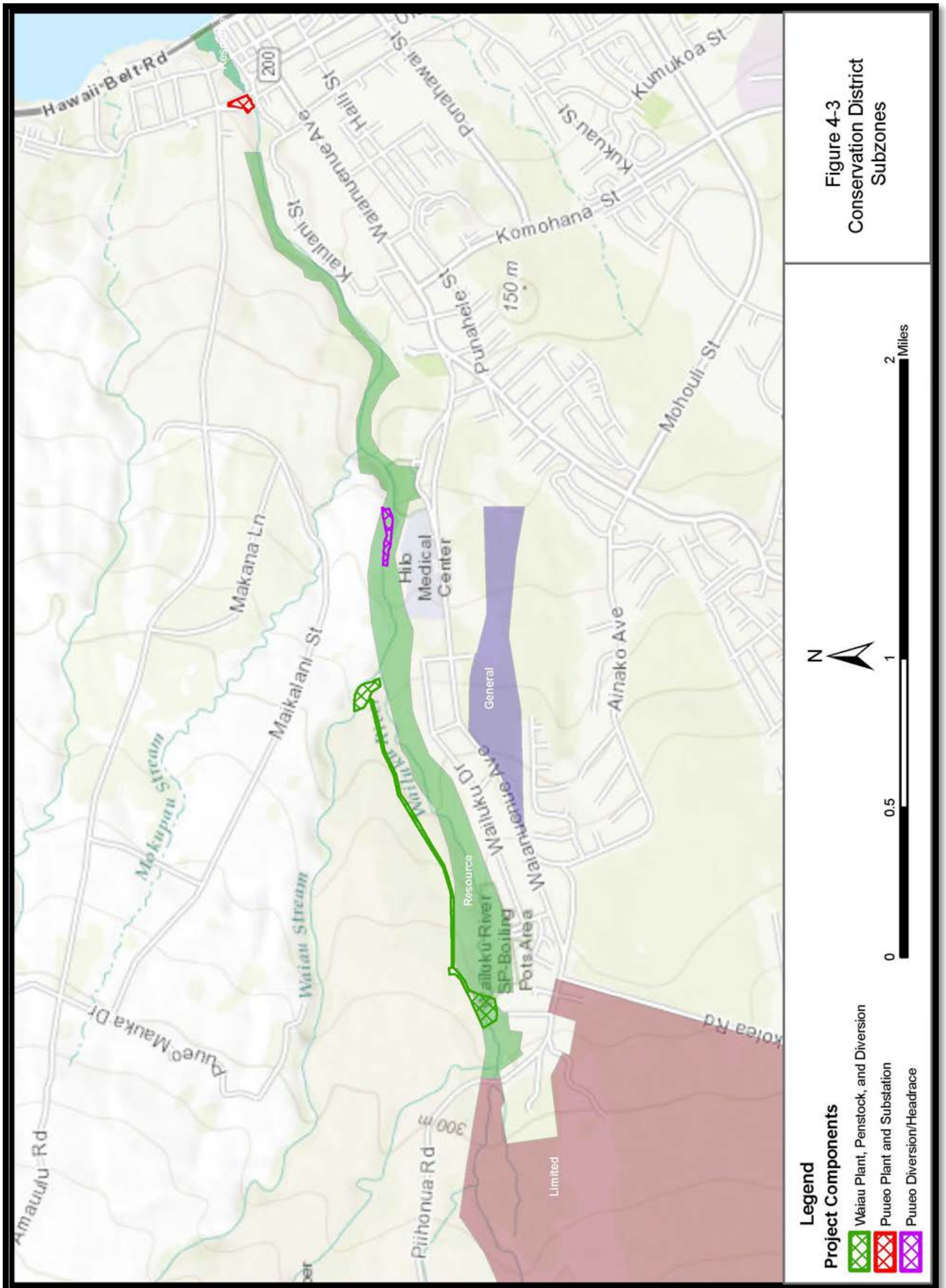
Figure 4-3
Conservation District
Subzones
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
0
0.5
1
2
Miles
N
Resource
General
Limited
Hilo Medical Center
Wailuku River SP-Boiling Pots Area
Hawaii Belt Rd
Kaiulani St
Waianuenue Ave
Haili St
Ponahawai St
Kukuau St
Kumukoa St
Komohana St
Punahele St
150 m
Mohouli St
Ainako Ave
Wailuku Dr
Makana Ln
Maikalani St
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m

The Wailuku River and its tributaries traverse the Humuʽula-Piʽihonua tract upstream and mauka of the Proposed Action. The potable water requirement is from Sub Ag land use area with a lesser amount from Commercial and Pastoral land use areas. The Sub Ag area is located along the lower boundary at Saddle road in an area where annual ambient rainfall reaches up to 112 inches, and most of the area requiring potable water receives sufficient rainfall to support rainwater catchment systems. The non-potable water demand for the tract is from Sub Ag and Pastoral land uses. The Sub Ag area receives sufficient rainfall to sustain irrigation requirements. However, the Pastoral area would require a stream diversion from the Wailuku River such that farmers could collect and haul water to supply livestock. DHHL has determined that a reservation of 0.972 mgd from the Wailuku River would satisfy the non-potable water demand.

The average water flow in the Wailuku River at the USGS water gage at Piʽihonua from 1929 through 2016 is 168.5 mgd (USGS, 2017b). The proposed increased water use for the Waiau Plant is 45 cfs (29.1 mgd) for a total of 100 cfs (64.6 mgd), which would be returned to the river at the Waiau Plant. There would be no increase in intake for the Puʽuʽeo Plant. Therefore, the amount of water requested for non-consumptive use would have no impact on the DHHL water reservation of 0.972 mgd. Therefore, the Proposed Action is consistent with the SWPP.

The remaining plans currently have draft updates under review.

4.2 Department of Hawaiian Home Lands Planning Documents

Department of Hawaiian Home Lands General Plan

The *Department of Hawaiian Home Lands General Plan* (DHHL, 2002) provides goals and objectives to support the mission of managing Hawaiian Home Lands effectively and to develop and deliver lands to native Hawaiians. There are goals and objectives for the following: land use planning, residential uses, agricultural and pastoral uses, water resources, land and resource management, economic development, and building healthy communities. This document identifies the following goals and policies for water resources:

GOALS:

- *Provide access to quality water in the most cost-effective and efficient manner.*
- *Ensure the availability of sufficient water to carry out Hawaiian Home Lands' mission.*
- *Aggressively exercise and protect Hawaiian Home Land water rights.*

OBJECTIVES:

- *Establish water partnership arrangements.*
- *Identify and establish a clear understanding of existing water resources available to the Hawaiian Home Lands Trust.*
- *Implement State water use plans, rules, and permits to ensure access to water resources for current and future uses on Hawaiian Home Lands.*

Discussion: The Proposed Action does not conflict with the goals and objectives of the *Department of Hawaiian Home Lands General Plan.* The Proposed Action is a non-consumptive use of surface water; therefore, there would be no loss of access or availability of water to Hawaiian Home Lands.

Department of Hawaiian Home Lands Hawaiʽi Island Plan

The *Department of Hawaiian Home Lands Hawaiʽi Island Plan* (DHHL, 2002b), hereafter referred to as the Hawaiʽi Island Plan, provides a comprehensive assessment of DHHL properties on Hawaiʽi Island, as well as a summary of beneficiary interest in these lands by award type (i.e., residential, agricultural, or pastoral). The goal of the Hawaiʽi Island Plan is to assess and recommend future uses for Hawaiian Home Lands.

The Hawaiʽi Island Plan identifies Lower Piʽihonua as a Priority Tract recommended for Residential and Subsistence Agriculture use. This tract is located on the north side of the Wailuku River and Waiau Plant. A total of 115 Residential lots of 10,000 square feet each and 235 Subsistence Agriculture lots of two acres each are recommended for Lower Piʽihonua.

<u>Discussion</u>: The Proposed Action does not conflict with the recommendations for Lower Piʽihonua as outlined in the Hawaiʽi Island Plan.

Kaūmana-Piʽihonua Regional Plan

The *Kaūmana-Piʽihonua Regional Plan* (DHHL, 2017) documents the current conditions and trends in the Kaūmana-Piʽihonua tracts and identifies a prioritized list of project important to the community and the DHHL. The guiding principles of the *Kaūmana-Piʽihonua Regional Plan* are food self-reliance, energy self-reliance, cultural awareness, economic development, and community center. One of the priority projects identified in the *Kaūmana-Piʽihonua Regional Plan* is development of a Community Pasture, which may be located at Lower Piʽihonua. A site assessment and plan for the project will be required, which must identify the types and location of improvements, including stream water diversion, if necessary.

<u>Discussion</u>: The Proposed Action does not conflict with the priority projects identified in the *Kaūmana-Piʽihonua Regional Plan* for Lower Piʽihonua. If the Community Pasture project requires a stream diversion, it is expected that it would be located upstream from the Waiau Plant diversion structure since the Waiau Plant is at the eastern (downstream) edge of the Lower Piʽihonua tract. Therefore, the diversion for the Waiau Plant would have no impact on any future diversion for the Lower Piʽihonua tract.

4.3 County of Hawaii Planning Documents

County of Hawaiʽi General Plan

The County of Hawaiʽi's General Plan is the policy document for the long-range comprehensive development on the island of Hawaiʽi. 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 Hawaiʽi General Plan*:

Energy

3.2 GOALS:
(a) Strive toward energy self-sufficiency
(b) Establish the Big Island as a demonstration community for the development and use of natural energy resources.

3.3 POLICIES:
(a) Encourage the development of alternate energy resources.
(e) Ensure a proper balance between the development of alternative energy resources and the preservation of environmental fitness and ecologically significant areas.
(f) Strive to assure a sufficient supply of energy to support present and future demands.

3.4 STANDARDS
(a) New power plants

Discussion: The purpose of the Proposed Action is to continue to operate the two hydropower projects on the Wailuku River: the Waiau Plant and the Puʽuʽeo Plant. Renewable energy generated by hydropower projects reduces imports of oil for conventional diesel electric power generation and the associated pollution of the air and water resources. The continued operation of HELCO's Wailuku River hydroelectric plants and increased capacity of the Waiau Plant would further help to achieve the State of Hawaiʽi's goal of 100% renewable energy by 2045. Therefore, the Proposed Action is consistent with the Energy Goal of the *County of Hawai'i General Plan.*

Historic Sites

6.2 GOALS:
(a) Protect, restore, and enhance the sites, buildings, and objects of significant historical and cultural importance to Hawaiʽi.
(b) Appropriate access to significant historic sites, buildings, and objects of public interest should be made available.
(c) Enhance the understanding of man's place on the landscape by understanding the system of the ahupuaʽa.

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.
(k) Develop policies to protect Hawaiian rights as identified under judicial decisions.
(o) Recognize the importance of certain natural features in Hawaiian culture by incorporating the concept of "cultural landscapes" in land use planning.

6.4 STANDARDS:
(a) The evaluation of the importance of specific historic sites is necessary for future action. The following standards establish a framework for evaluating sites.
(b) Importance in the life or activities of a major historic person
(c) Associated with a major group or organization in the history of the island or community.
(d) Associated with a major historic event (cultural, economic, military, social, or political).
(e) Associated with a major recurring event in the history of the community (such as annual celebrations).
(f) Associated with a past or continuing institution that has contributed substantially to the life of the community.
(g) Unique example of a particular style or period.
(h) One of the few of its age remaining.
(i) Original materials and/or workmanship that can be valued in themselves.
(j) Sites with a preponderance of original materials in context and complexes rather than single isolated sites unless they are of great significance.
(k) Sites of traditional and cultural significance.

Discussion: HELCO is currently diverting and using water from the Wailuku River to power its Waiau and Puʽuʽeo hydroelectric plants under an existing Revocable Permit No. S-7463. Under a proposed long-term water lease, continued use of the Waiau and Puʽuʽeo power plants would be in operation for the next 65 years. Operations of the repowered Waiau Plant would divert more water from the Wailuku River during periods of high flow than current operations. However, automatic water level controls would ensure the natural river flow past the diversion is maintained. The proposed project is not anticipated to have any impacts toward marine resource gathering and fresh water fishing. Therefore, no significant cultural impacts would occur.

Construction at the Waiau Plant would occur in previously disturbed areas and there would be no impact to archaeological or historic resources. There would be no change to the outside of the Waiau powerhouse, which has been part of the landscape for nearly a century. Any changes to the outside of the powerhouse would require consultation with SHPD. Therefore, the Proposed Action is consistent with the Historic Sites goals of the *County of Hawaiʽi General Plan.*

Natural Beauty

7.2 GOALS:
(d) Protect scenic vistas and view planes from becoming obstructed.

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: Rainbow Falls, Peʽepeʽe Falls, and Boiling Pots and their surrounding areas are identified as Natural Beauty Sites in the District of South Hilo. Construction at the Waiau Plant would not be visible from these locations. Operations of the Waiau and Puʽuʽeo Plants would have the same visual effect as current operations. No additional structures would be constructed; therefore, scenic vistas and view planes would not become obstructed. The Proposed Action is consistent with the applicable Goals and Policies of the Natural Beauty category of the *County of Hawaiʽi General Plan*.

Natural Resources and Shoreline

8.2 GOALS:

(a) Protect and conserve the natural resources from undue exploitation, encroachment, and damage.

(c) Protect and promote the prudent use of Hawaiʻi's unique, fragile, and significant environmental and natural resources.

(e) Protect and effectively manage Hawaiʻi's open space, watersheds, shoreline, and natural areas.

(f) Ensure that alterations to existing land forms, vegetation, and construction of structures cause minimum adverse effect to water resources, and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of an earthquake.

8.3 POLICIES:

(a) Require users of natural resources to conduct their activities in a manner that avoids or minimized adverse effects on the environment.

(h) Encourage public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.

(i) Encourage an overall conservation ethic in the use of Hawaiʻi's resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawaiʻi.

(n) The installation of utility facilities, highways, and related public improvements in natural and wildland areas should avoid contamination or despoilment of natural resources where feasible by design review, conservation principles, and by mutual agreement between County and affected agencies.

(q) Develop policies by which native Hawaiian gathering rights will be protected as identified under judicial decisions.

(u) Ensure that activities authorized or funded by the County do not damage important natural resources.

Discussion: The Proposed Action would not create new facilities; rather, it would modify existing facilities. BMPs would be employed during construction and any ground-disturbing activities to minimize impacts to natural resources. Therefore, the Proposed Action is consistent with the applicable Goals and Policies of the Natural Resources and Shoreline category of the *County of Hawaiʽi General Plan.*

Public Utilities

11.2 GOALS:

(a) Ensure that properly regulated, efficient, and dependable public and private utility services are available to users.

(b) Maximize efficiency and economy in the provision of public utility services.

(c) Design public utility facilities to fit into their surroundings or concealed from public view.

11.3 POLICIES:

(d) Improvement of existing utility services shall be encouraged to meet the needs of users.

Discussion: The Proposed Action includes repowering of the existing Waiau Hydroelectric Plant to ensure continuous operation for the next 65 years. Proposed improvements include replacement of the 350-kW unit with an estimated 1,500-kW unit and refurbishment of the existing 750-kw unit to increase output to 800-kW. These improvements would maximize efficiency of the existing facility, as well as reduce the State's reliance on fossil fuels for energy generation and further help to achieve the State of Hawaiʽi's goal of 100% renewable energy by 2045. Therefore, the Proposed Action is consistent with the applicable Goals and Policies of the Public Utilities category of the *County of Hawaiʽi General Plan*.

Land Use Pattern Allocation Guide (LUPAG)

The Land Use Pattern Allocation Guide (LUPAG) is a part of the *County of Hawaiʽi 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 4-4** shows the LUPAG-designated land uses in the proposed project area. The Waiau Plant and penstock are located on lands designated Important Agricultural Land (ial). The diversion structures for both plants are located on lands designated Conservation Area (con). The Puʽuʽeo powerhouse is located on land designated Medium Density Urban (mdu).

County of Hawaiʽi Zoning

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

Discussion: The diversion and intake structure for the Waiau Plant are designated Open (O). The penstocks for both plants and the Waiau Plant powerhouse are located on lands zoned Agriculture. The Puʽuʽeo Plant is located on lands zone Multi-Family Residential (RM). **Figure 4-5** shows the existing zoning in the project area.

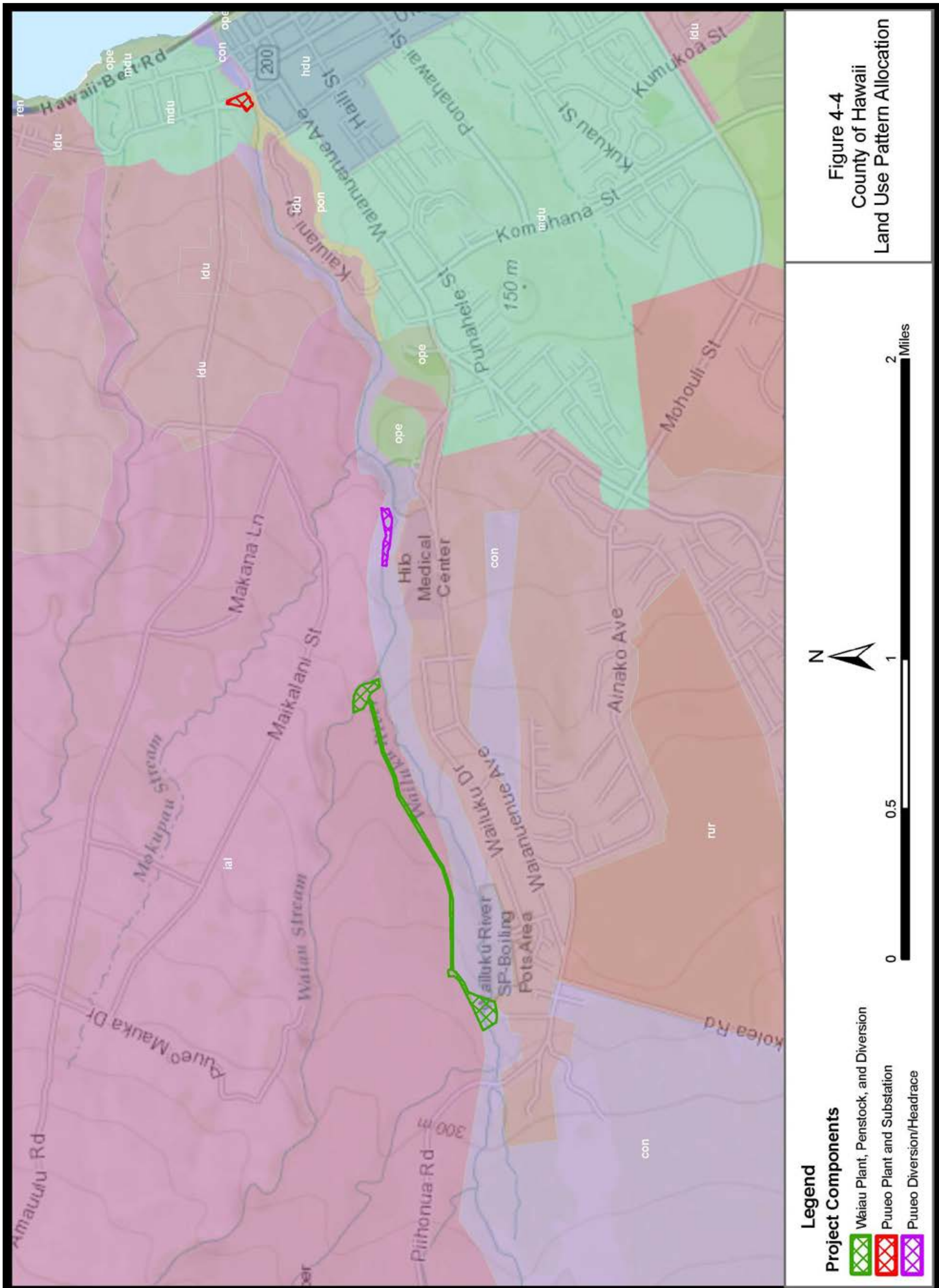
Figure 4-4
County of Hawaii
Land Use Pattern Allocation
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2
Miles
Hawaii Belt Rd
Waianuenue Ave
Kaiulani St
Haili St
Ponahawai St
Kukuau St
Kumukoa St
Komohana St
Punahele St
Mohouli St
Ainako Ave
Waianuenue Ave
Wailuku Dr
Makana Ln
Maikalani St
Mokupau Stream
Waiau Stream
Puueo Mauka Dr
Piihonua Rd
Amauulu Rd
Kolea Rd
Hilo Medical Center
Wailuku River SP-Boiling Pots Area
150 m
300 m
ldu
mdu
hdu
ope
con
rur
ial

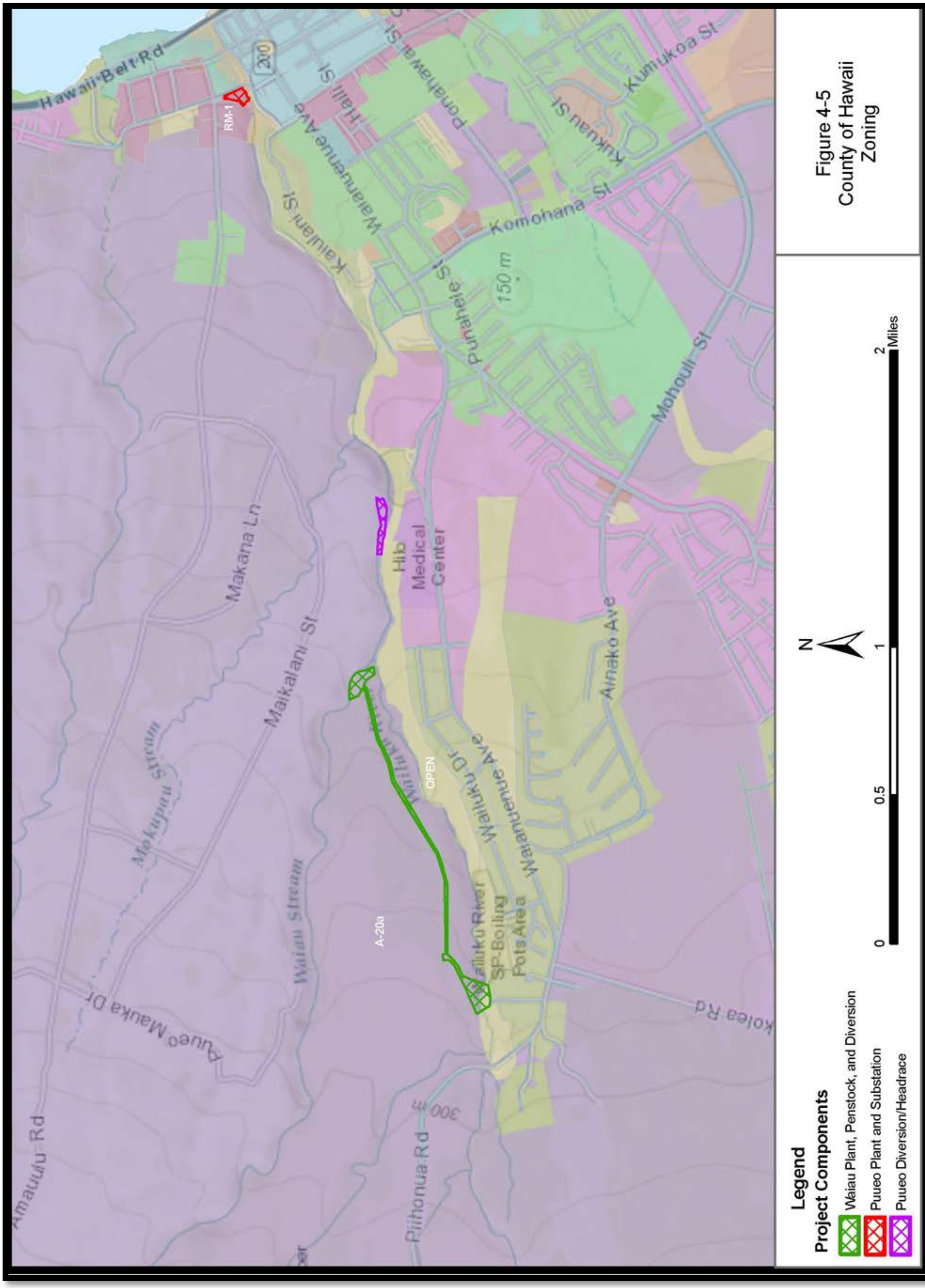
Figure 4-5
County of Hawaii
Zoning
Legend
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2 Miles
Hawaii Belt Rd
RM-1
Kaiulani St
Waianuenue Ave
Haili St
Ponahawai St
Kumukoa St
Kukuau St
Komohana St
150 m
Mohouli St
Makana Ln
Maikalani St
Mokupau Stream
Waiau Stream
Hilo Medical Center
Ainako Ave
OPEN
Wailuku Dr
Wailuku River SP-Boiling Pots Area
A-20a
Puueo Mauka Dr
300 m
Piihonua Rd
Amauulu Rd

Permissible uses in the Open District (O) include utility substations, although there is no provision for utility generating plants. The Multi-Family Residential (RM) district provides for medium and high density residential use, including full community facilities and services. Utility generating plants are not considered a permitted use in the Multi-Family Residential district. The Agricultural (A) district provides for agricultural and very low density agriculture-based residential use. Although utility substations and wind energy facilities are permitted uses, there is no provision for hydropower plants.

Although hydropower is not a permitted use in the zoning districts where the existing facilities are located, the existing facilities were constructed prior to the zoning ordinance. Therefore, they are a permissible non-conforming use.

County of Hawaiʽi Special Management Area

Pursuant to the Hawaiʽi CZM Program, HRS 205A, the counties have enacted ordinances establishing Special Management Areas (SMA). The County of Hawaiʽi 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 Hawaiʽi Planning Department.

Discussion: As shown in **Figure 4-6,** none of the facilities associated with the Waiau and Puʽuʽeo Plants are located within the SMA. Therefore, a SMA Use Permit is not required for the Proposed Action.

Hawaiʽi County Water Use and Development Plan Update

The *Hawaiʽi County Water Use and Development Plan* (WUDP) (DWS, 2010) was prepared in compliance with the State Water Code. The WUDP provides a long-range guide for water resource development in Hawaiʽi County. The objective of the WUDP is "to set forth the allocation of water to land use through the development of policies and strategies which shall guide the County in its planning, management, and development of water resources to meet projected demands." The general recommendations provided in the WUDP include the following:

1. Reserve the Highest Quality of Water for the Most Valuable End Use
2. Promote Water Conservation
3. Initiate More Monitoring and Studies

Discussion: As per the WUDP, potable water is considered the highest quality water. The Wailuku River lies within the Northeast Mauna Loa aquifer sector. Within this sector, it is recommended that groundwater continue to be developed as the primary potable water source in locations of anticipated development. The Proposed Action includes a non-consumptive use of surface water; therefore, the Proposed Action would have no impact to the potable water source.

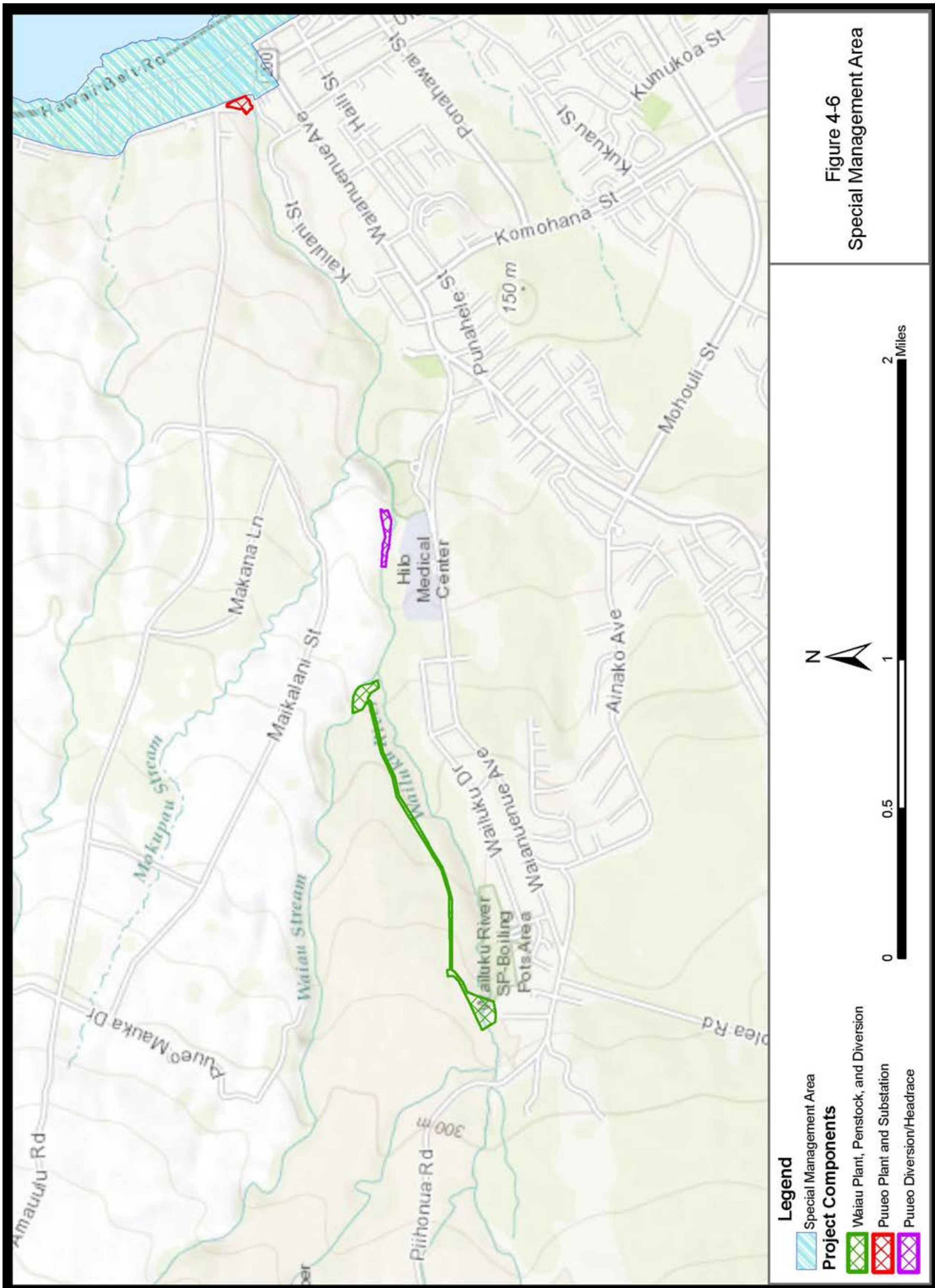
Figure 4-6
Special Management Area
Legend
Special Management Area
Project Components
Waiau Plant, Penstock, and Diversion
Puueo Plant and Substation
Puueo Diversion/Headrace
N
0
0.5
1
2 Miles
Kumukoa St
Ponahawai St
Haili St
Waianuenue Ave
Kukuau St
Komohana St
Kaiulani St
Punahele St
150 m
Mohouli St
Medical Center
Makana Ln
Maikalani St
Ainako Ave
Wailuku Dr
Waianuenue Ave
Mokupau Stream
Waiau Stream
Wailuku River SP-Boiling Pots Area
Puueo Mauka Dr
Amauulu Rd
Piihonua Rd
300 m

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CHAPTER 5: FINDINGS AND CONCLUSION

5.1 Significance Criteria

HAR 11-200 provides significance criteria for which all projects in Hawaiʽi 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.

Impacts from the Proposed Action would be short-term and temporary during the construction period. There would be no change of land use with implementation of the Proposed Action. The use of water from the Wailuku River would be a non-consumptive use and would not have any impacts to aquatic biota.

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

There would be no change to the current or potential land use within the project area with implementation of the Proposed Action. The use of the water from the Wailuku River would be a non-consumptive use and would have a beneficial impact on air quality because of the continued operation of the existing hydropower plants.

(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.

Repowering of the Waiau Plant would increase the capacity to 2,075 kW from the existing 1,100 kW. The estimated annual output would be approximately 10,200 MWh. This increase in the generation of renewable energy for the next 65 years would decrease the required generation of electricity from fossil fuel sources. By displacing fossil fuel power generation, the Proposed Action is consistent with the long-term environmental policies or goals and guidelines expressed in HRS 344.

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

The continued operation of HELCO's Wailuku River hydroelectric plants will enable the contribution to the electrical grid to continue. The repowering of the Waiau Plant is expected to produce about 10,200 MWH/year, and this potential energy production would service 1,700 500 KWH/month/residential-customers (2%) of HELCO's 85,029 overall customers. The Proposed Action will benefit the community and 100% of HELCO customers as part of the HELCO grid in reducing the cost of energy production while increasing Hawaiʽi County's renewable energy percentage toward achieving the Hawaii Clean Energy Initiative 2045 goals.

(5) Substantially affects public health.

The Proposed Action would have some temporary, minor impacts on air, noise, and water quality during construction; however, these impacts would be minimized to the extent practicable by the employment of BMPs and compliance with permit conditions. The Proposed Action would not result in any post-construction or long-term effects on public health, although there may be health benefits that result from the positive impact on air quality by the reduction of fossil-fueled energy generation and the associated air emissions. ~~The Proposed Action would have no effects on public health.~~

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

The Proposed Action would not have substantial secondary impacts, as it would not invoke population changes or effects on public facilities.

(7) Involves a substantial degradation of environmental quality.

No long-term impacts to any resource, as discussed in **Chapter 3: Environmental Setting, Potential Impacts, and Minimization and Mitigation Measures**, are anticipated with implementation of the Proposed Action. Any impacts would be during the construction phase and would be short-term and temporary.

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

The Proposed Action involves the repowering of an existing facility and the extension of an existing non-consumptive water lease. There would be no impacts from continued operation of the facility. All potential impacts from repowering the Waiau Plant would be short-term and temporary during construction. Therefore, the Proposed Action would not have cumulative impacts.

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

Impacts to the endangered Hawaiian hoary bat could occur due to vegetation removal, which may occur as part of the penstock replacement and/or substation expansion. During clearing, grubbing, or tree trimming/cutting, the removal of tall, woody vegetation can temporarily displace bats using the vegetation for roosting. As bats use multiple roosts within their home territories, this disturbance from the removal of vegetation is likely to be minimal. To minimize impacts to the endangered Hawaiian hoary bat, no trees taller than 15 feet would be trimmed or removed between June 1st and September 15th when juvenile Hawaiian hoary bats that are not capable of flying may be roosting in the trees.

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

Short-term, construction related impacts would occur to air quality, noise, and water quality. A dust control plan would be developed and implemented to minimize fugitive dust during construction, to be approved by the DOH. To reduce noise exposure to nearby residences, 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. Additionally, construction plans and specifications would include BMPs to minimize erosion on the project site during and after construction, as well as measures to contain runoff on site during construction.

The Proposed Action would have beneficial impacts to air quality by reducing fossil-fueled energy generation and the associated air emissions. Noise associated with operation of the hydropower plants would be confined to the powerhouses and thus would not impact nearby residences. There would be no impact to water quality during operation of the Proposed Action as the water use is non-consumptive and no additives are used.

(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.

Construction at the Waiau Plant would not create conditions that would exacerbate natural hazards. The County of Hawaiʽi Civil Defense directs and coordinates the County's emergency preparedness and response program to ensure prompt and effective action when natural or man-caused disaster threatens or occurs anywhere in the County of Hawaiʽi. Construction personnel would respond to any emergency messages or alerts, as appropriate, to ensure their safety during construction.

The existing Waiau and Puʽuʽeo powerhouses and associated facilities have been operational for over 100 years without significant damage from natural hazards. These facilities were built to withstand their natural environment, and it is expected that they will continue to do so.

Both facilities are unmanned. The only time personnel visit the facilities is for inspections and/or maintenance. Personnel would respond to any emergency messages or alerts, as appropriate, to ensure their safety during these visits to the facilities.

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

The Proposed Action would allow for continued operations at the existing Waiau and Puʽuʽeo plants. There would be no impact to visual resources.

(13)Requires substantial energy consumption.

Implementation of the Proposed Action would ensure the continued operation of HELCO's Wailuku River hydroelectric plants. The increased capacity of the Waiau Plant would further help to achieve the State of Hawaiʽi's goal of 100% renewable energy by 2045.

5.2 ~~Anticipated Finding of No Significant Impact~~ Determination

Based on the significance criteria set forth in 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~~ the Approving Agency has issued a Finding of No Significant Impact (FONSI). ~~will be filed with the State of Hawaiʽi Office of Environmental Quality Control following the public comment period.~~ This finding is founded on the basis of impacts and mitigation measures examined in this EA, comments received during the pre-assessment consultation phase, and comments received on the Draft EA. Comments and responses are included in this Final EA in **Appendix A**.

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CHAPTER 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-1**.

Federal

- U.S. Army Corps of Engineers

State of Hawaiʽi

- Department of Agriculture
- Department of Business, Economic Development & Tourism
- Department of Hawaiian Home Lands
- Department of Health (DOH), Clean Water Branch *
- DOH, Clean Air Branch
- DOH, Environmental Planning Office *
- DOH, Indoor and Radiological Health Branch
- Department of Accounting and General Services *
- Department of Land and Natural Resources (DLNR), Division of Aquatic Resources *
- DLNR, Division of Forestry and Wildlife *
- DLNR, Land Division *
- DLNR, Division of State Parks *
- DLNR, Engineering Division *
- DLNR, Office of Coastal and Conservation Lands
- DLNR, State Historic Preservation Division
- DLNR, Commission on Water Resource Management *
- Office of Hawaiian Affairs

County of Hawaiʽi

- Office of the Mayor *
- Department of Environmental Management
- Hawaiʽi Fire Department *
- Hawaiʽi Police Department *
- Hawaiʽi County Council, District 1
- Hawaiʽi County Council, District 2 *
- Department of Parks and Recreation
- Planning Department *
- Civil Defense Agency
- Department of Public Works

- Department of Water Supply *

Non-Governmental Organizations

- Sierra Club of Hawaiʻi
- Hawaiʻi Audubon Society
- Nature Conservancy Hawaiʻi, Hawaiʻi Island Program *
- The Outdoor Circle
- Hawaiʻi's Thousand Friends

CHAPTER 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
	Dean Uchida	Project Manager Review	Environmental Assessment
Parham & Associates Environmental Consulting, LLC	James E. Parham, Ph.D	Author Field Lead	Stream Habitat Assessment
ASM Affiliates	Bob Rechtman, Ph.D.	QA/QC	Cultural Impact Assessment
	Lauren M.U.K. Tam Sing	Author	Cultural Impact Assessment
	Teresa Gotay, M.A.	Author	Cultural Impact Assessment
	Lokelani Brandt, M.A.	Author	Cultural Impact Assessment
SMS Hawaii	Faith Sereno Rex	QA/QC	Socio-Economic Impact Assessment
	Kanaloa Schrader	Author	Socio-Economic Impact Assessment

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CHAPTER 8: REFERENCES

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Appendix A
Comment Letters and Responses

A-1 Pre-Assessment Consultation Letters and Responses

A-2 Comment Letters Received on the Draft EA and Responses

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A-1 Pre-Assessment Consultation Letters and Responses

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From:	Miwa, Amy
To:	Jennifer Scheffel
Cc:	Conrad Hokama; Chung, Aaron
Subject:	Wailuku River Hydroelectric Facilities
Date:	Tuesday, January 03, 2017 3:06:53 PM

Aloha Jennifer,

Thank you for your cooperation in sending a copy of the letter received by Council Member Chung regarding the Wailuku River hydroelectirc facilities. As a follow up to pour conversation, there is always a possibility that the Piihinua Community may want to hold a community meeting to allow members of the community to receive information directly and may request assistance from our office. If this does happen, what is your availability for such meeting?

Thank you,

Amy

Amy W. Miwa
Legislative Assistant to
Council Member Aaron Chung
District 2, South Hilo
Work: 808-961-8015
Fax: 808-961-8912
E-mail: Amy.Miwa@hawaiicounty.gov

Jennifer Scheffel

To:	Miwa, Amy
Subject:	RE: Wailuku River Hydroelectric Facilities

From: Jennifer Scheffel [mailto:jscheffel@ssfm.com]
Sent: Tuesday, January 03, 2017 3:49 PM
To: Miwa, Amy
Cc: Conrad Hokama; Chung, Aaron
Subject: RE: Wailuku River Hydroelectric Facilities

Aloha Amy,

We will be conducting community meetings as part of the Water-Lease process with DLNR and DHHL. We expect that we will hold the first meeting this summer prior to publication of the Draft Environmental Assessment. However, we are always available to answer questions and will respond to any emails/letters/phone calls we receive.

Cheers!
jen

Jennifer Scheffel | Environmental Planner

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From: Miwa, Amy [mailto:Amy.Miwa@hawaiicounty.gov]
Sent: Tuesday, January 03, 2017 3:07 PM
To: Jennifer Scheffel <jscheffel@ssfm.com>
Cc: Conrad Hokama <conrad.alumside@hawaiiantel.net>; Chung, Aaron <Aaron.Chung@hawaiicounty.gov>
Subject: Wailuku River Hydroelectric Facilities

Aloha Jennifer,

Thank you for your cooperation in sending a copy of the letter received by Council Member Chung regarding the Wailuku River hydroelectirc facilities. As a follow up to pour conversation, there is always a possibility that the Piihinua

Community may want to hold a community meeting to allow members of the community to receive information directly and may request assistance from our office. If this does happen, what is your availability for such meeting?

Thank you,

Amy

Amy W. Miwa
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DAVID Y. IGE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
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SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
FIRST DEPUTY

JEFFREY T. PEARSON
DEPUTY DIRECTOR - WATER

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

1-4-17

Date: January 4, 2017
DAR # 5459

MEMORANDUM

AM

TO: Bruce S. Anderson, DAR Administrator
DATE:
FROM: Troy Sakihara, Aquatic Biologist
SUBJECT: Wailuku River Hydroelectric Facilities Long-Term Water Lease & Waiau Plant Repowering

Comment	Date Request	Receipt	Referral	Due Date
	December 29, 2016	January 3, 2017	January 4, 2017	January 27, 2017

Requested by: Jennifer Scheffel, Senior Environmental Planner
SSFM International, Inc.

Summary of Proposed Project

Title: Wailuku River Hydroelectric Facilities, Long-Term Water Lease and Waiau Plant Repowering, Hilo, Hawaii, Tax Map Key: (3) 2-6-009:025

Project by: Hawaii Electric Light Company, Inc. (HELCO)

Location: Wailuku River, District of South Hilo, County of Hawaii

Brief Description: This is an application by HELCO for a long-term (65 year) water lease to the Board of Land and Natural Resources to continue to divert water from Wailuku River for non-consumptive use to power the Waiau and Pu'u'eo hydroelectric plants owned and operated by the applicant. In addition, HELCO is proposing work to repower the Waiau Plant along the confluence of Wailuku River and Waiau Stream.

Comments: DAR has no major concerns on the proposed project and long-term water lease application. DAR would only like to ensure that Best Management Practices are upheld during all phases of the project, especially during the penstock replacement. In particular, all efforts should be made to prevent or at least minimize any run-off pollutants from entering Wailuku River due to ground disturbance during this portion of the project. Thank you for providing DAR the opportunity to review and comment on the proposed project. Should there be any changes to the project plans, DAR requests the opportunity to review and comment on those changes.

SSFM International

RECEIVED
JAN -3 2017
Division of Aquatic Resources
DAR #5459

December 29, 2016

SSFM 2016_008

suspense date, January 27, 2017

Dr. Bruce Anderson
Department of Land and Natural Resources
Division of Aquatic Resources
1151 Punchbowl Street, Room 330
Honolulu, Hawai'i 96813

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Dr. Anderson:

JK✓
TS

Hawai'i Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawai'i. HELCO is currently diverting and using water from the Wailuku River for hydroelectric production at their Waiau and Pu'u'eo Plants pursuant to Revocable Permit No. S-7463. On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR work with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the Board of Land and Natural Resources (BLNR) (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Pu'u'eo Plants located alongside the Wailuku River in Hilo.

In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant, which is located at the confluence of the Wailuku River and Waiau Stream on a bluff overlooking Kaimukanaka Falls (TMK (3) 2-6-009:025). HELCO's Waiau Plant is a "run-of-the-river" hydroelectric plant served by a diversion and intake structure located on the Wailuku River near Hilo on Hawai'i Island, just upstream of Pe'epe'e Falls, and a 4,888-foot-long buried steel penstock to transport water from the diversion to the plant. The Waiau Plant was constructed in 1920 with a single 750 kilowatt (kW) horizontal-axis hydraulic Pelton turbine generator, referred as Unit 1. In 1928, a second Pelton 350 kW unit, referred to as Unit 2, was relocated from the Pu'u'eo Plant to the Waiau Plant. On July 29, 2016, HELCO filed their application with the Hawai'i Public Utilities Commission (HPUC) for the expenditure of funds to upgrade the Waiau Plant.

HELCO has contracted SSFM International, Inc., to prepare an Environmental Assessment (EA) for compliance with State environmental regulations under Hawai'i Revised Statutes (HRS) Chapter 343 and Hawai'i Administrative Rules (HAR) Title 11, Chapter 200. In addition, SSFM has contracted Parham & Associates Environmental Consulting, LLC, to assess the environmental impact of the project on native stream animals using the Hawaiian Stream Habitat Evaluation Procedure. This letter and attachments are being provided to solicit any comments, concerns, or regulatory requirements that you may have in regards to this project. We would greatly appreciate your cooperation in providing us with written comments within 30 days of the date of this letter. If you have any questions on this matter or the proposed project, please feel free to contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)
Dean Ushida (SSFM)

Attachments: Project Description
Project Location Map

DAR#5459

Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering

PROJECT DESCRIPTION

1.1 Proposed Action

The Proposed Action consists of three distinct components: (1) application for a long-term water use lease for the Waiau and Pu'u'eo Plants on the Wailuku River (Section 1.1.1), (2) repowering of the Waiau Plant (Section 1.1.2), and (3) application for an easement for the Waiau diversion structure encroachment on state land (Section 1.1.3).

1.1.1 Long-Term Water Lease

As described in Section 1.1, HELCO has requested a long-term water lease to replace the existing revocable permit authorizing the non-consumptive use of water from the Wailuku River for its two Wailuku River hydroelectric facilities. The proposed use of the leased water would be to utilize water from the Wailuku River to operate the Waiau and Pu'u'eo hydro generators. At the beginning of the process, river water is diverted into a canal. At Pu'u'eo, level controls automatically maintain a minimum water level within the canal to ensure natural river flow past the diversion is maintained. At the Waiau plant, the canal water level is maintained manually by HELCO operators. As part of the repowering of the Waiau Plant, discussed in Section 1.1.2, automatic water level controls similar to those in operation at the Pu'u'eo Plant would be installed.

After passing through the canal, diverted water enters a penstock where it is piped to the powerhouse. Once at the powerhouse, the water is passed through a hydroelectric turbine, then released back into the river via an open-channel tailrace[1]. The existing stream diversions are in working condition and no additional improvements are proposed to divert water from the stream. Under the repowering plan before the PUC, the maximum amount of water diverted during high flow conditions for the Waiau diversion would increase from 55 cubic feet per second (CFS) to 100 CFS. The maximum amount for Pu'u'eo at high flow conditions is 130 CFS.

1.1.2 Repowering of the Waiau Plant

HELCO's Waiau Plant is a "run-of-the-river" hydroelectric plant served by a diversion and intake structure located on the Wailuku River near Hilo on Hawai'i Island, just upstream of Pe'epe'e Falls, and a 4,888-foot-long buried steel penstock[2] to transport water from the diversion to the plant.

The Waiau Plant was constructed in 1920 with a single 750 kilowatt (kW) horizontal-axis hydraulic Pelton turbine generator, referred as Unit 1. In 1928, a second Pelton 350 kW unit, referred to as Unit 2, was relocated from the Pu'u'eo Plant to the Waiau Plant.

The repowering component of the Proposed Action would include the following at the Waiau Plant.

1. Repowering (i.e., replacement) of Unit 2
2. Rehabilitation of Unit 1
3. Penstock Replacement
4. Powerhouse Modifications

[1] Flume or channel leading away from a waterwheel or turbine.
[2] A penstock is a sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydroelectric turbines.

5. Substation Modifications

Annual energy generation was estimated to be 10,214 MWh/yr at a levelized lifecycle energy production cost of $94/MWh. All modifications to the Waiau Plant would be in-kind and would retain the existing function of the facility. No work would be conducted at the Pu'u'eo Plant.

Repowering of Unit 2

The smaller and older 350 kW Unit 2 would be replaced by a larger, new turbine-generator. The turbine would either be a horizontal-axis Pelton or a Turgo impulse turbine. The size will be constrained by the size of the penstock, but it is estimated that the capacity will be 1,500 kW. The existing unit would be disposed of at the Hilo landfill, which has a special section for large metal waste.

Rehabilitation of Unit 1

The existing 750 kW Unit 1 would be refurbished by rewinding the generator with more efficient coils and refurbishment of the Pelton water wheel (buckets and nozzle) to increase capacity and restore useful life. As a result of this refurbishment, the capacity of the unit would be increased from 750 kW to 800 kW. All work would be within the existing powerhouse.

Penstock Replacement

The last 300-foot section of riveted, 38-inch-diameter penstock immediately before the powerhouse would be removed due to its poor condition and replaced with 45-inch-diameter welded steel pipe. There would be ground disturbing activities to remove and replace the penstock. Construction activities would be within a 20-foot right-of-way (ROW) on HELCO property.

Powerhouse Modifications

Powerhouse modifications would be required to accommodate the new turbine. In addition to modifications to the interior of the powerhouse, there would be exterior modifications associated with the penstock and the tailrace. The penstock will include a new bifurcated section with block valves in concrete boxes immediately outside the mauka entrance to the powerhouse. The majority of the facility would be below grade. The makai tailrace will be removed and rebuilt to accommodate the additional water discharged from the new turbine. The tailrace will be an open concrete channel that will be above grade.

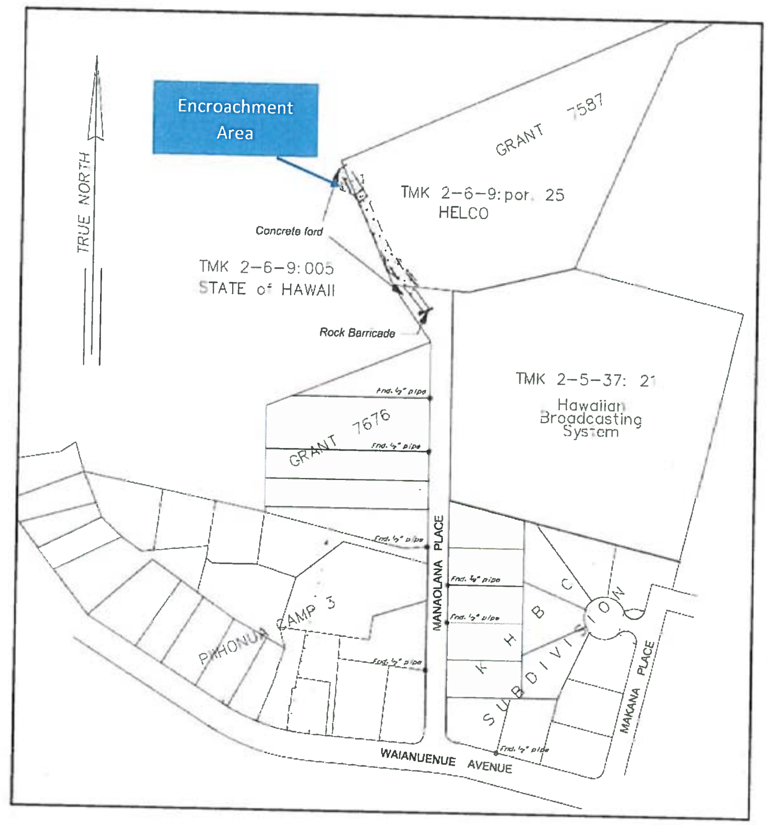
Substation Modifications

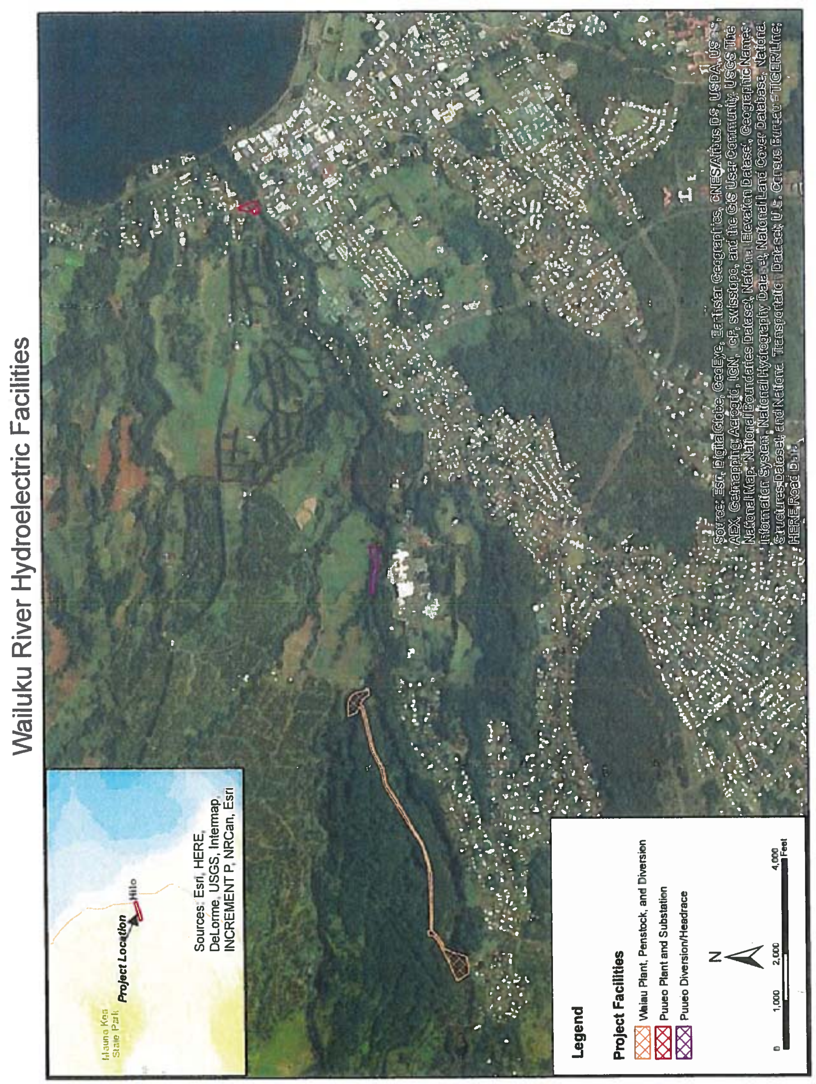
The substation adjacent to the Waiau Plant would require modifications to account for the additional energy being generated by the Waiau Plant. Specifically, a new generator would be installed and the existing transformer would be replaced with a new, larger transformer. If it is determined that the existing transformer contains polychlorinated biphenyls (PCBs), it would be disposed of in compliance with 40 Code of Federal Regulations (CFR) 761.60. The overall footprint of the substation would be approximately 800 to 1000 square feet and would remain within the HELCO property boundary. The existing underground feeder line between the powerhouse and substation would be replaced.

1.1.3 State Land Use Easement

The Waiau diversion structure encroaches onto state lands managed by the DHHL (see Figure 1). Specifically, the encroachment involves approximately 1,600 square feet of the HELCO diversion structure for the Waiau Plant into adjacent DHHL property. HELCO is currently consulting with DHHL's Land Management Division to resolve the encroachment by obtaining an easement.

Figure 1. Waiau Diversion Structure Encroachment





SSFM International

February 17, 2017 SSFM 2016_008

Dr. Bruce Anderson
Department of Land and Natural Resources
Division of Aquatic Resources
1151 Punchbowl Street, Room 330
Honolulu, Hawai'i 96813

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Dr. Anderson:

Thank you for your letter dated January 4, 2017 (DAR #5459) regarding the subject project. We offer the following responses to your letter.

The proposed project will employ Best Management Practices during all phases of the project. We will notify you if there are any changes to the project plans. In addition, a copy of the Draft Environmental Assessment (EA) will be provided when published.

Your January 4 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 any additional comments or questions regarding this project, please contact Jennifer Scheffel at (808) 356-1273 or via email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

DAVID Y. IGE
GOVERNOR OF HAWAII

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

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
EMD/CWB

01008PMHK.17

January 9, 2017

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

Dear Ms. Scheffel:

SUBJECT: Comments on the pre-Environmental Assessment Consultation for Hawaii Electric Light Company Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Plant Repowering Hilo, Island of Hawaii, Hawaii TMKs: (3) 2-6-009:025

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated December 29, 2016, requesting comments on the subject project. The DOH-CWB has reviewed the document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. The Hawaii Electric Light Company (Applicant) may be responsible for fulfilling additional requirements related to our program. We recommend that they also read our standard comments on our website at: http://health.hawaii.gov/epo/files/2013/05/Clean-Water-Branch-Std-Comments.pdf.

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

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

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

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

2. The Applicant may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).

For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, your Applicant must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee ($1,000 for an individual NPDES permit or $500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: https://eha-cloud.doh.hawaii.gov/epermit/. They will be asked to do a one-time registration to obtain your login and password. After they register, click on the Application Finder tool and locate the appropriate form. They can then follow the instructions to complete and submit the form.

3. If your Applicant's project involves work in, over, or under waters of the United States, it is highly recommended that they contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

    Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

5. It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:

    a. Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects

Ms. Jennifer M. Scheffel
January 9, 2017
Page 3

01008PMHK.17

natural ecosystems and traditional beneficial uses of State waters, like community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological bio-engineering of drainage ways must be identified in the planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

b. Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g., minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.

c. Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.

d. Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.

e. Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.

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

Sincerely,

Alec Wong

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

MHK:ctt

c: Ms. Jennifer M. Scheffel, SSFM International, Inc. [via e-mail jscheffel@ssfm.com]
DOH-EPO [via e-mail Noella.Narimatsu@doh.hawaii.gov only]

SSFM International

February 17, 2017

SSFM 2016_008

Mr. Alec Wong, P.E., Chief
State of Hawai‘i Department of Health
Clean Water Branch
PO Box 3378
Honolulu, Hawai‘i 96801-3378

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai‘i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Wong:

Thank you for your letter dated January 9, 2017 (01008PMHK.17) regarding the subject project. The Draft Environmental Assessment (EA) will include an adequate review of the standard comments provided via the Department of Health's website. We offer the following responses to your comments.

1. The proposed project will be designed in accordance with the applicable Administrative Rules of the Department of Health, including Chapters 1-54 and 11-55.
2. National Pollutant Discharge Elimination System and related permits will be addressed in the Draft EA.
3. The proposed project will involve work over waters of the US, but will not involve work below the ordinary high water mark. A pre-assessment consultation letter has been sent to the U.S. Army Corps of Engineers.
4. Discharges associated with the proposed project will comply with the applicable State Water Quality Standards contained in the Administrative Rules of the Department of Health, including Chapters 11-54 and 11-55.
5. The proposed project will be designed to be consistent with the State's position regarding sustaining water quality and beneficial uses of State waters.
   a. The proposed project does not include any paving or landscaping.
   b. The Draft EA will include a discussion on water quality and the beneficial uses of State waters. The project will be designed to minimize impacts on natural resources and water quality.
   c. The proposed project does not include landscaping or associated irrigation.
   d. The proposed project does not include paving or landscaping.
   e. There is no stormwater infrastructure at the existing hydroelectric plants.

Your January 9 letter and this response letter will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

If you have any additional comments or questions on this matter or the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

Harry Kim
Mayor

SSFM INTERNATIONAL, INC.
RECEIVED
JAN 13 2017
JMS

Darren J. Rosario
Fire Chief

Renwick J. Victorino
Deputy Fire Chief

FILE COPY

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

January 10, 2017

Jennifer M. Scheffel
Sr. Environmental Planner
SSFM International
501 Summer Street, Suite 620
Honolulu, Hawai'i 96817

Dear Ms. Scheffel,

SUBJECT: Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

The Hawai'i Fire Department has no comments or issues with regard to the Wailuku River Hydroelectric Facilities long-term water lease and Waiau Plant Repowering application as noted above.

DARREN J. ROSARIO
Fire Chief

KV:ds

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

SSFM International

February 17, 2017

SSFM 2016_008

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

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Rosario:

Thank you for your letter dated January 10, 2017 regarding the subject project. We note that your department has no comments or issues with the proposed project.

Your January 10 letter, along with this response letter, will be included in the Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process.

Should you have any comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

Harry Kim
Mayor

County of Hawai`i

POLICE DEPARTMENT
349 Kapi`olani Street • Hilo, Hawai`i 96720-3998
(808) 935-3311 • Fax (808) 961-2389

Paul K. Ferreira
Police Chief

Kenneth Bugado, Jr.
Deputy Police Chief

RECEIVED
JAN 17 2017

FILE COPY

January 12, 2017

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

Dear Ms. Scheffel:

Subject: Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering, Hilo, HI
Tax Map Key (TMK): (3)2-6-009:025

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 Richard Sherlock, South Hilo Patrol, at 961-2214.

Sincerely,

HENRY J. TAVARES, JR.
ASSISTANT POLICE CHIEF
AREA I OPERATIONS

RS/lli
170002

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

SSFM International

February 17, 2017

SSFM 2016_008

Mr. Henry J. Tavares, Jr., Assistant Police Chief
County of Hawai'i
Hawai'i Police Department, Area 1 Operations
349 Kapiolani Street
Hili, HI 96720

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tavares:

Thank you for your letter dated January 12, 2017 regarding the subject project. We note that the County of Hawai'i Police Department does not anticipate significant impacts to traffic and/or public safety from the proposed project.

Your January 12 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 any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

501 Sumner Street | Suite 620 | Honolulu, Hawaii 96817 | Tel 808.531.1308 | 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 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

EPO 17-008

January 25, 2017

Ms. Jennifer M. Scheffel
Sr. Environmental Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817
Email: jscheffel@ssfm.com

Dear Ms. Scheffel:

SUBJECT: Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering, Hilo, Hawaii
TMK: (3) 2-6-009: 025

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your lease to our office on January 5, 2017.

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 and available strategies to support sustainable and healthy design are provided at: http://health.hawaii.gov/epo/landuse. Projects are required to adhere to all applicable standard comments.

EPO has recently updated the environmental Geographic Information System (GIS) website page. It now compiles various maps and viewers from our environmental health programs. The eGIS website page is continually updated so please visit it regularly at: http://health.hawaii.gov/epo/egis.

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 (HAR, Section 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, 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.

EPO recommends you review the need and/or requirements for a Clean Air Branch permit. The Clean Air Branch can be consulted via e-mail at: Cab.General@doh.hawaii.gov or via phone: (808) 586-4200.

A phase I Environmental Site Assessment (ESA) and site investigation should be conducted for residential development or redevelopment projects in current or formerly used industrial areas and on formerly and currently zoned agricultural land used for growing sugar, pineapple or other agricultural products. If the investigation shows that a release of petroleum, hazardous substance, pollutants or contaminants may have occurred at the site, the site

should be properly characterized through an approved Hawaii State Department of Health (DOH)/Hazard Evaluation and Emergency Response Office (HEER) soil and/or groundwater sampling plan. Please refer to Sections 3 and 4 of the HEER Office Technical Guidance Manual http://www.hawaiidoh.org If the site is found to be contaminated, then all removal and remedial actions to clean up hazardous substance or oil releases by past and present owners/tenants must comply with Chapter 128D, Environmental Response Law, HRS, and Title 11, Chapter 451, HAR, State Contingency Plan. To identify HEER records related to the property, visit http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/public-records

You may also wish to review the draft Office of Environmental Quality Control (OEQC) viewer at: http://eha-web.doh.hawaii.gov/oeqc-viewer. This viewer geographically shows where some previous Hawaii Environmental Policy Act (HEPA) {Hawaii Revised Statutes, Chapter 343} documents have been prepared.

In order to better protect public health and the environment, the U.S. Environmental Protection Agency (EPA) has developed a new 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 request that you utilize all of this information on your proposed project to increase sustainable, innovative, inspirational, transparent and healthy design. Thank you for the opportunity to comment.

Mahalo nui loa,

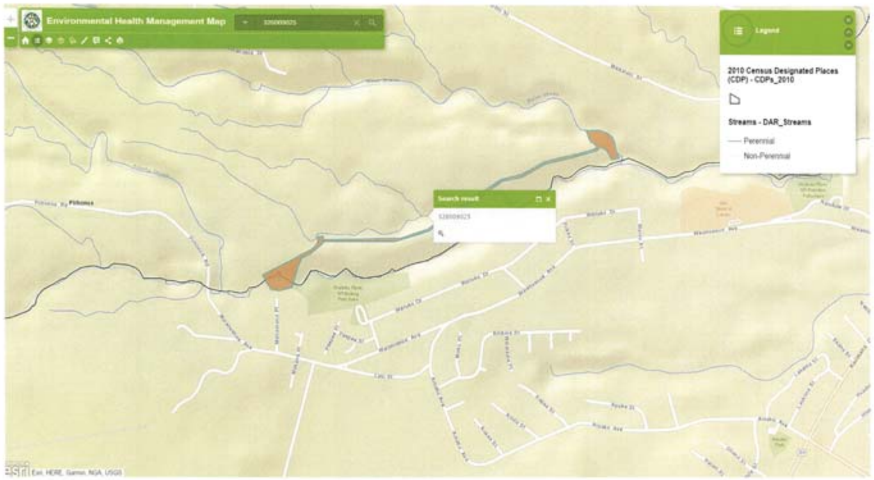
Laura Leialoha Phillips McIntyre, AICP
Program Manager, Environmental Planning Office

LM:nn

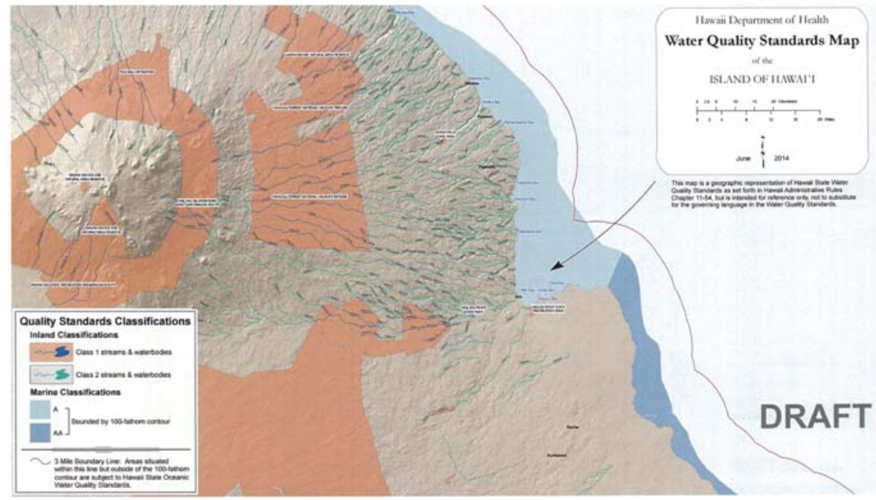
Attachment 1: Environmental Health Management Web App Snipit of Project Area: http://health.hawaii.gov/epo/egis
Attachment 2: Clean Water Branch: Water Quality Standards Map - Hawaii
Attachment 3: Wastewater Branch: Recycled Water Use Map of Project Area
Attachment 4: Historic Sugarcane Map of Project Area
Attachment 5: U.S. EPA EJSCREEN Report for Project Area

c: DOH: DHO HI, EMD, CWB, SDWB, CAB {via email only}

Attachment 1: Environmental Health Management Web App Snipit of Project Area: http://health.hawaii.gov/epo/egis

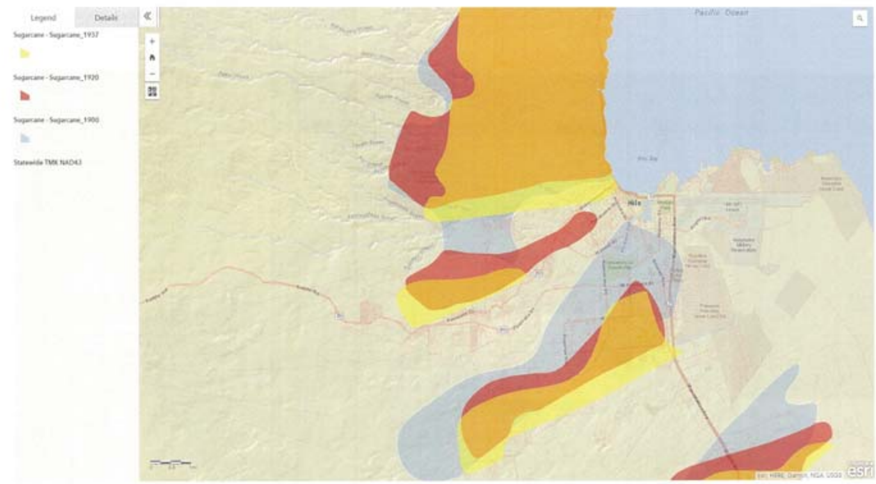


Attachment 2: Clean Water Branch: Water Quality Standards Map - Hawaii



Attachment 3: Wastewater Branch: Recycled Water Use Map of Project Area

Attachment 4: Historic Sugarcane Map of Project Area



Attachment 5: U.S. EPA EJSCREEN Report for Project Area

EPA United States Environmental Protection Agency

EJSCREEN Report (Version 2016)

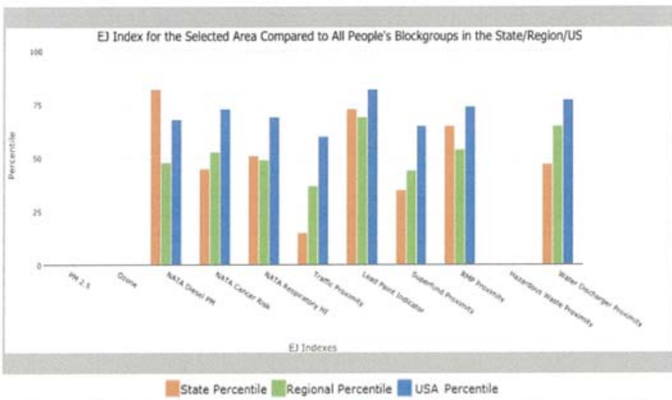
1 mile Ring Centered at 19.714556,-155.136176, HAWAII, EPA Region 9

Approximate Population: 1,988

Input Area (sq. miles): 3.14

Wailuku River Hyrdroelectric Facilities

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	82	48	68
EJ Index for NATA* Air Toxics Cancer Risk	45	53	73
EJ Index for NATA* Respiratory Hazard Index	51	49	69
EJ Index for Traffic Proximity and Volume	15	37	60
EJ Index for Lead Paint Indicator	73	69	82
EJ Index for Superfund Proximity	35	44	65
EJ Index for RMP Proximity	65	54	74
EJ Index for Hazardous Waste Proximity*	N/A	N/A	N/A
EJ Index for Water Discharger Proximity	47	65	77



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 2016)

1 mile Ring Centered at 19.714556,-155.136176, HAWAII, EPA Region 9

Approximate Population: 1,988

Input Area (sq. miles): 3.14

Wailuku River Hyrdroelectric Facilities

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0
National Pollutant Discharge Elimination System (NPDES)	0

EPA United States Environmental Protection Agency

EJSCREEN Report (Version 2016)

1 mile Ring Centered at 19.714556,-155.136176, HAWAII, EPA Region 9

Approximate Population: 1,988

Input Area (sq. miles): 3.14

Wailuku River Hyrdroelectric Facilities

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	9.37	N/A	9.32	N/A
Ozone (ppb)	N/A	N/A	N/A	51	N/A	47.4	N/A
NATA* Diesel PM (µg/m³)	0.331	0.149	90	0.978	<50th	0.937	<50th
NATA* Cancer Risk (lifetime risk per million)	34	34	60	43	<50th	40	<50th
NATA* Respiratory Hazard Index	1.1	1	63	2	<50th	1.8	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	1.1	990	6	1100	3	590	5
Lead Paint Indicator (% Pre-1960 Housing)	0.3	0.16	76	0.24	64	0.3	60
Superfund Proximity (site count/km distance)	0	0.098	29	0.15	13	0.13	16
RMP Proximity (facility count/km distance)	0.19	0.19	76	0.57	45	0.43	53
Hazardous Waste Proximity⁺ (facility count/km distance)	N/A	0.14	N/A	0.14	N/A	0.11	N/A
Water Discharger Proximity (facility count/km distance)	0.17	0.34	42	0.2	67	0.31	56
Demographic Indicators							
Demographic Index	50%	52%	43	47%	55	36%	73
Minority Population	77%	77%	39	58%	67	37%	83
Low Income Population	21%	26%	43	36%	31	35%	31
Linguistically Isolated Population	0%	6%	23	9%	19	5%	44
Population With Less Than High School Education	10%	9%	63	17%	41	14%	47
Population Under 5 years of age	3%	6%	15	7%	18	6%	19
Population over 64 years of age	24%	15%	87	13%	90	14%	90

* 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.

+ The hazardous waste environmental indicator and the corresponding EJ index will appear as N/A if there are no hazardous waste facilities within 50 km of a selected location.

For additional information, see: www.epa.gov/environmentaljustice

SSFM International

February 17, 2017 SSFM 2016_008

Ms. Laura Leialoha Phillips McIntyre, AICP, Program Manager
State of Hawaii Department of Health
Environmental Planning Office
P.O. Box 3378
Honolulu, HI 96801

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Ms. McIntyre:

Thank you for your letter dated January 25, 2017 (EPO 17-008) regarding the subject project. We offer the following response to your comments.

The Draft Environmental Assessment (EA) will include an adequate review of the standard comments provided via the Department of Health Environmental Planning Office website. Furthermore, we appreciate your information regarding online resources. We will utilize these resources during the preparation of the Draft EA. A copy of the Draft EA will be provided to you for review when published.

Your January 25 letter, along with this response, will be included in the Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Should you have any additional comment or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

Harry Kim
Mayor

Wilfred M. Okabe
Managing Director

Barbara J. Kossow
Deputy Managing Director

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JAN 2 6 2017

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County of Hawai'i
Office of the Mayor

25 Aupuni Street, Suite 2603 • Hilo, Hawai'i 96720 • (808) 961-8211 • Fax (808) 961-6553
KONA: 74-5044 Ane Keohokalole Hwy., Bldg C • Kailua-Kona, Hawai'i 96740
(808) 323-4444 • Fax (808) 323-4440

January 23, 2017

Jennifer M. Scheffel
Senior Environmental Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawai`i 96817

Subject: Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai`i
TMK: (3) 2-6-009-:025

Dear Ms. Scheffel,

Thank you for providing the County of Hawai`i with the opportunity to provide comments in preparation for the development of an Environmental Assessment (EA) for Hawai`i Electric Light Company's (HELCO) proposed improvements to the Wailuku River Hydroelectric Facilities, Long-Term Water Lease and Waiau Plant Repowering project.

The County of Hawai`i supports this project for the following reasons:

- The proposed improvements and water lease will maximize existing and new renewable energy sources from surviving and permitted hydro power sources at a minimum cost. Compared to other existing Renewable Energy Power Purchase Agreements ("PPAs") this project is cost-effective in the range of 8-9 cents/kWh versus other renewable projects that can be 15-20 cents/kWh. Further, the low project costs will remain stable over the 65-year life of the project and act as a hedge against upward changes in fossil fuel prices and renewable energy PPAs tied to HELCO's avoided cost of energy.
- The proposed improvements will occur at an existing site that minimizes public intrusion and impact.
- Additionally, this project has many benefits that could not be obtained elsewhere as it takes advantage of high rainfall on the East-side of the Island.

- Finally, hydro units are exceptional projects in that the equipment is very robust and has proven to last upwards of 100 years.

Again, thank you for providing the opportunity to offer comments.

Sincerely,

Harry Kim

Harry Kim
Mayor

HK:gs

Cc: Diane L. Ley, Director
Department of Research & Development

SSFM International

February 17, 2017 SSFM 2016_008

Mr. Harry Kim, Mayor
County of Hawai‘i
Office of the Mayor
25 Aupuni Street, Suite 2603
Hilo, HI 96720

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai‘i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Kim:

Thank you for your letter dated January 23, 2017 regarding the subject project. We appreciate the support of the County of Hawai‘i Mayor's Office.

Your January 23 letter, along with this response letter, will be included in the Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

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

January 26, 2017

SSFM International, Inc.
Attn: Ms. Jennifer M. Scheffel, Sr. Environmental Planner via email: jscheffel@ssfm.com
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Scheffel:

SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering

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) Land Division – Hawaii District, (b) Land Division - Administration, and (c) Division of Forestry & Wildlife on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

2017 JAN -9 P 1:13
RECEIVED
LAND DIVISION
HILO, HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

January 5, 2017

2017 JAN 17 AM 11:30
RECEIVED
LAND DIVISION
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

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
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowring
LOCATION: Hilo, Island of Hawaii; TMK: (3) 2-6-009:025
APPLICANT: Hawaii Electric Light Company, Inc.

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **January 25, 2017.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed:

Print Name: GORDON C. HEIT
Date: 1/12/17

cc: Central Files
Kevin Moore
Ian Hirokawa

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

January 5, 2017

RECEIVED
LAND DIVISION
2017 JAN 12 AM 7:21
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

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
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering
LOCATION: Hilo, Island of Hawaii; TMK: (3) 2-6-009:025
APPLICANT: Hawaii Electric Light Company, Inc.

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **January 25, 2017.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed: Ian H

Print Name: Ian Hirokawa
Date: 1/12/17

cc: Central Files
Kevin Moore
Ian Hirokawa

17004

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
LAND DIVISION
AM 10:55
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

January 5, 2017

MEMORANDUM

~~TO:~~ FR: **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
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

~~FROM:~~ TO: Russell Y. Tsuji, Land Administrator
SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering
LOCATION: Hilo, Island of Hawaii; TMK: (3) 2-6-009:025
APPLICANT: Hawaii Electric Light Company, Inc.

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **January 25, 2017.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed:

Print Name: DAVID G. SMITH
Date: 1/19/17

cc: Central Files
Kevin Moore
Ian Hirokawa

SSFM International

February 17, 2017 SSFM 2016_008

Mr. Russell Y. Tsuji, Land Administrator
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai‘i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tsuji:

Thank you for your letter dated January 26, 2017 regarding the subject project. We appreciate you distributing the pre-assessment consultation letter throughout the Department of Land and Natural Resources. We note that the Land Division – Hawai‘i District has no objections to the proposed project. We also note that the Land Division – Administration and the Division of Forestry and Wildlife have no comments.

Your January 26 letter, along with this response letter, will be included in the Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process.

Should you have any comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

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)1026.7

FILE COPY

JAN 27 2017

SSFM INTERNATIONAL, INC.
RECEIVED
JAN 30 2017
JMS

RECEIVED
JAN 30 2017
SSFM INTERNATIONAL, INC.
FILE

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

Dear Ms. Scheffel:

Subject: Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawaii
Tax Map Key (TMK): (3) 2-6-009:025

This is in response to your letter dated December 29, 2016 regarding the subject project. The proposed long-term water lease and project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

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

Sincerely,

RODERICK K. BECKER
Comptroller

c: Mr. Jerry Watanabe, DAGS Hawaii District Office

SSFM International

February 17, 2017

SSFM 2016_008

Mr. Roderick Becker, Comptroller
State of Hawaiʻi Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawaiʻi 96810-0019

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawaiʻi
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Becker:

Thank you for your letter dated January 27, 2017 ((P)1026.7) regarding the subject project. We note that your department has not comments at this time.

Your January 27 letter, along with this response letter, will be included in the Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process.

Should you have any comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

January 30, 2017

Subject: Wailuku River Hydroelectric Facilities

Long-Term Water Lease and Waiau Plant Repowering

Hilo, Hawaii

Tax Map Key (TMK): (3) 2-6-009:025

Dear HELCO/SSFN

Regarding ENVIRONMENTAL ASSESSMENT

I would like to commend you on your decision to upgrade the two hydroelectric stations along the Wailuku River. Your reuse of existing infrastructure is superb. You will be able to produce clean energy in the midst of a large population center borrowing a natural resource for a short while and then returning it to its rightful place. This project will benefit our Island community greatly. I support your endeavor! However there is an idea I wish to present to you regarding the Wailuku River. The water in the river comes from our Aina. The uka upland forests of ohia, hapuu and the many other families that generate rain fall and moisture fills the Wailuku River. You will not have your Hydro station in Ka`u: No can, no more river! That is how special the land is along the Wailuku River. Just as special as the Wailuku River itself and upland forest that feed Wailuku. In Hawaii's past, companies used the land and made great profit, provided commerce and employment on the Islands. As sugar became no longer profitable they closed down and left the Island and her people to fend for themselves. The land which gave so much was just cast aside. Invasive species, erosion. This is all water under the bridge. My proposal to you is this: Donate 2% of the profits generated by the two Hydro stations to a Conservation Fund. This fund would be available to organizations and groups wishing to do Conservation, preservation of things of our Aina. There people actively cleaning, rebuilding, educating with Loko ia (fishponds) around the island. The State Division of Forestry and Wildlife is attempting to create a Koa Canoe log forest in Kapapala so there will be canoe logs for future generations of paddlers as well as to perpetuate Hawaiian canoe culture. There are groups around the Island working with our children and young adults, bringing awareness of our Aina and our deeply forgotten, in many cases spiritual connection to our Aina. The point is these groups need financial help to get important Aina projects where they need to be. People would apply for grants and all that entails, reporting back results as well as 2 or 4 year updates. There are nonprofit organizations that could possibly mange this type of program for you. One that comes to mind is (KUA AINA ULU Auamo) (808) 627-2545 you may specify that this funding go towards the Island of Hawaii. Should you wish to talk story more on the invitation I would be happy to work with you in gathering a better understanding of what this could do for our people and our Aina. Thank you for reading this invitation. As the world population grows to more than nine billion, science tells us that to create a world where nature and people thrive together we must act swiftly and with urgency to generate the biggest impact as quickly as possible. Please give back to the land.

Aloha Aina,

John R. Replogle

jreplogle@tnc.org

(808) 936-7161

SSFM International

February 17, 2017 SSFM 2016_008

Mr. John R. Replogle
The Nature Conservancy of Hawaiʻi
Hawaiʻi Island Program
PO Box 1132
Naʻalehu, HI 96772

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawaiʻi
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Replogle:

Thank you for your email dated January 30, 2016 with attached comments on the subject project. We would like to thank you for your comments and support of the proposed project; HELCO offers the following response.

In fulfilling our mission to empower our customers and communities with affordable, reliable, clean energy, the Hawaiian Electric Companies are also committed to being good stewards of the environment, and we take our responsibility very seriously.

As you may know, the Companies have been long-time supporters of The Nature Conservancy, and have also supported many nonprofit community and environmental-related organizations on Hawaiʻi Island through corporate contributions and employee volunteer projects.

In 2016, Hawaiʻi Electric Light employees and their friends and families volunteered 3,420 hours to 78 community service projects, and donated more than $75,000 to Hawaiʻi Island United Way.

For funding of individual projects and programs, we invite The Nature Conservancy and other nonprofit organizations to apply for an HEI Charitable Foundation grant. Full details on the application process can be found at hei.com under the Community Advancement section.

Should you have any comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

Harry Kim
Mayor

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

County of Hawaiʻi
PLANNING DEPARTMENT

Michael Yee
Director

Daryn Arai
Deputy Director

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

January 27, 2017

Ms. Jennifer Scheffel
SSFM International, Inc.
501 Sumner Street
Honolulu, HI 96817

Dear Ms. Scheffel:

SUBJECT: Pre-Consultation for Draft Environmental Assessment
Project: Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Plant Repowering
TMKs: (3) 2-6-007:001, (3) 2-6-009:025, & (3) 2-6-029: 044, Hilo, Hawaiʻi

Thank you for your letter dated December 29, 2016, requesting comments from this office regarding the preparation of a Draft Environmental Assessment (EA) for the subject project.

Hawaii Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawaii. HELCO is currently diverting and using water from the Wailuku River for hydroelectric production at their Waiau and Puʻuʻeo Plants pursuant to Revocable Permit No. S-7463. On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR work with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the Board of Land and Natural Resources (BLNR) (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puʻuʻeo Plants located alongside the Wailuku River in Hilo.

In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant, which is located at the confluence of the Wailuku River and Waiau Stream on a bluff overlooking Kaimukanaka Falls (TMK (3) 2-6-009:025). HELCO's Waiau Plant is a "run-of-the-river" hydroelectric plant served by a diversion and intake structure located on the Wailuku River near Hilo on Hawaii Island, just upstream of Peʻepeʻe Falls, and a 4,888-foot-long buried steel penstock to transport water from the diversion to the plant. The Waiau Plant was constructed in 1920 with a single 750 kilowatt (kW) horizontal-axis hydraulic Pelton turbine generator, referred

as Unit 1. In 1928, a second Pelton 350 kW unit, referred to as Unit 2, was relocated from the Puʻuʻeo Plant to the Waiau Plant. On July 29, 2016, HELCO filed their application with the Hawaii Public Utilities Commission (HPUC) for the expenditure of funds to upgrade the Waiau Plant.

TMK: (3) 2-6-007:001 Puʻuʻeo Plant and Substation
This is part of a request for a long term water lease only. No other changes are proposed for this site. The project site zoning designation is Multiple-Family Residential (RM-1) and is situated within the State Land Use Urban District. Adjacent river property is within the State Land Use Conservation District. In addition, according to the County of Hawaiʻi General Plan 2005 (amended December 2006), the subject property is designated as Medium Density Urban by the Land Use Pattern Allocation Guide. The subject area is not within the Special Management Area (SMA).

TMK: (3) 2-6-029:044 Puʻuʻeo Diversion/Headrace
This is part of a request for a long term water lease only. No other changes are proposed for this site. The project site zoning designation is Agricultural (A-20a) and is situated within the State Land Use Conservation District. In addition, according to the County of Hawaiʻi General Plan 2005 (amended December 2006), the subject property is designated as Conservation by the Land Use Pattern Allocation Guide. The subject area is not within the Special Management Area (SMA).

TMK: (3) 2-6-009:025 Waiau Plant
The Waiau Plant was constructed in 1920 with a single 750 kilowatt (kW) horizontal-axis hydraulic Pelton turbine generator, referred as Unit 1. In 1928, a second Pelton 350 kW unit, referred to as Unit 2, was relocated from the Puʻuʻeo Plant to the Waiau Plant. The repowering component of the Proposed Action would include the following at the Waiau Plant.

1. Repowering (i.e., replacement) of Unit 2
2. Rehabilitation of Unit 1
3. Penstock Replacement
4. Powerhouse Modifications
5. Substation Modifications

The project site is zoned Agricultural (A-20a) and Open by the County of Hawaii. The project site is situated within the State Land Use Agricultural and Conservation Districts. In addition, according to the County of Hawaiʻi General Plan 2005 (amended December 2006), the subject property is designated as Intensive Agricultural Land and Conservation by the Land Use Pattern Allocation Guide. The subject area is not within the Special Management Area (SMA).

Comments
Please verify that the proposed is in conformance with Hawaiʻi Revised Statutes (HRS) §205-4.5 (23). A special permit as defined in HRS §205-6 may be required if the proposed work does not conform to HRS §205-4.5(23). Additionally, the applicant shall secure all necessary approvals and permits from other affected federal, state, and county agencies as necessary to comply with all applicable laws and regulations.

Please provide us with a copy of the Draft EA for our review.

Ms. Jennifer Scheffel
SSFM International, Inc.
January 27, 2017
Page 3

If you have any questions or if you need further assistance, please feel free to contact Hans Santiago of this office at 961-8165.

Sincerely,

for MICHAEL YEE
Planning Director

HKS:
P:\wpwin60\Hans\EA-EIS Review\Wailuku River Hydroelectric Facilities-TMK26009025.doc

---

SSFM International

February 17, 2017 SSFM 2016_008

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

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Yee:

Thank you for your letter dated January 27, 2017 regarding the proposed project. We offer the following response to your comment.

The Draft Environmental Assessment (EA) will evaluate the proposed project's conformance with state and county land use plans and policies, as well as provide a list of permits and approvals required for the project.

A copy of your January 27 letter, as well as this response letter, will be included in the Draft EA. We appreciate your participation in the pre-assessment consultation review process. A copy of the Draft EA will be provided for your review when published.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

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

February 1, 2017

SSFM INTERNATIONAL, INC.
RECEIVED
FEB 06 2017
JMS
FILE

Ms. Jennifer M. Scheffel
SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, HI 96718

Dear Ms. Scheffel:

Subject: Pre-Environmental Assessment
Hawai'i Electric Light Company, Inc.
Wailuku River Hydroelectric Facilities
Tax Map Key 2-6-009:025

FILE COPY

This is in response to your Pre-Environmental Assessment letter dated December 29, 2016.

Please be informed that there are no Department of Water Supply facilities within the proposed project area.

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

February 17, 2017 SSFM 2016_008

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

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Okamoto:

Thank you for your letter dated February 1, 2017 regarding the subject project. The information you have provided will be included in the Draft Environmental Assessment (EA).

Additionally, your February 1 letter, as well as this response letter, will be included in the Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

501 Sumner Street | Suite 620 | Honolulu, Hawaii 96817 | Tel 808.531.1308 | Fax 855.329.7736 | www.ssfm.com
Planning | Project & Construction Management | Structural, Civil & Traffic Engineering

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

February 8, 2017

SSFM International, Inc.
Attn: Ms. Jennifer M. Scheffel, Sr. Environmental Planner via email: jscheffel@ssfm.com
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Scheffel:

SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent you on January 26, 2017, enclosed are comments from the Engineering Division on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2017 FEB -7 AM 11:47
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

January 5, 2017

'17 JAN 6 AM 10:29 ENGINEERING

MEMORANDUM

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

To: ~~FROM:~~ Russell Y. Tsuji, Land Administrator
SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering
LOCATION: Hilo, Island of Hawaii; TMK: (3) 2-6-009:025
APPLICANT: Hawaii Electric Light Company, Inc.

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **January 25, 2017.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed:

Print Name: Carty S. Chang, Chief Engineer
Date: 1/9/17

cc: Central Files
Kevin Moore
Ian Hirokawa

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Tsuji
Ref: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering

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 designated Flood Hazard.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zone designations can be found using the Flood Insurance Rate Map (FIRM), which can be accessed through the Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT).

Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may take precedence over the NFIP standards as local designations prove to be more restrictive. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7253.
- Kauai: County of Kauai, Department of Public Works (808) 241-4846.

Signed: [signature]
CARTY S. CHANG, CHIEF ENGINEER

Date: 1/9/17

SSFM International

March 1, 2017 SSFM 2016_008

Mr. Russell Y. Tsuji, Land Administrator
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tsuji:

Thank you for your letter dated February 8, 2017 regarding the subject project. We appreciate you distributing the pre-assessment consultation letter throughout the Department of Land and Natural Resources. We offer the following response to the Engineering Division comments:

The Flood Hazard Zone designation(s) for the project area will be included in the Draft Environmental Assessment. The proposed project will comply with the local flood ordinance, as applicable.

Your February 8th letter, along with this response letter, will be included in the Draft Environmental Assessment. We appreciate your participation in the pre-assessment consultation review process.

Should you have any comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

[signature]

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Ushida (HELCO)
Yvonne Izu (Morihara Group)

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

February 27, 2017

SSFM International, Inc.
Attn: Ms. Jennifer M. Scheffel, Sr. Environmental Planner via email: jscheffel@ssfm.com
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Scheffel:

SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent you on January 26, and February 8, 2017, enclosed are comments from the Commission on Water Resource Management on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

RECEIVED
LAND DIVISION
2017 FEB 24 AM 11: 0
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

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

January 5, 2017

RECEIVED
COMMISSION ON WATER RESOURCE MANAGEMENT
2016 JAN -6 PM 1:55

MEMORANDUM

FR:

~~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
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

TO:

~~FROM:~~ Russell Y. Tsuji, Land Administrator
SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering
LOCATION: Hilo, Island of Hawaii; TMK: (3) 2-6-009:025
APPLICANT: Hawaii Electric Light Company, Inc.

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project. Please submit any comments by **January 25, 2017.**

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed: /s/ Jeffrey T. Pearson, P.E.

Print Name: Deputy Director
Date: February 22, 2017

cc: Central Files
Kevin Moore
Ian Hirokawa

RFD. 4544.8
14403

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
KAMANA BEAMER, PH.D.
MICHAEL G. BUCK
NEIL J. HANNAHS
MILTON D. PAVAO
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

February 22, 2017

REF: RFD.4544.8

TO: Mr. Russell Tsuji, Administrator
State of Hawaii, DLNR Land Division Oahu, DLNR-LD

FROM: Jeffrey T. Pearson, P.E., Deputy Director
Commission on Water Resource Management

SUBJECT: Wailuku River Hydroelectric Facilities; Long-Term Water Lease and Waiau Plant Repowering

FILE NO.: RFD.4544.8
TMK NO.: (3) 2-6-009:025

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:

If you have any questions, please contact Dean Uyeno of the Commission staff at 587-0234.

SSFM International

September 15, 2017 SSFM 2016_008

Mr. Jeffrey T. Pearson, P.E., Deputy Director
State of Hawaiʻi Department of Land and Natural Resources
Commission on Water Resource Management
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawaiʻi
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Pearson:

Thank you for your letter dated February 22, 2017 (REF: RFD.4544.8) regarding the subject project. The Proposed Action as presented in the Draft Environmental Assessment does not include any new diversion structures or modifications to the existing structures. In addition, there would be no new or expanded diversions of surface water. Therefore, a Stream Diversion Works Permit and Petition to Amend the Interim Instream Flow Standard are not anticipated to be required for the project.

Your February 22nd letter and this response letter will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

If you have any additional comments or questions on this matter or the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

A-2 Comments Received on the Draft EA and Responses

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From: - -
To: norman.uchida@hawaiielectriclight.com; Jennifer Scheffel
Subject: HELCO Long-term Water Lease
Date: Thursday, March 8, 2018 10:35:14 PM

Aloha,

Below are my comments on the subject project DEA.

Can the current revocable permit no. S-7463 be attached to the EA for review?

What are the requirements of the current revocable permit and has HELCO satisfied all permit requirements?

Is the current water diversion metered? If not, will it be metered or can a meter be installed during this project?

Are there any reporting of water use being conducted currently? If not, will there be?

A Building Permit must be required for the work at the Plants (e.g., building renovations with mechanical drawings)

Was the Army Corp consulted regarding proposed work? Please submit DEA to them for review and comment.

Army Corp permits should be looked into more as some of the work may trigger their required permits. Where is the dewatering water planned to be discharged?

Are there any checks and balances to ensure that the water that is returned to the river will be the same or better quality of water?

HELCO is using water that is a natural resource and making money off of it. How will this save the current Hawaii County residences money in their pockets when they use HELCO electricity and have to pay for it? Is their any cost saving for the average household in Hawaii County?

Is only 300-ft of penstock being replaced? What if additional penstock length needs to be replaced, how will this be addressed during construction? What's the condition of the remaining penstock no being replaced? Where is the 20-ft ROW on HELCO property, I didn't see that on the maps?

The 65-year lease is too long. This gives one company too much control over a large amount of water for a lengthy time. With global warming it is uncertain to tell how much rainfall there would be in the future years and if their are droughts water will be scarce. The lease should be shortened to at most 5-years and have proper check and balances to ensure no abuse. If not, the long term lease should not be allowed.

Thank you for allowing the community to review and provide comments on this DEA.

Sent from my iPhone

SSFM International

March 19, 2018 SSFM 2016_008

hawaiibooks@hotmail.com
VIA EMAIL

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai‘i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Sir or Madam:

Thank you for your comments and questions on the Draft Environmental Assessment (EA) for the subject project. We appreciate your comments and offer the following responses.

Can the current revocable permit no. S-7463 be attached to the EA for review?

RESPONSE: The current permit will be attached as an appendix to the Final EA.

What are the requirements of the current revocable permit and has HELCO satisfied all permit requirements?

RESPONSE: HELCO has satisfied permit requirements. The Board of Land and Natural Resources renewed the revocable permit (RP) again in December 2017 without comment (regarding permit conditions) from the staff or board members.

Is the current water diversion metered? If not, will it be metered or can a meter be installed during this project?

RESPONSE: The current water diversion is not metered and there are no plans to install a meter as part of the Proposed Action. Water flow through the Waiau and Puueo Plants is indirectly measured using power output of the generators. In addition, the use of the water is a non-consumptive use, meaning that all water is returned to the river at the plants.

Are there any reporting of water use being conducted currently? If not, will there be?

RESPONSE: Monthly reports on water throughput are filed with the State of Hawaii Commission on Water Resources Management, DLNR.

A Building Permit must be required for the work at the Plants (e.g., building renovations with mechanical drawings)

RESPONSE: Work at the Waiau Plant is limited to work on the generators, replacement of a section of penstock, and other work as described in the Draft EA. The Proposed Action does not include building renovations, and it is expected that a building permit would not be required. However, HELCO will obtain all of the necessary County permits for all work associated with the Proposed Action.

Was the Army Corp consulted regarding proposed work? Please submit DEA to them for review and comment.

RESPONSE: The U.S. Army Corps of Engineers (USACE) was consulted as part of the Pre-Assessment Consultation process for the Draft EA. They did not provide any comments. A copy of the Draft EA has been provided to the USACE.

Army Corp permits should be looked into more as some of the work may trigger their required permits. Where is the dewatering water planned to be discharged?

RESPONSE: There will be no work in Waters of the U.S., and no permit from the USACE is expected to be required. No dewatering is associated with the Proposed Action.

Are there any checks and balances to ensure that the water that is returned to the river will be the same or better quality of water?

RESPONSE: The design of the two hydroelectric plants is such that all water drawn from the river is returned to the river without the addition of any foreign matter or additives. The quality of the water that is returned to the river is unchanged.

HELCO is using water that is a natural resource and making money off of it. How will this save the current Hawaii County residences money in their pockets when they use HELCO electricity and have to pay for it? Is their any cost saving for the average household in Hawaii County?

RESPONSE: HELCO’s use of the water is non-consumptive (i.e., all water taken in by the plant will be returned to the river just downstream of the facility. The production of electricity by a hydroelectric plant reduces the amount of fossil fuel used by HELCO, and savings are passed on to HELCO’s customers in the form of reduced energy rates. The financials for the Proposed Action were reviewed by the State Consumer Advocate and approved by the Public Utilities Commission in Decision and Order No. 34868 in Docket No. 2016-0192, which is publicly available. The project also further reduces the cost of power from the plant while providing environmental benefits since reducing the amount of fossil fuel that is utilized to generate energy reduces greenhouse gas emissions (i.e., carbon dioxide). The project is anticipated to save the average HELCO customer money on their electric bill. Specifics regarding these projected savings can be found in the PUC docket.

Is only 300-ft of penstock being replaced? What if additional penstock length needs to be replaced, how will this be addressed during construction? What's the condition of the remaining penstock no being replaced? Where is the 20-ft ROW on HELCO property, I didn't see that on the maps?

RESPONSE: The balance of the 4,888-foot-long penstock was replaced in 1949 and relined with cement mortar in 1998 and is not in need of replacement. The “Pipeline 20’ ROW” is provided in the easement document for Grant 7587. The description of the ROW will be included as an appendix of the Final EA.

The 65-year lease is too long. This gives one company too much control over a large amount of water for a lengthy time. With global warming it is uncertain to tell how much rainfall there would be in the future years and if their are droughts water will be scarce. The lease should be shortened to at most 5-years and have proper check and balances to ensure no abuse. If not, the long term lease should not be allowed.

RESPONSE: As described in the Draft EA, the original Waiau Hydro units have been in operation since at least the 1920s and hydroelectric facilities are generally long-term investments. Therefore, in order to realize the most benefit for customers, as well as to assist in the goal of 100% renewable energy by 2045, HELCO is seeking a longer lease. Although HELCO has applied for a 65 year lease, the period of the lease is at the discretion of the DLNR. The Waiau Hydro facility is a run-of-the-river hydroelectric facility; therefore, it only uses water as available from the flow of the river, which is then returned to the river just downstream of the facility.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

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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:

EPO 18-065

March 22, 2018

Ms. Jennifer M. Scheffel
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817
Email: jscheffel@ssfm.com

Dear Ms. Scheffel:

SUBJECT: Draft Environmental Assessment (DEA) for Wailuku River Hydroelectric Facilities Long-term Water Lease and Waiau Repowering
TMK: (3) 2-6-009: 025, 005; 2-6-007: 001; 2-6-019: 044

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your DEA to our office via the OEQC link:
http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2018-03-08-HA-DEA-HELCO-Wailuku-River-Long-term-Water-Lease.pdf

We understand from the OEQC publication form project summary that *"Hawaii Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawaii. HELCO is currently diverting and using water from the Wailuku River for hydroelectric production at their Waiau and Puueo Plants pursuant to Revocable Permit No. S-7463 issued by the Board of Land and Natural Resources (BLNR). On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR work with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the BLNR (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puueo Plants located alongside the Wailuku River in Hilo. In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant."*

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.

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.

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.

You may also wish to review the draft Office of Environmental Quality Control (OEQC) viewer at: http://eha-web.doh.hawaii.gov/oeqc-viewer. This viewer geographically shows where some previous Hawaii Environmental Policy Act (HEPA) {Hawaii Revised Statutes, Chapter 343} documents have been prepared.

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: Norman Uchida, HELCO (via email: Norman.Uchida@hawaiielectriclight.com)
Ian Hirokawa, DLNR (via email: Ian.c.hirokawa@hawaii.gov)
DOH: DHO HI, CWB, SDWB, CAB, IRHB {via email only}

Attachment 1: Office of Environmental Quality Control (OEQC) viewer (of some past EA's, EIS's in area)
Attachment 2: U.S. EPA EJSCREEN Report for Project Area

Attachment 1: Office of Environmental Quality Control (OEQC) viewer (of some past EA's, EIS's in area)

Attachment 2: U.S. EPA EJSCREEN Report for Project Area

EPA United States Environmental Protection Agency

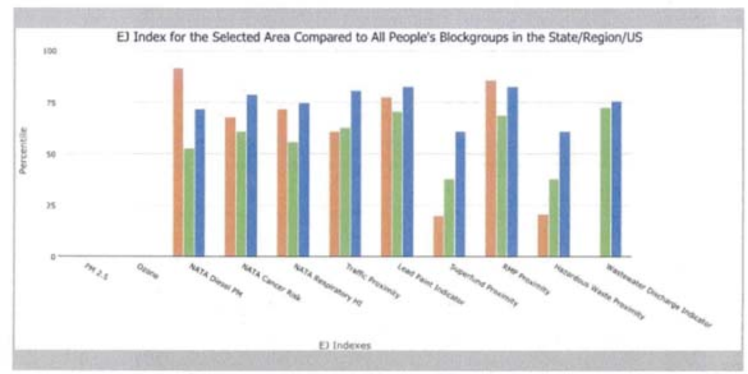
EJSCREEN Report (Version 2017)

1 mile Ring Centered at 19.727506,-155.089907, HAWAII, EPA Region 9

Approximate Population: 4,564

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	92	53	72
EJ Index for NATA* Air Toxics Cancer Risk	68	61	79
EJ Index for NATA* Respiratory Hazard Index	72	56	75
EJ Index for Traffic Proximity and Volume	61	63	81
EJ Index for Lead Paint Indicator	78	71	83
EJ Index for Superfund Proximity	20	38	61
EJ Index for RMP Proximity	86	69	83
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.

1 mile Ring Centered at 19.727506,-155.089907, HAWAII, EPA Region 9

Approximate Population: 4,564

Input Area (sq. miles): 3.14

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

1 mile Ring Centered at 19.727506,-155.089907, HAWAII, EPA Region 9

Approximate Population: 4,564

Input Area (sq. miles): 3.14

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in $\mu g/m^3$)	N/A	N/A	N/A	9.9	N/A	9.14	N/A
Ozone (ppb)	N/A	N/A	N/A	41.8	N/A	38.4	N/A
NATA* Diesel PM ($\mu g/m^3$)	0.403	0.149	91	0.978	<50th	0.938	<50th
NATA* Cancer Risk (lifetime risk per million)	38	34	78	43	<50th	40	<50th
NATA* Respiratory Hazard Index	1.3	1	78	2	<50th	1.8	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	190	1000	52	1100	44	590	62
Lead Paint Indicator (% Pre-1960 Housing)	0.26	0.16	74	0.24	61	0.29	57
Superfund Proximity (site count/km distance)	0.0028	0.1	5	0.15	0	0.13	0
RMP Proximity (facility count/km distance)	0.71	0.39	85	0.98	60	0.73	68
Hazardous Waste Proximity (facility count/km distance)	0.0029	0.1	5	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	67%	51%	90	47%	77	36%	86
Minority Population	81%	77%	45	59%	70	38%	84
Low Income Population	54%	26%	93	36%	76	34%	80
Linguistically Isolated Population	2%	6%	44	9%	31	5%	59
Population With Less Than High School Education	10%	9%	68	17%	43	13%	50
Population Under 5 years of age	6%	6%	44	7%	42	6%	46
Population over 64 years of age	14%	16%	47	13%	67	14%	59

* 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.

SSFM International

April 20, 2018 SSFM 2016_008

Ms. Laura Leialoha Phillips McIntyre, AICP
Department of Health, Environmental Planning Office
P.O. Box 3378
Honolulu, HI 96801-3378

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Ms. McIntyre:

Thank you for your letter dated March 22, 2018 (EPO 18-065) providing comments on the Draft Environmental Assessment (EA) for the subject project. On behalf of the Hawaii Electric Light Company (HELCO), we offer the following responses to your comments:

Hawaii's Environmental Review Laws
Direct, indirect (secondary), and cumulative effects are addressed in Chapter 3 of the Draft and Final EA. The assessment of impacts on public health has been expanded in Section 5.1 of the Final EA.

State and Federal Environmental Health Land Use Guidance
The State Standard Comments were reviewed during the preparation of the Draft EA. The Proposed Action will adhere to all applicable standard comments.

Hawaii Environmental Health Portal
The Draft EA was prepared utilizing in-field research and online resources, including the Hawaii Environmental Health Portal.

Clean Water Branch
HELCO will apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the State of Hawaii Department of Health, Clean Water Branch, prior to initiating construction.

There would be no work within Waters of the U.S.; therefore, a permit is not required. The Draft EA was submitted to the U.S. Army Corps of Engineers (USACE) Regulatory Branch for review. The USACE provided a "Determination of No Permit Required" on April 16, 2018.

Fugitive Dust
Section 3.1 of the Draft EA provides measures that would be implemented to minimize impacts to air quality from fugitive dust. This section has been expanded in the Final EA to include dust control for roadways used to access the project site.

Hazardous Waste
Construction debris would be disposed of at the Hilo Sanitary Landfill, which has a special section for large metal waste. Construction debris would include the generator that is replaced, 300 feet of penstock, the existing substation components, and the existing circuit breakers in the powerhouse. The transformers at the substation have been replaced within the last 10 years; therefore, there would be no PCBs associated with the transformers. No burning will occur as part of the Proposed Action.

Noise
No normal-working-hour noise-sensitive uses (i.e., schools and hospitals) are present near the Waiau Plant. It is not expected that construction noise would exceed acceptable levels at the nearby residence due to topography, vegetation, and the existing noise environment.
Noise generated from construction activities and the use of machinery would be minimized by requiring contractors to adhere to state and county noise regulations. To reduce noise exposure to nearby residences, 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.

EJ Screen
The Proposed Action would not have negative impacts to Environmental Justice populations. The repowering of the Waiau Plant is expected to produce about 10,000 MWH/year and this potential energy production would service 1,700 500 KWH/month/residential-customers (2%) of HELCO's 85,029 overall customers. It will benefit the community and 100% of HELCO customers as part of the HELCO grid in reducing the cost of energy production while increasing Hawaii County's renewable energy percentage toward achieving the Hawaii Clean Energy Initiative 2045 goals.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

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 9, 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: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering** located in Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044

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

At this time, enclosed are comments from the (a) Engineering Division and (b) Land Division – 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

'18 MAR 15 AM10:46 ENGINEERING

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 14, 2018

MEMORANDUM

~~TO:~~ FROM

DLNR Agencies:
X Div. of Aquatic Resources
__ Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
__ Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

~~FROM:~~ To Russell Y. Tsuji, Land Administrator

SUBJECT: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering**

LOCATION: Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044

APPLICANT: SSFM International on behalf of Hawaii Electric Light Company

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 5, 2018.**

The DEA can be found on-line at: http://health.hawaii.gov/oeqc/ (Click on The Environmental Notice in the middle of the page.)

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

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

Signed:
Print Name: Carty S. Chang, Chief Engineer
Date: 4/3/18

Attachment(s)
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

2018 MAR 16 P 12:20
RECEIVED
LAND DIVISION
HILO, HAWAII

March 14, 2018

MEMORANDUM

FROM:

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

RECEIVED
LAND DIVISION
2018 MAR 28 AM 11:08
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

TO:

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering**
LOCATION: Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044
APPLICANT: SSFM International on behalf of Hawaii Electric Light Company

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 5, 2018.**

The DEA can be found on-line at: http://health.hawaii.gov/oeqc/ (Click on The Environmental Notice in the middle of the page.)

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact 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: 3/22/18

Attachment(s)
cc: Central Files

SSFM International

April 20, 2018 SSFM 2016_008

Mr. Russell Y. Tsuji, Administrator
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawaiʻi
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tsuji:

Thank you for your letter dated April 9, 2018 providing comments on the Draft Environmental Assessment (EA) for the subject project, and thank you for distributing the Draft EA to Divisions within the Department of Land and Natural Resources. On behalf of the Hawaii Electric Light Company (HELCO), we note that the Engineering Division has no additional comments than those provided during the pre-assessment consultation process. Additionally, we note that the Land Division – Hawaii District has no objections to the Proposed Action.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

DAVID Y. IGE
GOVERNOR OF HAWAII

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

SSFM INTERNATIONAL, INC.
RECEIVED
APR 10 2018
JMS
JJK
FILE

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
EMD/CWB

04015PKP.18

April 4, 2018

FILE COPY

Ms. Jennifer M. Scheffel
Senior Environmental Planner
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Scheffel:

SUBJECT: Draft Environmental Assessment
Wailuku River Hydroelectric Facilities
Long-Term Water Lease and Waiau Plan Repowering
Hilo, Island of Hawaii

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated March 8, 2018, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://health.hawaii.gov/epo/files/2013/05/Clean-Water-Branch-Std-Comments.pdf

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

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

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

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

2. You may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).

For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for a NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee ($1,000 for an individual NPDES permit or $500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: https://eha-cloud.doh.hawaii.gov/epermit/. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the appropriate form. Follow the instructions to complete and submit the form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and Hawaii Administrative Rules (HAR), Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

5. It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:

   a. Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects natural ecosystems and traditional beneficial uses of State waters, like community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological bio-engineering of drainage ways must be identified in the planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

b. Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g. minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.

c. Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.

d. Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.

e. Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.

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

Sincerely,

Alec Wong

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

KP:ak

c: DOH-EPO [via e-mail Noella.Narimatsu@doh.hawaii.gov only]

SSFM International

April 20, 2018 SSFM 2016_008

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

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tsuji:

Thank you for your letter dated April 4, 2018 (Letter No. 04015PKP.18) regarding the subject project. The DOH-CWB Standard Comments were reviewed during the preparation of the Draft EA. On behalf of the Hawaii Electric Light Company (HELCO), we offer the following responses to your comments:

1. The Proposed Action will be designed in accordance with the applicable Administrative Rules of the Department of Health, including Chapters 11-54 and 11-55.
2. As noted in Section 1.5, Table 1-1 of the Draft EA, the Proposed Action will require an NPDES Individual Permit for discharges of construction stormwater. HELCO will coordinate with the DOH-CWB to obtain the necessary NPDES coverage.
3. The Proposed Action will involve work over waters of the US, but will not involve work below the ordinary high water mark. Therefore, a permit from the USACE will not be required. A copy of the Draft EA was sent to the USACE for review and comment. USACE provided a "Determination of No Permit Required" on April 16, 2018.
4. Discharges associated with the Proposed Action will comply with the State Water Quality Standards contained in the Administrative Rules of the Department of Health, including Chapters 11-54 and 11-55.
5. The proposed project will be designed to be consistent with the State's position regarding sustaining water quality and beneficial uses of State waters.
    a. The Proposed Action does not include any paving or landscaping.
    b. As per the State Water Code, HRS Chapter 174C, instream hydropower is considered a beneficial use of State waters. The Proposed Action is a non-consumptive use of water and there would be no change in water quality.
    c. The Proposed Action does not include landscaping or associated irrigation.
    d. The Proposed Action does not include paving or landscaping.
    e. There is no stormwater infrastructure at the existing hydroelectric plants.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

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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 11, 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: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering** located in Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent you on April 9, 2018, enclosed are comments from the (a) Division of Aquatic Resources, (b) Division of Forestry & Wildlife, and (c) Office of Conservation & Coastal Lands 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

5705b

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
MAR 15 2018
Division of Aquatic Resources

Ref- DAR ~~5459~~ 5705b

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 14, 2018

RECEIVED
LAND DIVISION
2018 APR -6 AM 10:56
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

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

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering**
LOCATION: Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044
APPLICANT: SSFM International on behalf of Hawaii Electric Light Company

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 5, 2018.**

The DEA can be found on-line at: http://health.hawaii.gov/oeqc/ (Click on The Environmental Notice in the middle of the page.)

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

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

Signed:

Print Name: Bruce S. Anderson, PhD, DAR Administrator

Date: 4/5/18

Attachment(s)
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 AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

RECEIVED
LAND DIVISION
2018 APR -6 AM 10: 56
DEPT. OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

Date: 4/4/2018
DAR # DAR 5705

MEMORANDUM

TO: Bruce S. Anderson, PhD
DAR Administrator

FROM: Troy Sakihara TS, Aquatic Biologist

SUBJECT: Draft EA for the Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering

Request Submitted by: Russell Tsuji, Administrator, Land Division, DLNR

Location of Project: Wailuku River, Hilo, Hawaii Island

Brief Description of Project:

This is a request for comments on a draft environmental assessment for the long-term lease and repowering of hydroelectric facilities along Wailuku River in the South Hilo District on Hawaii Island, which are owned and operated by Hawaii Electric Light Company. The proposed actions include 1) application of a long-term water lease for the Wai'au and Pu'u'eo water hydro generators, 2) repowering the Wai'au water plant, and 3) applying for an encroached easement on state land for the Wai'au diversion.

Comments:
☐ No Comments ☒ Comments Attached

Thank you for providing DAR the opportunity to review and comment on the proposed project. Should there be any changes to the project plan, DAR requests the opportunity to review and comment on those changes.

Comments Approved: Bruce Anderson Date: 4/5/18
Bruce S. Anderson, PhD
DAR Administrator

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

April 5, 2018

TO: Russel Y. Tsuji, Administrator
Land Division

FROM: James Cogswell
DOFAW Wildlife Program Manager

SUBJECT: Division of Forestry and Wildlife Comments on Draft Environmental Assessment for the Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering

The Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) has received your inquiry regarding Draft Environmental Assessment for the Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering, located in Hilo, Hawai'i, TMKs (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044. The proposed actions consist of an application by Hawaii Electric Light Company (HELCO) for a long-term water use lease of 65 years for the Waiau and Pu'u'eo hydroelectric facilities on the Wailuku River, repowering the Waiau Plant, and an application for an easement for the Waiau diversion structure encroachment on state land. Repowering the Waiau facility would include major equipment replacement and construction beginning 2019 and comprise of removal of vegetation over to replace 300 feet of penstock.

Endangered Species

The State and Federally listed Hawaiian hoary bat (*Lasiurus cinereus semotus*) has the potential to occur in the vicinity of the project area. Therefore, DOFAW recommends avoiding using barbed wire, as bat mortalities have been documented as a result of becoming ensnared by barbed wire during flight. If any trees are planned for removal during the bat breeding season there is a risk of injury or mortality to juvenile bats. To minimize the potential for impacts to this species, woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15). Site clearing should be timed to avoid disturbance to breeding Hawaiian hoary bats. The endangered Hawaiian hawk or 'io (*Buteo solitaries*) may occur in the project vicinity. DOFAW recommends surveying the area to ensure no Hawaiian hawk nests are present if trees are to be cut. Finally, we note that artificial lighting can adversely impact seabirds that may pass through the area at night causing disorientation which could result in collision with manmade artifacts or grounding of birds. If nighttime lighting is required during construction or operation, DOFAW recommends that any lights used be fully shielded to minimize impacts.

Application for a Water Lease (HRS §171-58)

As part of the process to obtain a long-term water lease, HRS §171-58 (e) requires the lessee and the Department to develop and implement a watershed management plan. DOFAW will work directly with HELCO to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed.

Should the proposed location of the project change, or should it become evident in the future that listed species are being impacted, DOFAW requests that the project proponent reinitiate consultation. If you have any questions, please contact Sharon Reilly, Conservation Initiative Coordinator at 808-587-4148 or Sharon.Reilly@hawaii.gov.

TM

HA-18-180

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
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2018 MAR 16 P 12:07

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

RECEIVED
LAND DIVISION
2018 APR -6 AM 10:55
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

March 14, 2018

MEMORANDUM

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

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Assessment for the **Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Repowering**
LOCATION: Hilo, Island of Hawaii; TMKs: (3) 2-6-009:025, (3) 2-6-007:001, and (3) 2-6-029:044
APPLICANT: SSFM International on behalf of Hawaii Electric Light Company

Transmitted for your review and comment is information on the above-referenced subject matter. We would appreciate your comments by **April 5, 2018.**

The DEA can be found on-line at: http://health.hawaii.gov/oeqc/ (Click on The Environmental Notice in the middle of the page.)

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

Diversion /Intake structures within the Conservation District appear to be non-conforming. Any Proposed improvements in the Conservation District should be reviewed by the DLNR-OCCL.

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

Signed: [signature]
Print Name: K. Tiger Mills
Date: 4-6-2018

Attachment(s)
cc: Central Files

April 20, 2018 SSFM 2016_008

Mr. Russell Y. Tsuji, Administrator
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, HI 96809

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Tsuji:

Thank you for your letter dated April 11, 2018 providing comments on the Draft Environmental Assessment (EA) for the subject project, and thank you for distributing the Draft EA to Divisions within the Department of Land and Natural Resources. On behalf of the Hawaii Electric Light Company (HELCO), we provide the following responses to comments from the Division of Aquatic Resources, Division of Forestry and Wildlife, and Office of Conservation and Coastal Lands.

Division of Aquatic Resources (DAR)
HELCO will provide changes to the project plan, if any, to DAR for review and comment.

Division of Forestry and Wildlife (DOFAW)
HELCO will incorporate the recommended measures to minimize potential impacts to the Hawaiian hoary bat, Hawaiian hawk, and seabirds. Potential impacts and measures to minimize such impacts to the Hawaiian hoary bat were included in Section 3.6 of the Draft EA. The minimization measures have been expanded in the Final EA to include the avoidance of the use of barbed wire. Section 3.6 of the Final EA has also been revised to include potential impacts and minimization measures for the Hawaiian hawk and seabirds.

We concur that HELCO and DOFAW will work together to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed.

Office of Conservation and Coastal Lands (OCCL)
No improvements to the diversion structure are included as part of the Proposed Action. If improvements to the diversion structure become necessary, HELCO will coordinate with the OCCL.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

PHONE (808) 594-1888

FAX (808) 594-1938

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
560 N. NIMITZ HWY., SUITE 200
HONOLULU, HAWAI'I 96817

HRD17-8204C

April 05, 2018

Jennifer Scheffel
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawai'i 96817

Re: Review of Draft Environmental Assessment – Wailuku River Long Term Water Lease
Pi'ihonua and Pu'u'eo Ahupua'a, South Hilo Moku, Hawai'i Mokupuni
Tax Map Key: (3) 2-6-009 (por.)

Aloha e Ms. Scheffel:

The Office of Hawaiian Affairs (OHA) has received a copy of the draft environmental assessment (DEA) for the Wailuku River hydroelectric facilities long-term water lease and Waiau repowering in Hilo. SSFM International, Inc., has prepared this DEA on behalf of Hawai'i Electric Light Company, Inc. (HELCO). Previously, HELCO utilized a revocable permit (RP No. S-7463) to divert water for the purpose of hydroelectric power production at their Waiau and Pu'u'eo plants, but is now requesting a 65 year long-term lease. Under the new lease, HELCO is also proposing several improvements at the Waiau plant to maintain and improve their hydroelectric operations (i.e., new turbine engines, powerhouse upgrades, new generators and transformers at substation, and penstock replacement). A portion of the Waiau water diversion structure encroaches upon land owned by the Department of Hawaiian Homelands (DHHL). As indicated in the DEA, discussions with DHHL are ongoing so that an easement can be obtained.

In a letter dated September 8, 2017, OHA provided support for the mitigation recommendations made by ASM Affiliates in their cultural impact assessment (CIA) done for this project. These recommendations were made in response to community concerns raised in interviews and meetings. In review of the DEA, we are concerned that some of the issues raised by the community in the CIA are not being considered as potential impacts in Chapter 3.

Section 3.5 Water Resources

In the CIA, the greatest community concern in response to the project was the water quality and temperature when the water re-enters the Wailuku River. ASM thus recommended "that HELCO establish a data collection process to ensure the hydropower facilities are not interfering" with water chemistry and temperature. Additionally, OHA had recommended that some kind of website or public outreach effort be set up so that anyone could view the results of on-going water monitoring. The Stream Habitat Assessment (page 81 of Appendix B of the DEA) by Dr. James Parham states that, "it is possible that water passing through the hydropower facilities picks up some pollutant that renders the Wailuku River unsuitable to native species". Although the author states this is unlikely, uncertainty remains since long term operational effects have not been monitored. Despite these concerns, the DEA discussion on impacts to water resources has no discussion of any potential impact to water temperature or chemistry. OHA requests that potential impacts to, and mitigation for, water temperature and chemistry should be discussed in Section 3.5.

Section 3.5 also mentions that the lease of State-owned water rights triggers compliance with Hawai'i Revised Statute (HRS) 171-58. This requires a lessee and the Department of Land and Natural Resources (DLNR) to develop (or include a covenant to develop) a watershed management plan. In the CIA, ASM had recommended that "HELCO work with other interested parties in their development and implementation of the Watershed Management Plan as they fulfill the requirements of HRS 171-58(f)." Continued dialog with the community was also encouraged during development and implementation of the watershed management plan.

Section 3.5 states that "HELCO does not own or control watershed lands on which to implement any watershed management plan." It is our understanding that HRS 171-58 does not require one to own the lands for which a watershed management plan is to be developed; thus, it is unclear why this statement regarding land ownership is included. The DEA goes on to state that HELCO will work with the Division of Forestry and Wildlife (DOFAW) and the Mauna Kea Watershed Alliance (MKWA) to find ways in which HELCO can participate in or contribute to watershed management plans. MKWA has already developed a draft watershed management plan for Mauna Kea which includes Wailuku River. Nowhere does it mention that HELCO will develop their own watershed management plan or tailor existing plans to HELCO operations. We ask that clarification be added on whether HELCO will develop their own watershed management plan or not. Although we commend the effort to collaborate with other organizations, it is unclear whether such collaborations assure compliance with HRS 171-58. DLNR's understanding of the matter should also be sought and discussed in Section 3.5 so it is clear on what HELCO must do and commits to doing.

Section 3.7 Cultural Resources

In the CIA, community members noted that several wild cultigens (kalo, mai'a, olonā) may be encountered along the river embankments and should be avoided. ASM thus recommended that "HELCO take steps to avoid disturbing these areas" when and if encountered. Furthermore, if avoidance is not possible, ASM recommended that HELCO work with local farmers to cultivate or relocate these cultigens. These cultigens are mentioned in Section 3.7 of the DEA, but no

Jennifer Scheffel
April 05, 2018
Page 3

discussion is provided regarding any potential impact to these flora or avoidance protocols. As originally recommended by ASM, we feel that protocols should be in place as a mitigation measure in Section 3.7 to deal with these cultigens should they be encountered during construction or hydroelectric operations.

Section 3.11 Visual Resources

In the CIA, community members had emphasized the importance of maintaining the natural character of the river. ASM thus recommended “disguising any exposed man-made infrastructure to blend with the natural terrain, texture, and color of the nearby area.” However, in the DEA discussion on impacts to visual resources, this recommendation is not considered as it was determined that “there would be no impact to visual resources” because the powerhouse is not visible from two main scenic points (Boiling Pots and Rainbow Falls). Thus, no minimization or mitigation measures are proposed in the DEA. We feel that the desire of the community to maintain the natural character of the river should be included and evaluated in Section 3.11.

We look forward to reviewing the final environmental assessment that addresses our concerns regarding the lack of attention to recommendations made in the CIA. Should you have any questions, please contact our Compliance Specialist, Kamakana C. Ferreira, at (808) 594-0227, or by email at kamakanaf@oha.org.

‘O wau iho nō me ka ‘oia ‘i‘o,

Kamana‘opono M. Crabbe, Ph.D.
Ka Pouhana, Chief Executive Officer

KC:kf

SSFM International

April 20, 2018 SSFM 2016_008

Mr. Kaman‘opono M. Crabbe, Ph.D., Ka Pouhana, CEO
Office of Hawaiian Affairs
560 N. Nimitz Highway, Suite 200
Honolulu, HI 96817

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai‘i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Crabbe:

Thank you for your letter dated April 5, 2018 (HRD17-8204C) providing comments on the Draft Environmental Assessment (EA) for the subject project. On behalf of the Hawaii Electric Light Company (HELCO), we provide the following responses to your comments:

Section 3.5 Water Resources

Temperature effects of hydroelectric projects are typically associated with reservoirs, which increase the retention time of incoming flows, resulting in increased water temperature. Additionally, and depending on the atmospheric conditions affecting the reservoir, temperature stratification may occur in the impoundment and when released into the downstream waters, temperatures of the receiving water could not only increase, but could decrease as well. By comparison, the Waiau and Pu‘u‘eo plants are run-of-the-river and do not use water impoundments. Water passes through the intakes and back out into the river in several minutes without heat addition or removal. Page 81 of Appendix B (Stream Habitat Assessment) of the DEA states that “In the supporting documentation provided by HELCO (2016a), they state the hydropower will cause no water pollution as no foreign objects or chemicals are introduced to the water during its passage through the hydropower penstock pipe or turbine”. There is no heat removal or addition to the water as it passes through the plant. Additionally, the increase in capacity for the plant will take advantage of periods of high-to-torrential river flow. HELCO presently has no plans to make any changes to the existing systems that would create a potential for temperature, chemical, or foreign object introduction into the river water and is committed to maintaining that policy for the duration of the project. Section 3.5 of the Final EA has been updated to include this information.

HELCO is currently working directly with the Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW) to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed. As per comments on the Draft EA from DOFAW received on April 11, 2018, “DOFAW will work directly with HELCO to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed." HELCO will continue to coordinate with DOFAW regarding the watershed management plan.

The statement in Section 3.5 of the Draft EA regarding land ownership as it relates to the implementation of a watershed management plan has been deleted from the Final EA. In addition, Section 3.5 of the Final EA has been revised to clearly state that DOFAW has agree to continue to coordinate with HELCO to determine the appropriate mechanism through which HELCO can contribute to the implementation of existing watershed management plans for the Wailuku watershed.

Section 3.7 Cultural Resources
Section 3.7 of the Final EA has been updated to include a discussion of the potential impacts to wild cultigens, as well as a commitment to work with local farmers should wild cultigens be encountered during construction or operation of the facilities.

Section 3.11 Visual Resources
The Proposed Action does not include any improvements or modifications to the exterior of the powerhouses. The powerhouses have been in existence for nearly a century and, as such, are a part of the historical landscape. Modifying the texture and color of the powerhouses to blend in with the natural terrain may conflict with their historical values and such changes would require consultation with SHPD.

Because the stream diversion structure does not divert low flows, flows in the river are continuous and uninterrupted, and, after powering the turbines, the water is returned to the river; thus, the natural character of the river is maintained to a large extent while also providing residents with an efficient source of renewable energy. Section 3.11 of the Final EA has been updated to expand on the discussion of potential impacts to visual resources from operation of the Proposed Action.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,

SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

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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 11, 2018

Ms. Jennifer Scheffel
SSFM International, Inc.
501 Sumner Street Suite 620
Honolulu, HI 96817

Dear Ms. Scheffel:

SUBJECT: Draft Environmental Assessment 30-Day Comment Period
Project: Wailuku River Hydroelectric Facilities Long-Term Water Lease and Waiau Plant Repowering
TMKs: (3) 2-6-007:001; (3) 2-6-009:025; (3) 2-6-029:044; Hilo, Hawai'i

Thank you for the opportunity to review and comment on the Draft Environmental Assessment for the 65-year water lease for hydroelectric facilities on the Wailuku River. The County of Hawai'i Planning Department offers the following comments and recommendations in addition and furtherance of previous coordination and support from the County[1].

1. Please provide a more comprehensive inclusion of cultural resource considerations.
   a. We recommend exploring cumulative impacts in sufficient depth and detail.
   b. We recommend addressing the recommended actions arising from the Cultural Impact Assessment (CIA); feasibility of implementation should be addressed in order to mitigate cultural considerations of the project.

2. Please include a more comprehensive analysis on potential impacts (direct, secondary and cumulative) during the entire 65-year lease period.
   a. If possible, we recommend quantifying the estimated percentage of renewable energy from the proposed operations as part of a larger share of energy produced on island and/or in the State. The statement that the operations "help the state achieve its goal of 100% renewable by 2045" should be explained in depth as it relates to comparing the alternatives.
   b. We recommend discussing cumulative and/or secondary impacts as it relates to the 65-year lease and associated water use.

[1] Coordination letters- Mayor's Office: 1/23/17; Planning Department: 1/27/17

   c. We recommend addressing alternative action considerations in greater depth. For example:
      i. Please explain in greater detail why Alternative 4 is not being considered at this time and discuss feasibility considerations.
      ii. Please explain the potential environmental and cultural benefits from Alternative 1.
   d. We recommend addressing any anticipated future construction (maintenance, expansion or other applicable "useful life" of infrastructure concerns) within the 65-year lease period.
   e. We recommend all statements regarding significance address the time period of at least the 65-year lease period proposed, including every phase of the proposed action.

3. We recommend the following sections of the County of Hawai'i 2005 General Plan (as amended) be discussed for consistency with the proposed action:
   a. Policies 3.3(e): Please discuss how the environmental fitness of Wailuku River and Hilo Bay is being preserved or enhanced as part of the proposed project in comparison to the alternatives.
      i. Standards 3.4(a)
      ii. Goals 6.2(b)(c)
      iii. Policies 6.3(k)(o)
      iv. Please address applicability and consistency with Standards 6.4; especially as it may relate to Alternatives.
      v. Goals 8.2(c)(e)(f)
      vi. Policies 8.3(a)(h)(i)(q)(u)

4. We respectfully encourage that coordination correspondence with United States Fish and Wildlife Service (USFWS) be included since "Wide-ranging terrestrial vertebrates listed as threatened or endangered may be present in the vicinity."

If you have any questions, please contact Kevin Sullivan of this office at (808) 961-8135.

Sincerely,

for MICHAEL YEE
Planning Director

KS:AS;ja
\\coh33\planning\public\wpwin60\CH343\2018\WailukuHydro DEA letterhead-AS 4-11-2018.doc

April 20, 2018 SSFM 2016_008

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

SUBJECT: **Wailuku River Hydroelectric Facilities**
Long-Term Water Lease and Waiau Plant Repowering
Hilo, Hawai'i
Tax Map Key (TMK): (3) 2-6-009:025

Dear Mr. Yee:

Thank you for your letter dated April 11, 2018 providing comments on the Draft Environmental Assessment (EA) for the subject project. On behalf of Hawaii Electric Light (HELCO), we provide the following responses to your comments:

1. Section 3.7 of the Final EA has been updated to include a discussion of the potential impacts and proposed minimization measures, where appropriate, of the Proposed Action to cultural resources as reported in the Cultural Impact Assessment.

2. a. HELCO estimated the average annual generation from the proposed project would increase from the existing 4,660 MWH by 5,554 MWH to 10,214 MWH. The increase in generation would reduce HELCO's composite cost of generating energy. In other words, use of fossil-fuel derived energy would decrease. In Public Utilities Docket No. 2016-0192, HELCO filed a response to a Supplementary Information Request from the Consumer Advocate (CA-SIR-1) and provided an estimated monthly bill impact for a typical residential customer utilizing 500 KWH per month. The impact of repowering the plant, all costs (capital and O&M) considered, would reduce the customer's bill due to the additional lower cost energy being available to displace fossil fuels.

   b. As stated in Section 3.12 of the Draft EA, 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 are those related to other past, present, and reasonably foreseeable future actions. The Proposed Action includes the application for a long-term water lease for a non-consumptive use of water from the Wailuku River to power two hydroelectric facilities. These facilities have been in operation for almost a century and have not resulted in negative cumulative impacts since the water use is non-consumptive. The Proposed Action is not expected to result in cumulative impacts from future actions since any future water leases would be required to go through the application process, which includes the development of a water reservation for Department of Hawaiian Home Lands properties.

   c.i. Although Alternative 4 (Add a third unit and rehabilitate Units 1 and 2) has the highest energy generation and lowest levelized production cost, it was not carried forward because of the extensive work required to the powerhouse exterior, longer project schedule and the potential cost risk that permitting delays could impose. In short, the risk of delays and project complexities outweighed the projected benefits.

   c.ii. Alternative 1 (Retirement and Decommissioning of the Waiau Plant) is essentially a run-to-failure option. For HELCO's customers, it represents the most costly option and reverses progress made towards a fully renewable grid. The Company regards Waiau and Pu'u'eo hydro facilities as a valuable resource for the island and has not viewed run-to-failure as a viable option.

   d. and e. The Company has no long-range construction plans for the 65-year term of the requested lease. This project represents the last phase of a long-term plan to preserve the hydro assets, which has included repowering Pu'u'eo, replacing worn sections of penstock, mortar lining of the penstock interiors, and installation of impressed current cathodic penstock protection.

3. A discussion of the Policy 3.3(e) has been added to the County of Hawai'i General Plan discussion in Section 4.3 of the Final EA.

   With regard to Standards 3.4(a), "New power plants shall incorporate devices that minimize pollution", the Proposed Action does not include construction or operation of a new power plant. Continuing operations at the Waiau and Puueo Hydroelectric Facilities will be in compliance with all applicable regulations to minimize pollution.

4. The Proposed Action does not involve any Federal agencies or actions and does not require Federal consultation under the Endangered Species Act. The Department of Land and Natural Resources, Division of Forestry and Wildlife has provided comments on the Draft EA with recommendations for measures to minimize impacts to special status species and seabirds. These recommendations have been incorporated into Section 3.6 of the Final EA.

Should you have any additional comments or questions regarding the proposed project, please contact me at (808) 356-1273 or by email at jscheffel@ssfm.com.

Mahalo,
SSFM INTERNATIONAL, INC.

Jennifer M. Scheffel

Jennifer M. Scheffel
Sr. Environmental Planner

cc: Norman Uchida (HELCO)
Yvonne Izu (Morihara Group)

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

April 16, 2018

SUBJECT: Determination of No Permit Required Wailuku River Hydroelectric Facilities Water Lease Waiau Repowering, Hilo, HI DA File No. POH-2018-00075

Ms. Jennifer Scheffel
SSFM International
501 Summer Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Scheffel:

The Honolulu District, U.S. Army Corps of Engineers (Corps), Regulatory Branch has received your request for a determination of whether a Department of the Army (DA) permit is required for the continued water diversion from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puueo Plants, all over the Wailua River in Wailua, Island of Kauai, Hawaii (Enclosure 1). Your request has been assigned DA file number POH-2018-00075. Please reference this number in all future correspondence with our office relating to this action.

We have reviewed your submittal pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344; "Section 404") and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403; "Section 10"). Section 404 requires DA authorization for the discharge (placement) of dredged and/or fill material into waters of the U.S., including wetlands. Section 10 requires DA authorization for the placement of structures in, under or over navigable waters of the U.S. and/or other work affecting the course, location, condition or navigable capacity of such waters. To determine if a DA permit is required for a proposed action, the Corps must first determine whether the proposed project is located within the Corps' geographic jurisdiction (i.e., whether the activity is located within a water of the U.S.). If the activity is within a water of the U.S., the Corps must then determine whether the proposed activity is a regulated activity under Section 10 and/or Section 404, or if the activity is exempt under Section 404(f) and is not recaptured. The determination provided in this letter pertains only to whether the proposed project is an activity we regulate; it does not address geographic jurisdiction.

While we have not made a determination of the jurisdictional status of the aquatic resource(s) on your property, based on the information you provided, we have determined that your proposed project would not involve an activity subject to the regulatory jurisdiction of the Corps and therefore, a DA permit is not required. This determination of no permit required addresses only the proposed operations described in your submitted documentation and does not convey our determination of the jurisdictional status of the Wailua River. Should you require a geographic jurisdictional determination (JD) for this project, you must complete and return a JD Request Form (Enclosure 2).

While a DA permit is not required for your proposed project, you are responsible for obtaining all other applicable Federal, state, or local authorizations required by law. Be advised, a DA permit may be required if you alter the method, scope, or location of your proposed work. You should contact our office if you are considering modifying your project.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact me at 808-835-4310 or via e-mail at Vera.B.Koskelo@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

Vera B. Koskelo
Project Manager, Regulatory Branch

Enclosures

cc: State of Hawaii DBEDT Office of Planning (John Nakagawa)
State of Hawaii DOH-CWB (Darryl Lum)

Appendix B

Stream Habitat Assessment

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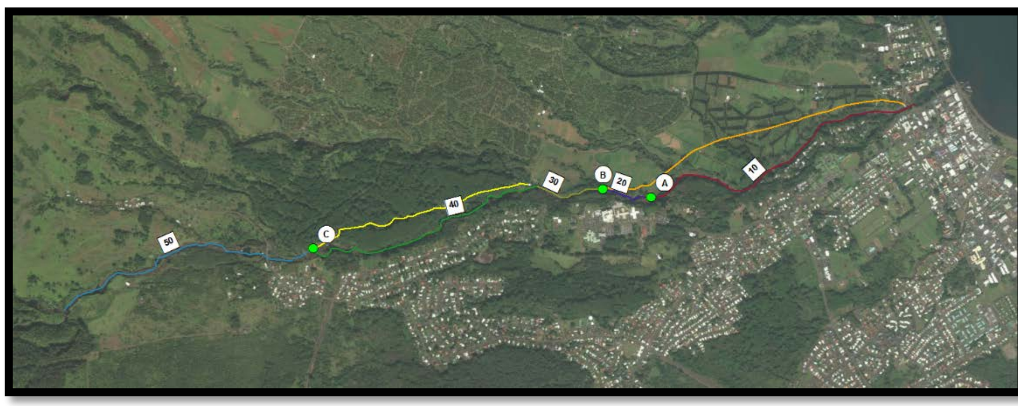
An Assessment of the Environmental Impact of the HELCO Wailuku Hydroelectric Plants on Native Stream Animals with Respect to Instream Habitat, Barriers to Migration, and Entrainment using the GIS Model-based Hawaiian Stream Habitat Evaluation Procedure



April 15, 2017

Prepared for:
Jared Chang
SSFM

Prepared by:

James Parham Ph.D.

Parham & Associates
Environmental Consulting, LLC

www.ParhamEnvironmental.com

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ABSTRACT

The Hawaii Electric Light Company (HELCO) operates the Wailuku River Hydroelectric Plants in the Wailuku River Watershed near Hilo, HI and is currently seeking to rehabilitate the units to improve power generation efficiency. The Wailuku River Hydropower facility consists of two separate power plants operated in a sequential “run of the river” design. The upper intake is for the Waiau hydro generator and after the water is returned to the river, the lower intake collects water for the Pu’u’eo hydro generator. As part of the permit process of seeking a long-term water lease and for any channel modifications, a quantification of the distribution and extent of native aquatic animals’ habitat is required. To accomplish this task, Parham & Associates Environmental Consulting (PAEC) combined the results of habitat assessments and biotic surveys with the Hawaiian Stream Habitat Evaluation Procedure (HSHEP) model to assess three broad issues associated with the proposed modifications of the Wailuku River Hydroelectric Plants:

1. loss of instream habitat from construction or diversion of stream flow,
2. creation of barriers to stream animal upstream movement, and
3. entrainment of downstream drifting larvae in the hydroelectric facility.

To better understand the relationship between stream discharge and observed habitat types, historical aerial imagery data was combined with stream discharge from the USGS gage. Aerial imagery of an approximately 1 km segment of the Wailuku River downstream of Rainbow Falls collected on five different dates were used to understand changes in habitat types in response to stream discharge. Discharge on the five dates range from a high of 122 cfs to a low of 12.8 cfs. In terms of percent frequency, approximately 50% of this reach is classified as stream pools and approximately 10% are classified as runs over all discharge rates. There is some variance in habitat type availability but they do not appear to be tightly linked to stream discharge. Unlike many small streams in Hawaii, the Wailuku River has large, deep plunge pools and these deep pools and the runs that connect them persist even at low stream discharge. Overall, instream habitat appeared excellent in the Wailuku River for native stream species.

To document biota, we used the High Definition Fish Survey (HDFS) approach to survey different sites. HDFS utilizes pole-mounted, high-definition, underwater video cameras to capture images of fish or other aquatic animals at a specific location. The underwater cameras are geo-referenced so that specific time and place information is recorded in conjunction with all video observations. Access to the Wailuku River was limited, but we were able to survey two areas. The first area was upstream of the waterfall above Piihonau Bridge and the second area was downstream near the low-water bridge crossing at the upper intake for the hydropower facility. In general, green swordtails, guppies and white cloud mountain minnows were the most

common species observed. We observed no native stream gobies at either site during the survey, although we surveyed numerous locations with excellent habitat conditions for the species. We observed three of the native shrimp, ‘Ōpae kala‘'ole, clinging to bedrock near swift flows at the upper survey site. Our species observations were similar to the results of historical surveys in the early 1980’s and early 1990’s. The primary reason for the lack of native species near the hydropower intakes was their inability to migrate upstream past Rainbow Falls. Rainbow Falls is a large, undercut waterfall on the Wailuku River and stream segments above the falls are unlikely to have substantial populations of native species due to the falls acting as a barrier to upstream movement.

The HSHEP Model for Wailuku River was developed using published information for species distributions at the watershed, reach scale and site scales and combined with local data from the habitat and biotic surveys. Stream animals’ distribution and habitat use were documented using information stored in the DLNR-DAR Aquatic Surveys Database. The DAR Aquatic Surveys Database represents over 13,000 survey locations and over 90,000 species observations. More than 370 different literature sources support the data contained within the DAR Aquatic Surveys Database. The HSHEP model leverages the data within the DAR Aquatic Surveys Database to develop quantitative measures of habitat use for native stream animals.

The native amphidromous stream animals (*Lentipes concolor*, *Sicyopterus stimpsoni*, and *Atyoida bisulcata*) were selected for model inclusion as these species have been observed within the Wailuku River system in the area of the Wailuku Hydropower facilities during prior surveys. Additional, these species have a diadromous life history that exposes the migrating animals to barriers in the stream pathway, entrainment into water diversion systems, and elimination of suitable habitat resulting from structures associated with the Wailuku Hydroelectric power plants and its water collection systems. There also exists distribution, habitat use, and habitat suitability indices for each of these species.

The results from the HSHEP model showed the overall pattern is similar for all three species with a relatively minor impact associated with the proposed hydropower modifications (1.4% to 0.1% range of estimated HU lost). The impacts were greatest for *Atyoida bisulcata* (1.4%) as they are found further upstream and with more habitat located near the hydropower intakes and lowest for *Sicyopterus stimpsoni* (0.1%) as most of their habitat was predicted to occur below Rainbow Falls and the hydropower intakes.

The primary differences between the current hydropower facility and the proposed hydropower modifications will be increased operating efficiencies with the new turbines and the resultant changes in water diversion amount through the turbines. Maintenance of a minimum flow in the natural streambed should effectively minimize habitat lost due to increased water run through the hydropower facilities. Maintenance of minimum flow would protect against long periods of low or no flow in the segments downstream of the intakes maintaining suitable habitat conditions.

Increased water diversion quantity at higher flows for the Waiau Diversion after modification has the potential to increase mortality on downstream drifting larvae entrained in the hydropower system. Given the low numbers of native species above the intakes this is unlikely to be cause for great concern. Additionally, downstream drifting larvae normally pass over numerous waterfalls and through highly turbulent cascades and thus many may pass through the turbines unharmed. There were no proposed changes to the intake structures, and therefore, is an unlikely that a barrier to upstream movement will be created where none exists currently.

Thus, the three main areas of concern that may decrease the suitability of a stream to native animals: loss of instream habitat, creation of barriers to upstream movement, and entrainment of downstream drifting larvae, are all likely minimized by the natural stream conditions in the location of the hydropower intakes and the proposed modifications are unlikely to cause substantial impact to native stream animal populations in Wailuku River. Based on the HSHEP model results, continued operation of the hydropower plants with proposed changes are unlikely to limit the population of native stream animals observed in the Wailuku River.

INTRODUCTION

The Hawaii Electric Light Company (HELCO) operates the Wailuku River Hydroelectric Plants in the Wailuku River Watershed near Hilo, HI and is currently seeking to rehabilitate the units to improve power generation efficiency. After an analysis of potential rehabilitation options, HELCO determined the best option was to repower Unit 2 and to rehabilitate Unit 1 (HELCO 2016a). The estimated new energy capacity of the plant will be approximately 2300KW and may introduce some changes to instream conditions near the project. As part of the permit process of seeking a long-term water lease and for any channel modifications, a quantification of the distribution and extent of native aquatic animals' habitat is required. To accomplish this task, Parham & Associates Environmental Consulting (PAEC) combined the results of habitat assessments and biotic surveys with the Hawaiian Stream Habitat Evaluation Procedure (HSHEP) model to assess three broad issues associated with the proposed modifications of the Wailuku River Hydroelectric Plants:

1. loss of instream habitat from construction or diversion of stream flow,
2. creation of barriers to stream animal upstream movement. and
3. entrainment of downstream drifting larvae in the hydroelectric facility.

The HSHEP model addressed two scenarios associated with the hydropower project. The first scenario was to assess suitable habitat with the hydropower plant, other major infrastructure and land-use conditions as they currently exist, and the second scenario was to assess suitable habitat with the proposed modifications and with all other conditions the same. The two scenarios allowed the comparison and quantification of the changes in suitable habitat for native stream animals as a result of the proposed modifications to the hydroelectric power facilities.

The HSHEP model approach used here has been used extensively in Hawaii. It has been used for instream flow determinations on East and West Maui streams (Parham et al. 2009, Parham 2013a), and Waimea River, Kauai (Higashi and Parham 2016), for hydropower impact assessment on Wailua River, Kauai (Parham 2013b), flood mitigation impact assessment on the Ala Wai Streams, Oahu (Parham 2015b, c) and other stream assessments across the state. In addition, the integrated field surveys and HSHEP approach underwent and passed formal professional review by the US Army Corps of Engineers for its application on the Ala Wai Streams Flood Mitigation Project (Parham 2015a). This report documents the findings of the habitat assessments, biotic surveys and the results of the HSHEP model assessing the impacts of the Wailuku River Hydroelectric Plants on the amount and distribution of native stream animal habitat.

GOAL AND OBJECTIVES

Goal

The primary goals of this project were to survey habitat and biotic conditions and integrate the results into the HSHEP model of the Wailuku River Watershed to assess impacts of proposed changes to the hydropower system.

Objectives

The HSHEP Model project on the Wailuku River Watershed focused on two main objectives: (1) assessing and quantifying suitable habitat using current conditions and (2) assessing and quantifying suitable habitat after proposed modifications to the hydropower facility.

To complete these objectives, the following steps were taken:

1. Assembled available data the for the Wailuku River and its watershed, as well as, the current Wailuku River Hydroelectric Plants system configuration and proposed modification.

2. Conducted field surveys to provide current information instream conditions in the Wailuku River associated with the Wailuku River Hydroelectric Plants.

3. Created HSHEP model for the Wailuku River and incorporated the survey and project condition data.

4. Ran HSHEP model to assess suitable habitat for native stream animals associated with two scenarios.
   a. <u>Scenario 1</u>: Quantify the amount and distribution of suitable habitat under current conditions in the watershed. This includes the presence of the Wailuku River Hydroelectric Plants and other conditions likely to influence stream animal habitat.
   b. <u>Scenario 2</u>: Quantify the amount and distribution of suitable habitat under proposed changes to the hydropower system. This scenario includes the presence of other conditions the same as scenario 1.

5. Documented the impact of the various physical structures associated with the overall Wailuku River Hydroelectric Plants on the amount and distribution of native stream animal habitat in a report.

Study Area Description

The Wailuku River is the largest perennial stream in Hawaii with a total length of 196.1 miles inclusive of all delineated perennial and non-perennial stream segments. The area of the Wailuku River Watershed is 252.2 square with maximum elevation of 13,779 feet (Parham et al., 2008). The watershed is a mix of urban, agricultural land, and forest at low elevations, mostly forested at middle elevations giving way to grasslands at higher elevations and finally bare land at the highest elevations. The stream has primarily been surveyed in the upper reaches as access to the middle reaches is difficult. The USGS stream gage is located at 1,090 ft elevation with a contributing watershed of 148.6 mile^2 (Figure 1) (online at: usgs.gov/usa/nwis/uv?16704000). The average annual discharge from the 1929 to 2015 is 260.7 cfs. The river is steep with numerous cascades and large waterfalls. For example, Rainbow Falls is a large undercut waterfall with the scenic overlook (Figure 2).

The Wailuku River Hydropower facility consists of two separate power plants operated in a sequential “run of the river” design (HELCO 2016a). The upper intake is for the Waiau hydro generator and after the water is returned to the river, the lower intake collects water for the Pu’u’eo hydro generator (Figure 3). A portion of the natural stream flow is allowed to pass the intake structures to ensure that a minimum flow remains in the river channel. The Waiau diversion removes water from the channel for approximately 1 mile before returning it to the river and the Pu’u’eo diversion removes water for approximate 1.25 miles before it returns to the river (HELCO 2016a).

With respect to this analysis, below are the proposed modifications as derived from the source documentation (HELCO 2016 a and b, SSFM 2016) and how they may impact native stream animal habitat.

Instream Habitat:

1. A minimum flow currently passes each intake. The amount of the minimum flow is not clear, but the proposed modification will continue current minimum flows and will automate the minimum flow at the Waiau diversion (SSFM 2016). The automation of the minimum flow bypass should decrease response time compared to manual flow adjustments and improve minimum flow in the upper diverted segment.
2. No in-channel construction is proposed on the intakes or at other locations. There should be no impact between current and proposed conditions.
3. Under the proposed repowering plans, the maximum flow diverted under high flow conditions will increase from 55 CFS to 100 CFS at the Waiau diversion. No increase in maximum flow diversion from the current 130 CFS at the Pu’u’eo diversion is planned. Given the highly torrential flows in Wailuku River, capturing additional high flow is unlikely to greatly impact instream habitat as long as minimum flow are sufficiently maintained, although some loss of habitat may occur.

Barriers to upstream movement:

1. No change is proposed in the stream channel at the intakes or at other locations. There should be no impact between current and proposed conditions with respect to the creation of a new instream barrier to movement.

Entrainment of downstream drifting larvae:

1. There are no changes in minimum flow quantity between current and proposed conditions and thus there should be no changes in entrainment at low flows between current and proposed modifications.
2. Under the proposed repowering plans, the maximum flow diverted under high flow conditions will increase from 55 CFS to 100 CFS at the Waiau diversion. No increase in maximum flow diversion from the current 130 CFS at the Pu’u’eo diversion is planned. The increased quantity of water passing through the Waiau diversion will increase the number of passively drifting larvae captured by the diversion and passing through the hydroelectric turbines.

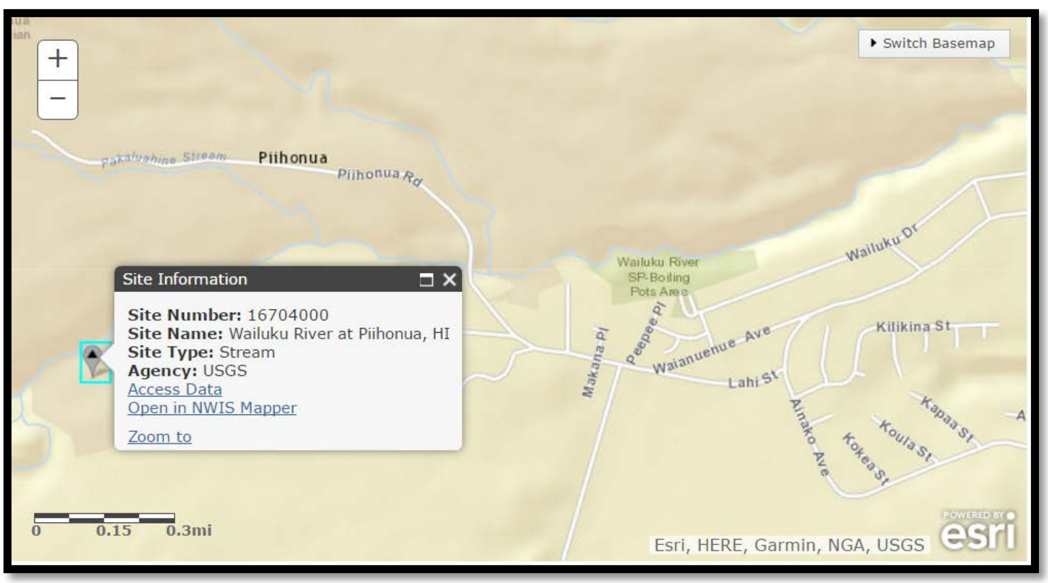


Figure 1: USGS gage site information for Wailuku River. The gage site is upstream of all surveys and the hydropower facilities. Image from the USGS stream gage website at: Usgs.gov/usa/nwis/uv?16704000

Figure 2: Rainbow Falls on the Wailuku River as viewed from the scenic park overlook.

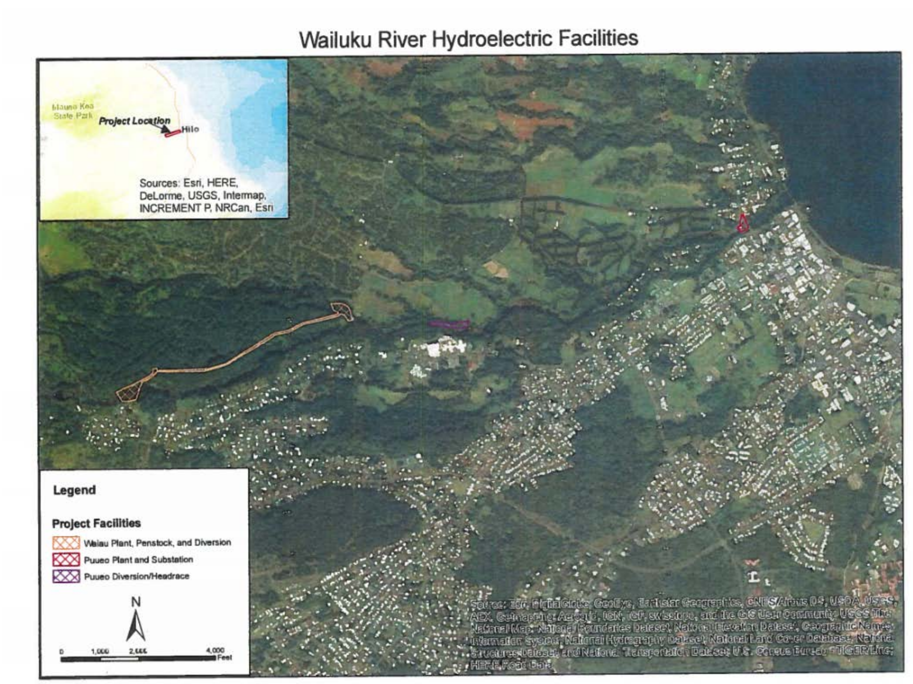


Figure 3: Map of the Wailuku River hydroelectric facilities from HELCO 2016a.

METHODS

Habitat Assessment

To better understand the relationship between stream discharge and observed habitat types, historical aerial imagery data on stream discharge for the USGS gage was used. A segment of Wailuku River from just below Rainbow Falls an elevation of 368 ft downstream 1.1 km to an area near the end of Kaiulani Street at an elevation of 180 ft was used for this analysis (Figure 4). First, a polygon representing the perimeter of the river over this segment was created in ArcGIS 10.1 (Figure 5). Within this polygon, 125 points were randomly created with the random point tool in ArcGIS 10.1. (Figure 6) The points were created so that there was at least a 10 m spacing between each point. The resultant random point shapefile was converted to a .kml file for use in Google Earth.

The random points were imported into Google Earth and superimposed onto the available aerial imagery. The point style was changed to an unfilled rectangle so that the habitat type visible within the rectangle was used to determine class membership (Figure 7). A total of 23 points were removed from the analysis as they were obviously obscured or not in the stream channel in any of the historical imagery. This left a final set of 102 random points. For each of the 102 random points, the habitat type was classified into one of five groups. The groups were: pool, run, riffle/cascade, dry, and N/A.

The historical imagery tool in Google Earth was used to select different dates with aerial imagery and associate them with the stream discharge data from the USGS Wailuku River gauge. The USGS Wailuku River gauge is upstream of the habitat assessment segment at approximately 1090 ft elevation (Data online at usgs.gov/usa/nwis/uv?16704000). The gauge data does not account for any diversions associated with the hydropower, but is the most accurate information available. The dates for the aerial imagery and associated concurrent USGS discharge are shown in Table 1. Examples of the historical images are shown in descending discharge order in Figure 8 - Figure 12. It is important to note that classification was done while zooming in to a much smaller scale than appears in the example figures. To understand the relationship between the amount of habitat type present and discharge, the percent frequency for each habitat type identified was calculated.

Table 1: Stream discharge and historical aerial image dates for the habitat assessment segment of Wailuku River.

Discharge (cfs at noon)	Image Date
122	8/28/2015
60.6	5/13/2012
53	6/9/2012
37.1	1/21/2013
12.8	11/2/2012

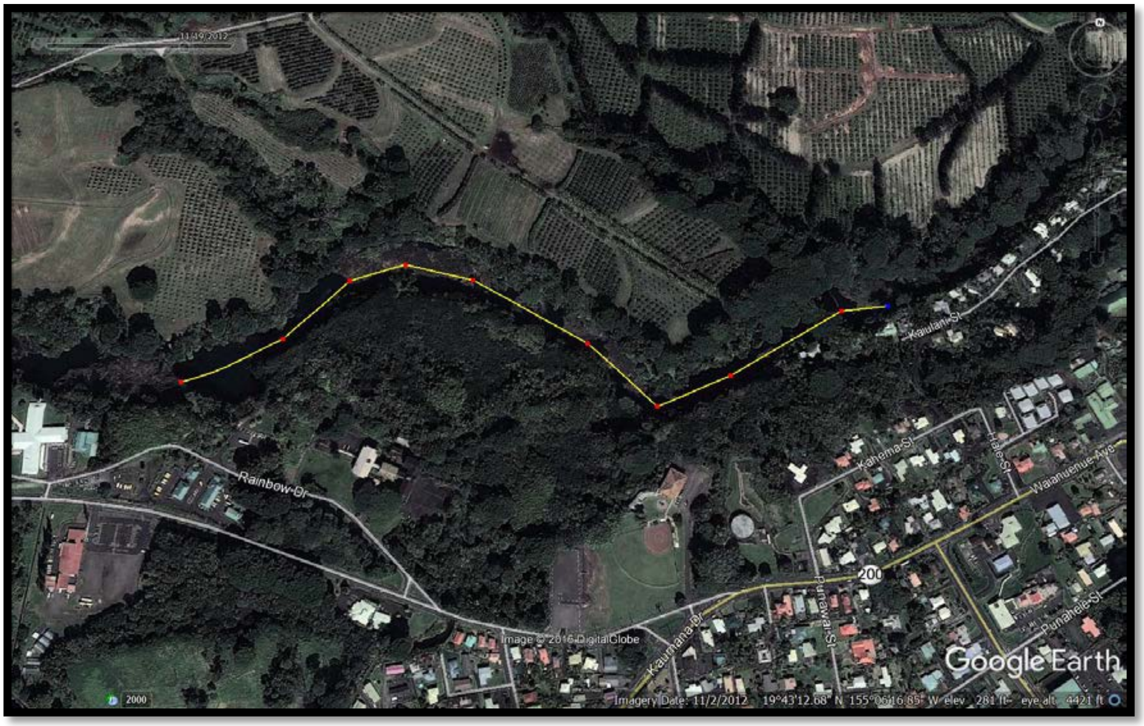


Figure 4: Segment length measured (1,113 m) for the Wailuku River habitat assessment.

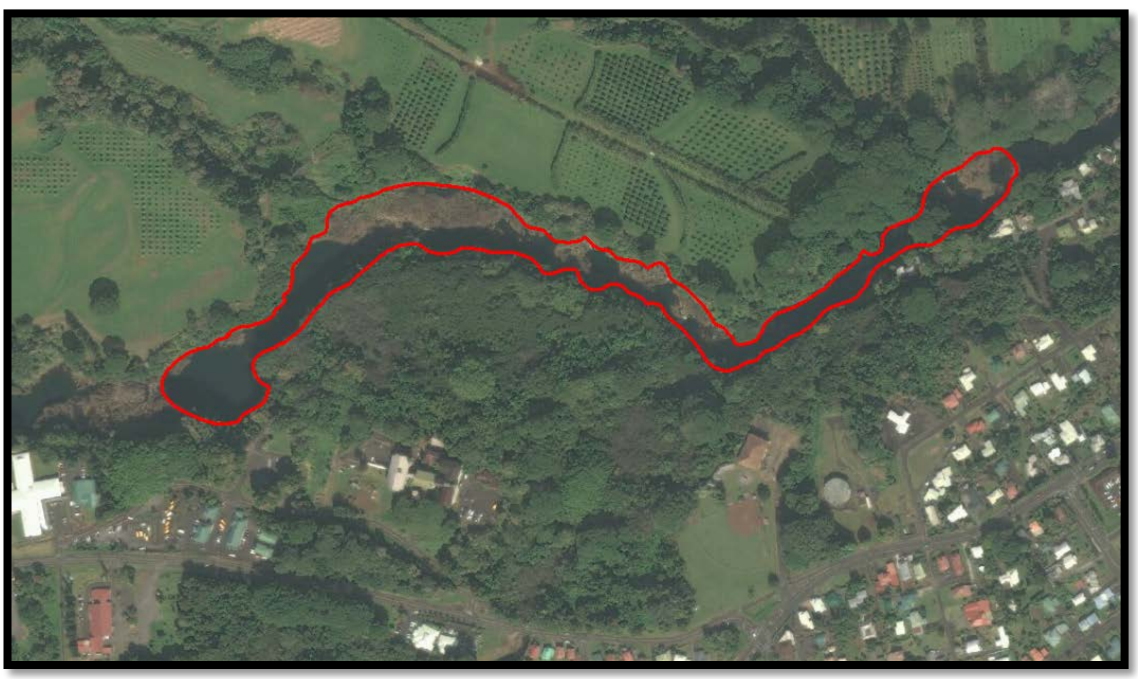


Figure 5: Polygon outline of Wailuku River used to create the random points used in the habitat assessment analysis.

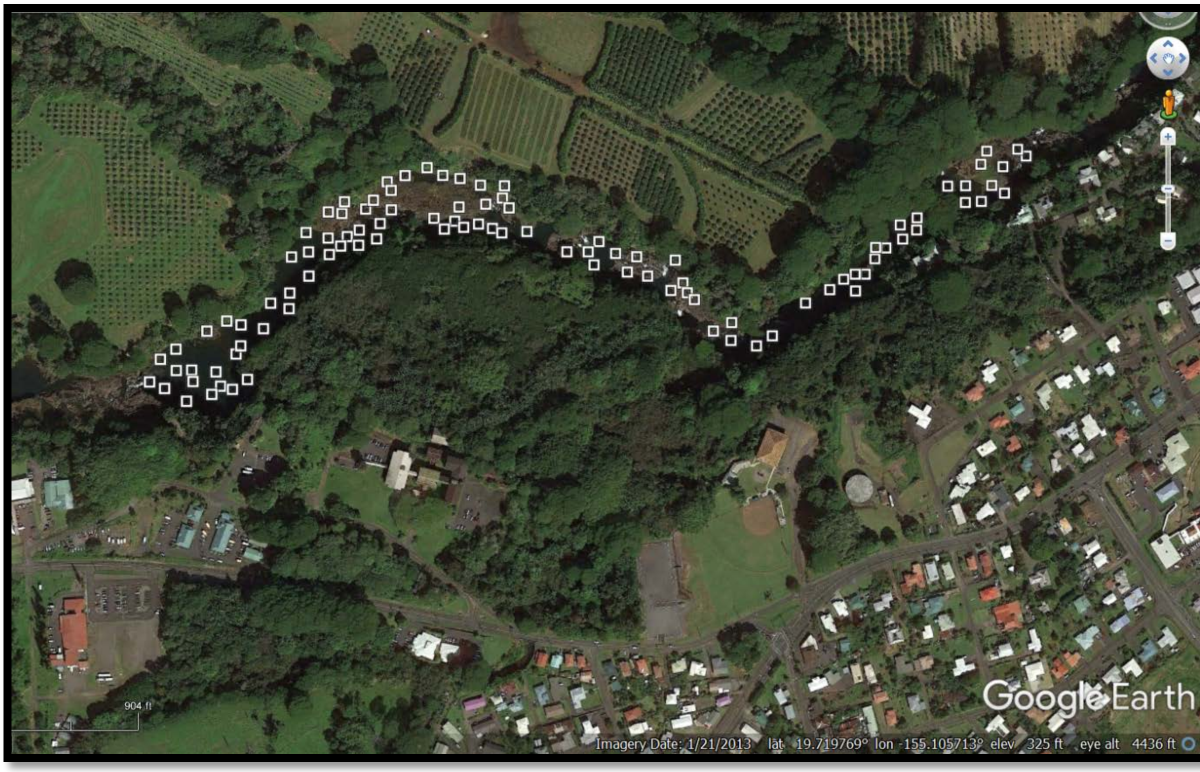


Figure 6: The 102 random points used in the habitat assessment of Wailuku River.

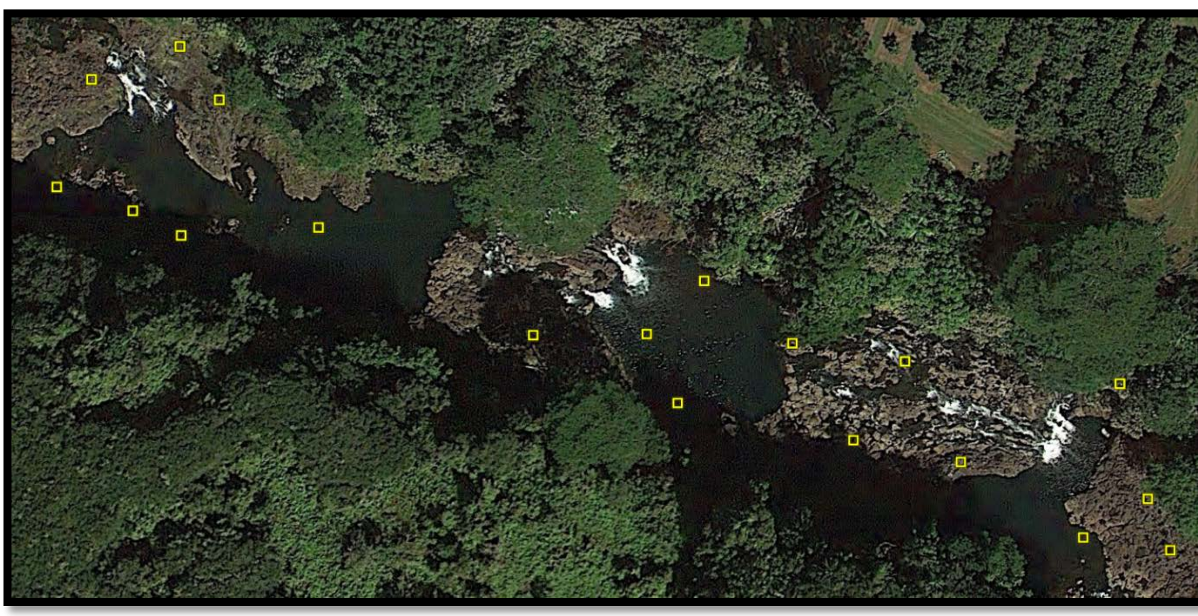


Figure 7: A close-up image of some of the random points used for the Wailuku River habitat assessment. The habitat type was classified to the majority type observed within the square outline.

Figure 8: Aerial image from 8/28/2015 of the Wailuku River habitat assessment segment. Wailuku River discharge was 122 cfs at the USGS gage site.

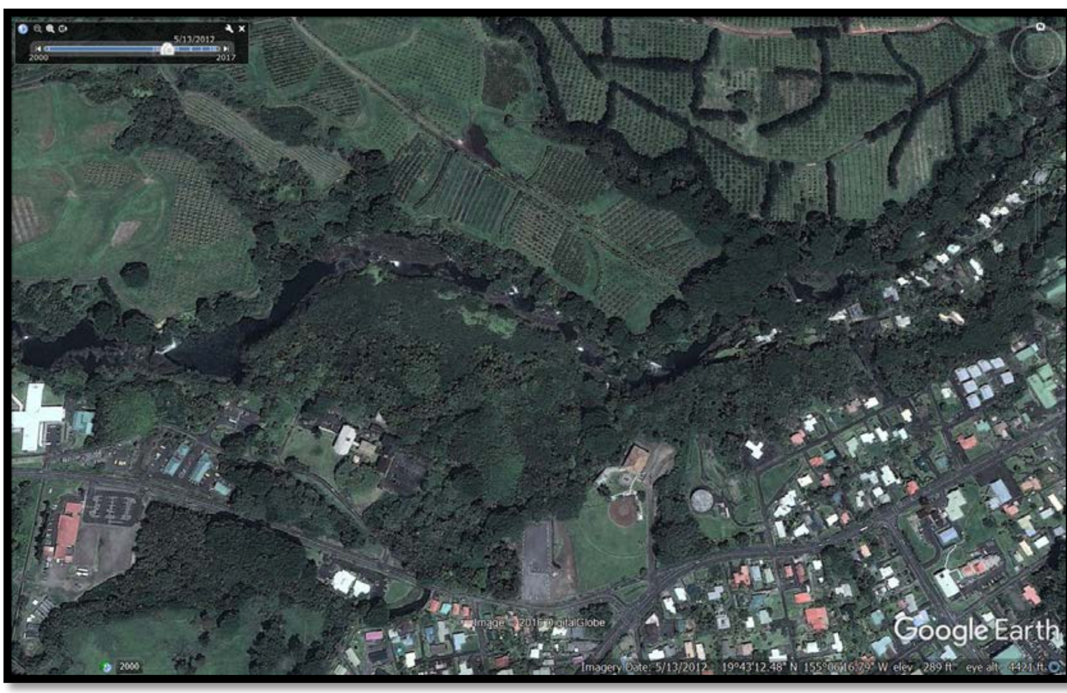


Figure 9: Aerial image from 5/13/2012 of the Wailuku River habitat assessment segment. Wailuku River discharge was 60.6 cfs at the USGS gage site.

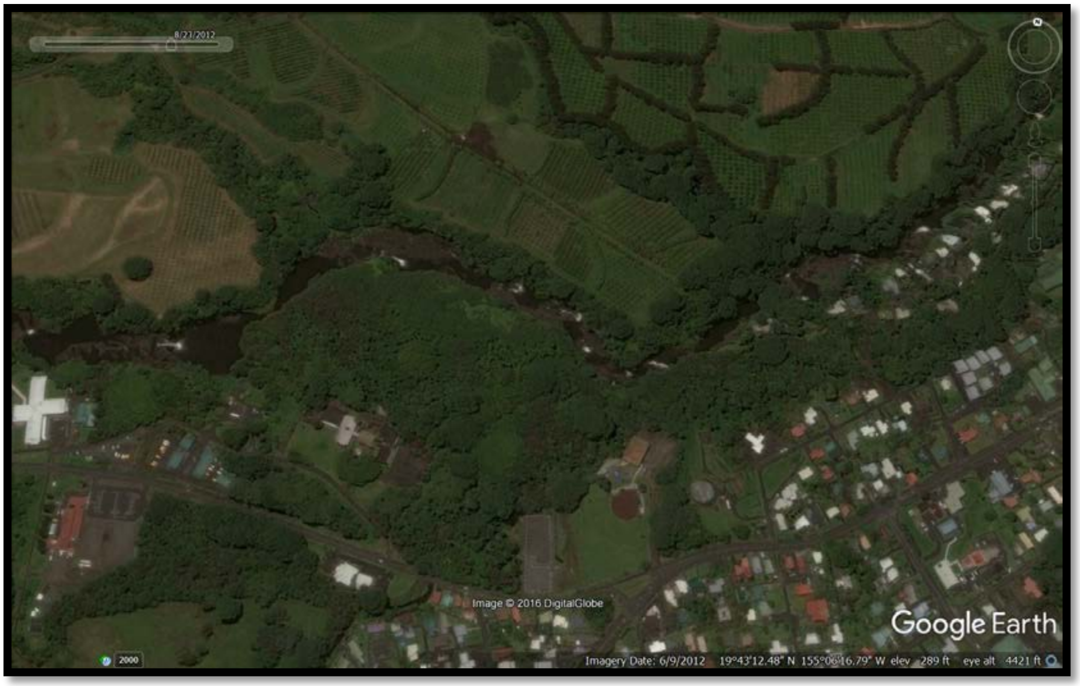


Figure 10: Aerial image from 6/9/2012 of the Wailuku River habitat assessment segment. Wailuku River discharge was 53.0 cfs at the USGS gage site.

Figure 11: Aerial image from 1/21/2013 of the Wailuku River habitat assessment segment. Wailuku River discharge was 37.1 cfs at the USGS gage site.

Figure 12: Aerial image from 11/2/2012 of the Wailuku River habitat assessment segment. Wailuku River discharge was 12.8 cfs at the USGS gage site.

Biotic Surveys

We used the High Definition Fish Survey (HDFS) approach to document biota in the survey segments. HDFS utilizes pole-mounted, high-definition, underwater video cameras to capture images of fish or other aquatic animals at a specific location (Figure 13) (Parham and Higashi, 2015). The underwater cameras are geo-referenced so that specific time and place information is recorded in conjunction with all video observations.

In general, the HDFS sample could be considered a point or timed sample. The cameras are moved into position, slowly lowered to the bottom, and then remain in position for approximately 30 seconds to capture a sample of animals at that location (Figure 14). In some locations, the camera is moved slowly to the next position without removing it from the water. During the timed samples, each 30-second sample observes approximately one square meter of instream habitat. This process is repeated at sites distributed evenly throughout the available habitat.

To document the animals observed in the videos, the HDSS Video Coder software (Parham 2014) with a list of potential animal species was used. Additional species, if observed, are listed as Other1, 2, or 3 and then identified after the classification process. This allows a single standard classification approach to be used for all survey video. The potential Hawaiian Stream species list included:

Native Fishes: O'opu nakea (*Awaous stamenius*), O'opu naniha (*Stenogobious hawaiiensis*), O'opu nopili (*Sicyotperus stimponi*), O'opu alamo'o (*Lentipes concolor*), O'opu akupa (*Eleotris sandvicensis*), Aholehole (*Kuhlia xenura*), Mullet (*Mugil cephalus*)

Native Crustaceans and Mollusks: Opae oeha'a (*Macrobrachium grandimanus*), Opae kala'ole (*Atyoida bisulcata*), Hihiwai (*Neritina granosa*), Hapawai (*Neritina vespertina*)

Introduced Fishes: Armored Catfish (*Hypostomus c.f. watawata)*, Bristlenose Catfish (*Ancistrus c.f. temmincki*), Bronze Corydoras (*Corydoras aeneus)*, Liberty Molly (*Poecilia sp. hybrid complex)*, Green Swordtail (*Xiphophorus hellerii)*, Guppy (*Poecilia reticulata)*, Mosquitofish (*Gambusia affinis*), Blackchin Tilapia (*Sarotherodon melanotheron)*, Convict Cichlid (*Amatitlania nigrofasciata)*, Smallmouth Bass (*Micropterus dolomieu)*, Carp (*Cyprinus carpio)*, Goldfish *(Carassius auratus)*, Dojo *(Misgurnus anguillicaudatus)*, White Cloud Mountain Minnow *(Tanichthys albonubes)*

Introduced Crustaceans, Mollusks, and Amphibians: Tahitian prawn (*Macrobrachium lar*), Grass Shrimp (*Neocaridina denticulata sinensis*), Crayfish (*Procambarus clarkii*), Cane Toad (*Bufo marinus*), Bull Frog (*Rana catesbeiana*)

Figure 15 shows examples of stream animals observed during the HDFS sample collection from various Hawaiian streams.

During classification, a start code was inserted when the camera is in position. Next, all individuals of all species were recorded, and then a stop code was recorded. For each sample, the habitat type was also recorded. This process allowed only high-quality underwater video samples to be used and were linked with the appropriate GPS data for that location.

To develop density estimates for stream animals, the total time for each site was recorded. The total time was divided by 30 seconds to estimate the area observed in m^2 as on average 1 m^2 was observed in each 30 seconds of observation. The total number of each species observed within each habitat type for the different areas surveyed were divided by the area of that habitat type to get the species density within each habitat type.

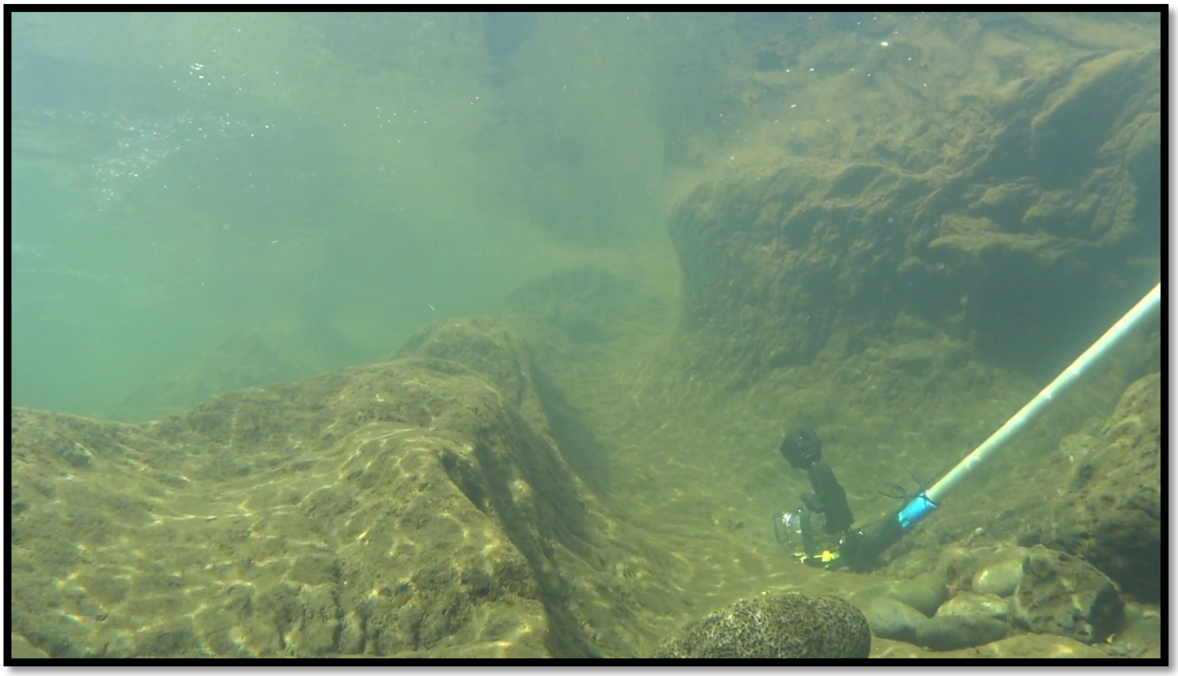


Figure 13: Underwater geo-referenced video camera with external video light used for the HDFS observations.

Figure 14: Example of HDFS surveys by Division of Aquatic Resources surveyors in Manoa stream, Oahu.

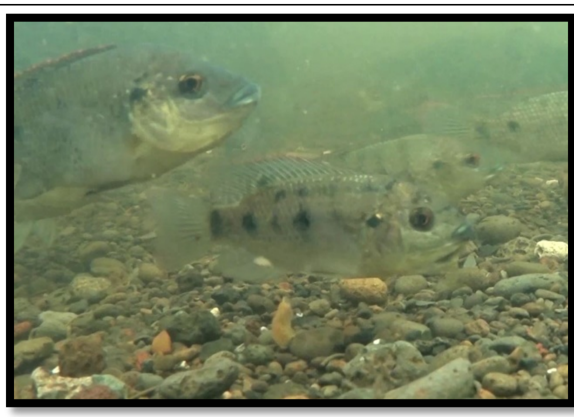
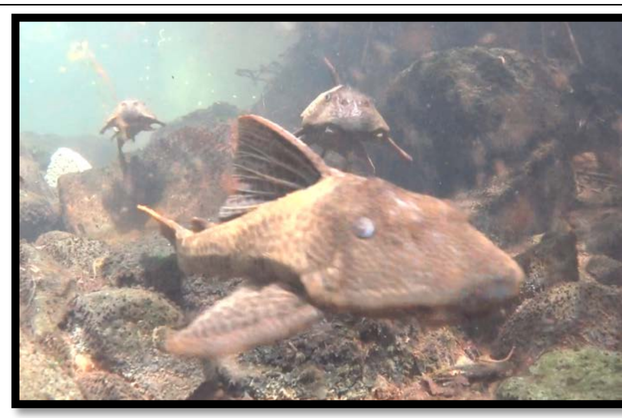
	
Native fish, *Awaous stamenius*, in a stream pool in I'ao Stream, Maui.	Native fish, *Sicyopterus stimpsoni*, on boulder substrate in I'ao Stream, Maui.
	
Native species, *Kuhlia xenura*, in the lower reach of I'ao Stream, Maui.	Introduced swordtails, *Xiphophorus hellerii*, in I'ao Stream, Maui.
	
Introduced Blackchin tilapia, *Sarotherodon melanotheron*, in Palolo Stream, Oahu.	Introduced armored catfish, *Hypostomus c.f. watawata* in Waiawa Stream, Oahu.

Figure 15: Examples of stream animals observed during HDFS projects on various Hawaiian Streams.

HSHEP Methods

A history of collaboration among biologists at Hawaii Division of Aquatic Resources (DAR) and researchers at various universities, agencies, museums, and private companies has focused on understanding the different aspects of the ecology and management of amphidromous stream animals (Fitzsimons and Nishimoto 2007). A goal of this collaboration was the development of an integrated model of Hawaiian streams that includes the life history characteristics of amphidromous animals, island stream hydrology, and critical management issues. This work resulted in the creation of the Hawaiian Stream Habitat Evaluation Procedure (HSHEP) Model (Parham et al. 2009).

The HSHEP model follows the overall concepts developed by the U.S. Fish and Wildlife Service to evaluate the quantity and quality of habitat available for a species of concern (USFWS 1980 a, b, USFWS 1981). In general, a Habitat Evaluation Procedure (HEP) model has several characteristics:

1. It is a habitat-based assessment method.
2. It assumes that habitat quality and quantity are related to the number of animals using a habitat over the long term.
3. It uses measurable attributes of habitat quality and quantity to create relationships between habitat suitability and animal occurrence and density.
4. It converts suitability relationships into standardized Habitat Suitability Indexes (HSI) that encompass the range of observed habitat conditions.
5. The HSI values range from 0 (unsuitable habitat) to 1 (most suitable habitat).
6. It multiplies the habitat quality (value from the HSI) with the habitat quantity (area) to determine overall Habitat Units (HU) within the area of concern.

As a result of the model design, HEP impact analyses allow the user to:

1. provide defined suitability-based estimates of HU within a study area,
2. provide impact assessments of the changes of HU within the study area under different management scenarios,
3. provide objective comparable unit measures for multi-site comparison,
4. quantify changes in HU to be annualized and comparable with other cost/benefit analyses,
5. create plots of the distribution of HU in map-based formats (GIS analyses) to address issues of habitat fragmentation or connectivity.

The HEP user manual describes a HEP model like this, "HEP is a convenient means of documenting and displaying, in standard units, the predicted effects of proposed actions." USFWS designed HEP to be a legally defensible, standardized format for impact assessment in natural resource settings (USFWS 1980 a). While HEP models were developed, and used for impact assessment nationally for hundreds of species of birds, mammals, and fish, the HSHEP

Model was the first to assess changes in Hawaiian stream animal habitat, particularly with respect to stream diversions.

Traditional HEP procedures were integrated with multi-spatial modeling efforts for Hawaiian streams (Parham 2002, Kuamo'o et al. 2007, Parham 2008). The multi-spatial models address issues of scale in addressing differences in habitat availability and species distributions. For example, the presence or density of amphidromous animals is influenced by the location of the sample site within a stream. Similar habitats found near the ocean may have different species assemblages than habitats found further inland. Additionally, characteristics of different watersheds and their streams influence the observed species assemblages. For example, streams with terminal waterfalls have different species assemblages than streams without terminal waterfalls. By assessing suitability at multiple spatial scales, different aspects of amphidromous animal ecology can be more appropriately modeled.

As a result of the combination of the HEP method with multi-scale analysis, management issues can be addressed on a site, stream segment, whole stream or region level. The overall HSHEP approach and methodology was professionally reviewed by the USACE and approved for use on the Ala Wai Flood Control Project (Parham 2015a).

The HSHEP Model for Wailuku River was developed using published information for species distributions at the watershed, reach scale and site scales and combined with local data from the habitat and biotic surveys. Stream animals' distribution and habitat use were documented using information stored in the DLNR-DAR Aquatic Surveys Database (2009). The DAR Aquatic Surveys Database represents over 13,000 survey locations and over 90,000 species observations. The database includes results from state surveys as well as those from federal, university, and private researchers. More than 370 different literature sources support the data contained within the DAR Aquatic Surveys Database. The HSHEP model leverages the data within the DAR Aquatic Surveys Database to develop quantitative measures of habitat use for native stream animals. For impact assessment projects in Hawaiian stream, habitat assessments are typically created for native freshwater fish and macroinvertebrates found in Hawaiian streams (Table 2).

Table 2: Highlighted species habitat evaluated within Wailuku River for this project.

Organism Type and Family	Scientific name	Hawaiian name
Freshwater fish (family Gobiidae)	*Awaous stamenius**	ʻOʻopu nākea
	*Lentipes concolor**	ʻOʻopu alamoʻo
	*Stenogobius hawaiiensis**	ʻOʻopu naniha
	*Sicyopterus stimpsoni**	ʻOʻopu nōpili
Freshwater fish (family Eleotridae)	*Eleotris sandwicensis**	ʻOʻopu akupa
Freshwater shrimp (Crustacean) (family Atyidae)	*Atyoida bisulcata**	ʻŌpae kalaʻ'ole
Freshwater prawn (Crustacean) (family Palaemonidae)	*Macrobrachium grandimanus**	ʻŌpae ʻoehaʻa
Freshwater snail (Mollusk) (family Neritidae)	*Neritina granosa**	Hīhīwai

*Identified as "Species of Greatest Conservation Need" in the Hawaii Statewide Aquatic Wildlife Conservation Strategy (Meadows et al. 2005).

The selection of the highlighted set of amphidromous stream animals (*Lentipes concolor*, *Sicyopterus stimpsoni*, and *Atyoida bisulcata*) is appropriate in this case for several reasons.

- These species have been observed within the Wailuku River system in the area of the Wailuku Hydropower facilities during prior surveys (USFWS 1984, Baker 1995, this study).

- All of these species have a diadromous life history, meaning that they migrate from the freshwater stream to the ocean and back again (McDowall 2007). This potentially exposes the migrating animals to barriers in the stream pathway, entrainment into water diversion systems, and elimination of suitable habitat resulting from structures associated with the Wailuku Hydroelectric power plants and its water collection systems.

- The DAR Aquatic Surveys Database has distribution and habitat use information for each of these species.

- The HSHEP model has habitat suitability indices developed for each of these species.

Awaous stamenius and *Neritina granosa* would be the next most likely species to include in this analysis although adults of these species have not been observed in the area of the Wailuku River hydropower facility. They are likely restricted to lower sections of the stream below Rainbow Falls and may react to the proposed hydropower modification is a similar pattern to *Sicyopterus stimpsoni.* Inclusion of these species would change the final overall habitat unit quantities observed, but would not change management recommendations to minimize habitat loss due to their habitat location downstream of any hydropower intake sites.

To characterize habitat availability, the HSHEP model applied a nested spatial hierarchy. For this project, the site, reach and stream segment spatial scales were the most important for assessing the impact of hydropower modifications on Wailuku River.

The methods from previously reported HSHEP models were followed and variables included at the watershed level were stream and watershed size, watershed wetness, watershed stewardship, the amount of estuary and shallow water marine habitats associated with the watershed, and the watershed land cover quality. The rating for these variables was presented in the *Atlas of Hawaiian Watersheds & Their Aquatic Resources* (Parham et al., 2008) and the variables for all 430 streams included in the atlas were used to develop the model at this level. Inclusion of the watershed scale in the HSHEP model allows for comparisons of the results for Wailuku River with other streams statewide.

Published information from the DAR Aquatic Surveys Database was used to describe variation of instream habitat and animal distributions. Variables included at the stream segment are elevation, distance inland from the ocean, and the slope of instream barriers. Native amphidromous animals are diadromous requiring a connection between the freshwater streams and the ocean to complete their life cycle. Thus, the ability of the animal to move upstream from the ocean will influence its observed distribution.

At the site level, records associated with each species' use of depth, substrate, habitat type, and water quality parameters were used to describe a species' habitat use. The data from the habitat and biotic survey results were used to further understand the location conditions within the Wailuku River. Combining habitat availability and species habitat use provided a mechanism to determine habitat suitability.

To describe the HSHEP model process and estimate the effect of the Hydroelectric power plants and associated water collection systems on the selected native stream animal habitat, the Impact Assessments techniques of the Habitat Evaluation Procedure (HEP) were followed (USFWS 1981). The impact assessment involves several steps including:

1) description of study area,
2) selection of survey sites,
3) description of site survey methodology,
4) selection of evaluation species,
5) description of suitability indices at each spatial scale,
6) description of step to create the HSHEP model,
7) quantification of currently available habitat units (HU) within the study area, and,
8) estimation of HU within the study area impacted proposed modifications Hydroelectric power plants and associated water collection systems.

The documentation of steps 1 through 6 are mostly project methodology with project specific survey and model results included in the results section of this report. The intent of this report design is to provide the reader with a step-by-step development of field surveys, the model, and the associated results.

Description of suitability indices at each spatial scale

One of the goals of developing useful metrics in the Habitat Evaluation Procedure was to have a positive linear relationship between the prediction variable and the actual occurrence of the animal. For the watershed variables, a linear regression was used to describe the relationship between the prediction and the actual data. The following set of figures show the relationship between the occurrences of native stream animals with different predictive variables. The relationships show the calculated or predicted variable score (x–axis) in comparison with the proportion of samples from actual field surveys that fall within different groups.

The following figures use data collected statewide (Division of Aquatic Resources 2009). Most these data come from DAR point quadrat surveys conducted throughout Hawaiian streams since the early 1990's (Higashi and Nishimoto 2007). The historical surveys provide the HSHEP model with extensive species and habitat observational data on which to base the relationships. As additional field information is gathered, the new information can be incorporated into the HSHEP model to improve the predictive quality of the model output.

Watershed level variables: (Reproduced from Parham et al. 2010, as these are the relationships applied within the HSHEP model)

Figure 16 – Figure 25 show the relationship between individual watershed variables and all native stream animals of concern.

Figure 26 – Figure 28 show the watershed suitability indices developed for each selected species. Note for this analysis, the selected species include amphidromous stream animals (*Lentipes concolor, Sicyopterus stimpsoni*, and *Atyoida bisulcata*).

Stream segment level variables: (Reproduced from Parham et al. 2010, as these are the relationships applied within the HSHEP model)

Figure 29 - Figure 34 show the relationship between individual stream segment variables and all native stream animals of concern.

Figure 35 – Figure 37 show the segment suitability indices developed for each selected species. Note for this analysis, the selected species include amphidromous stream animals (*Lentipes concolor, Sicyopterus stimpsoni*, and *Atyoida bisulcata*).

Site level variables:

The estimates of stream habitat at the site level were primarily based on habitat and biotic surveys and looked at stream conditions related to:

- habitat availability with respect to stream discharge,
- The availability of suitable habitat types, water depth, and substrates.

<u>Watershed and Stream Scale:</u> Watershed and Stream Size Rating

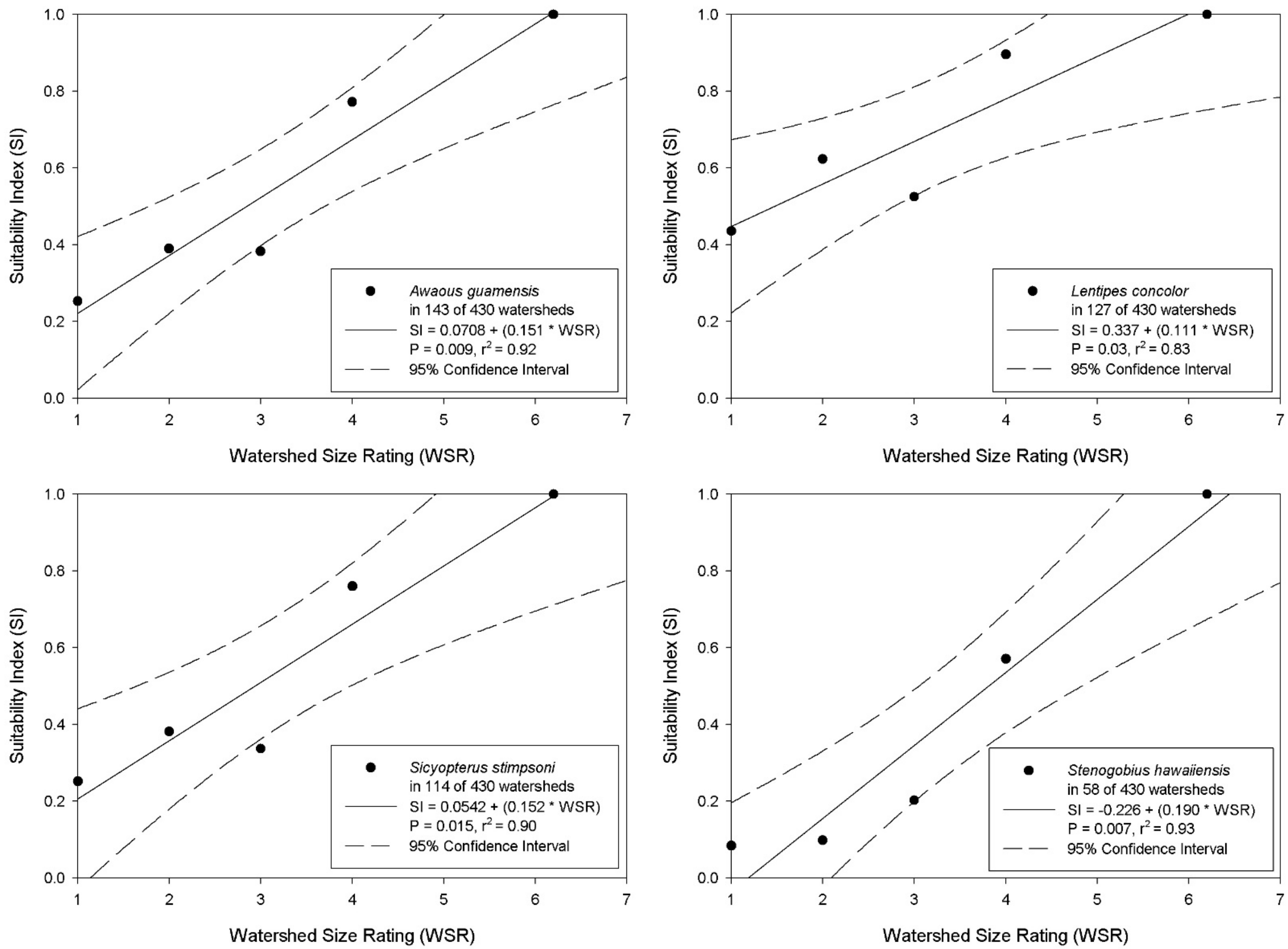


Figure 16: Suitability Indices for Watershed Size Rating for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis*.

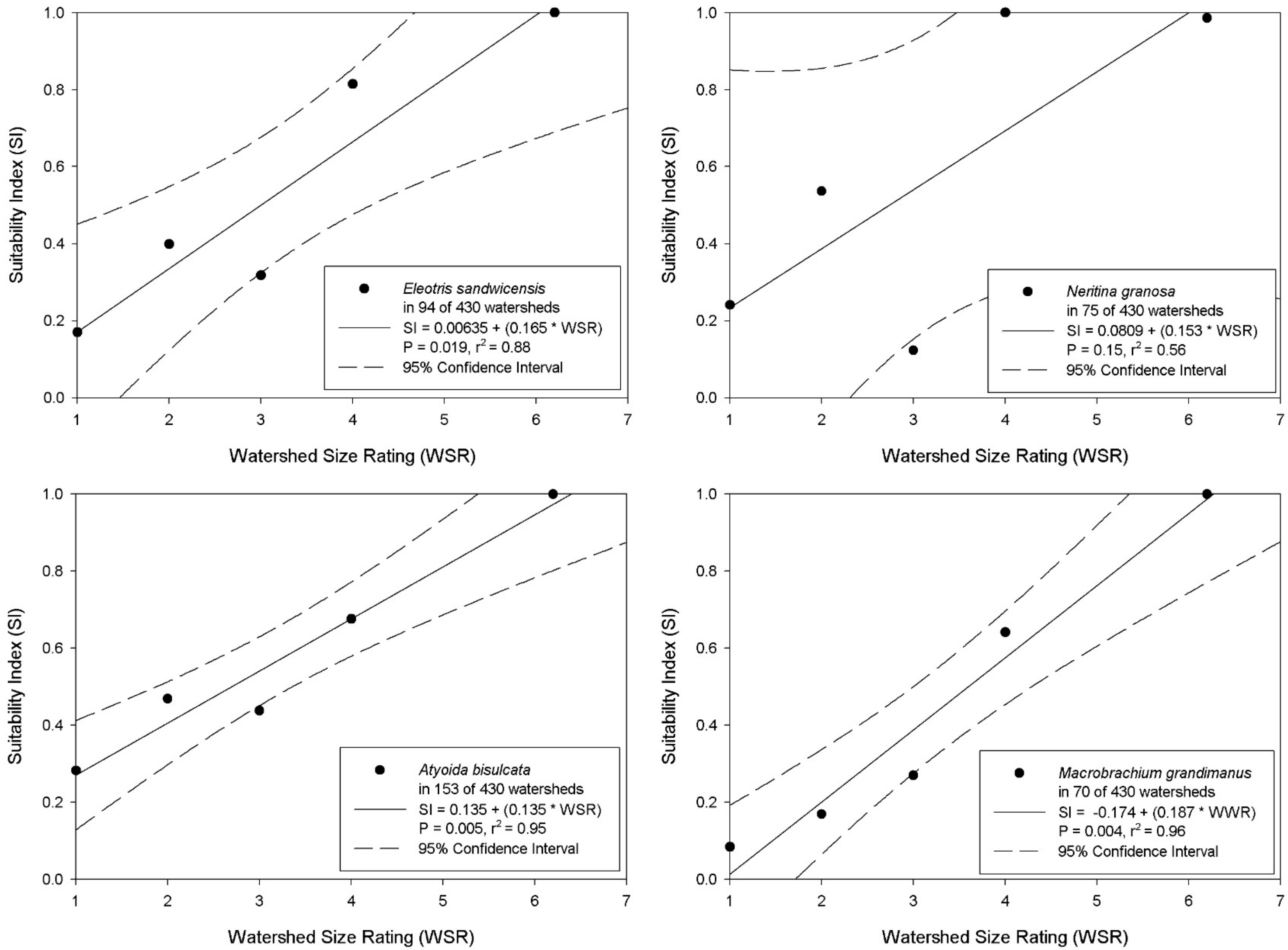


Figure 17: Suitability Indices for Watershed Size Rating for *Eleotris sandwicensis*, *Neritina granosa*, *Atyoida bisulcata*, and *Macrobrachium grandimanus*.

Watershed Wetness Rating

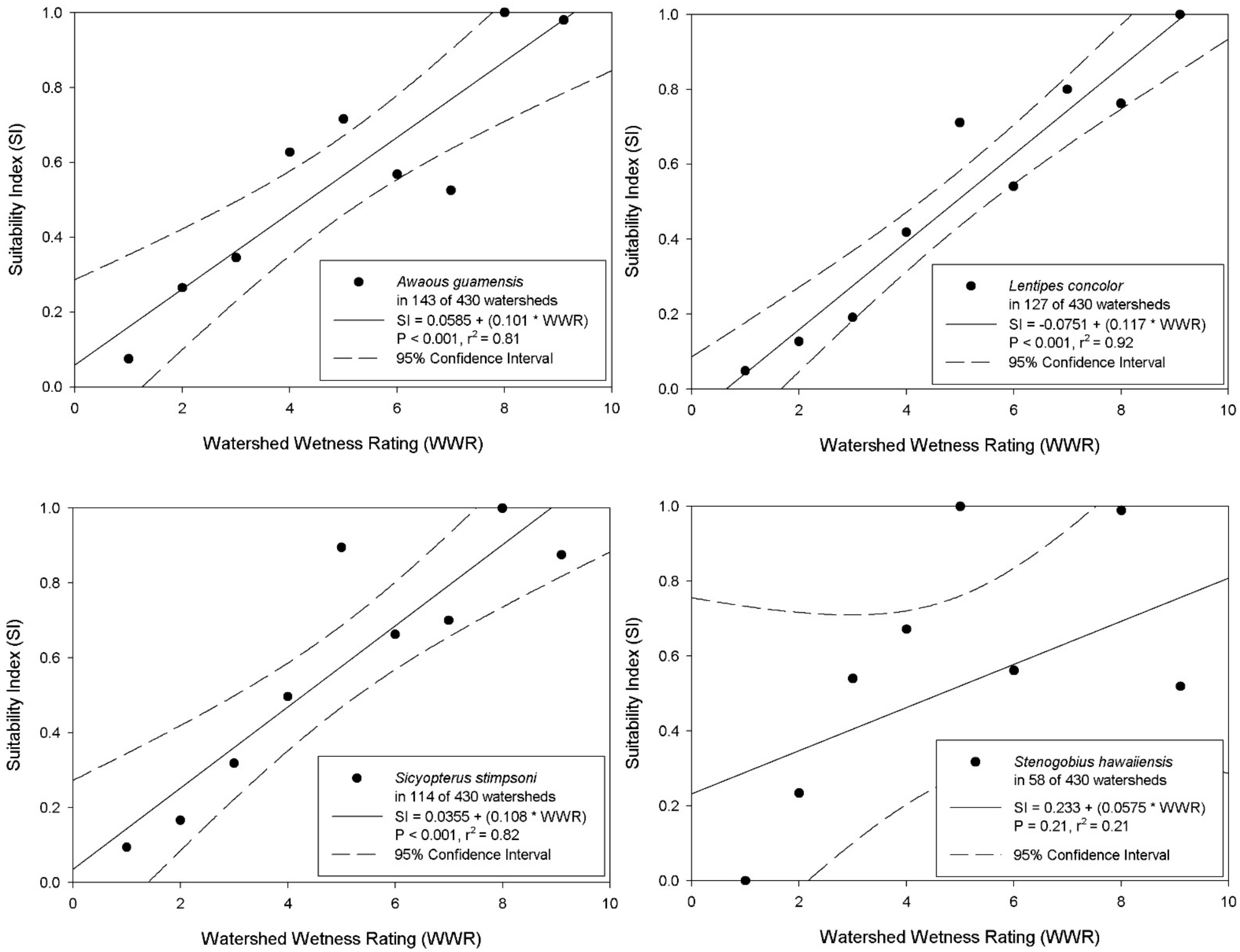


Figure 18: Suitability Indices for Watershed Wetness Rating for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

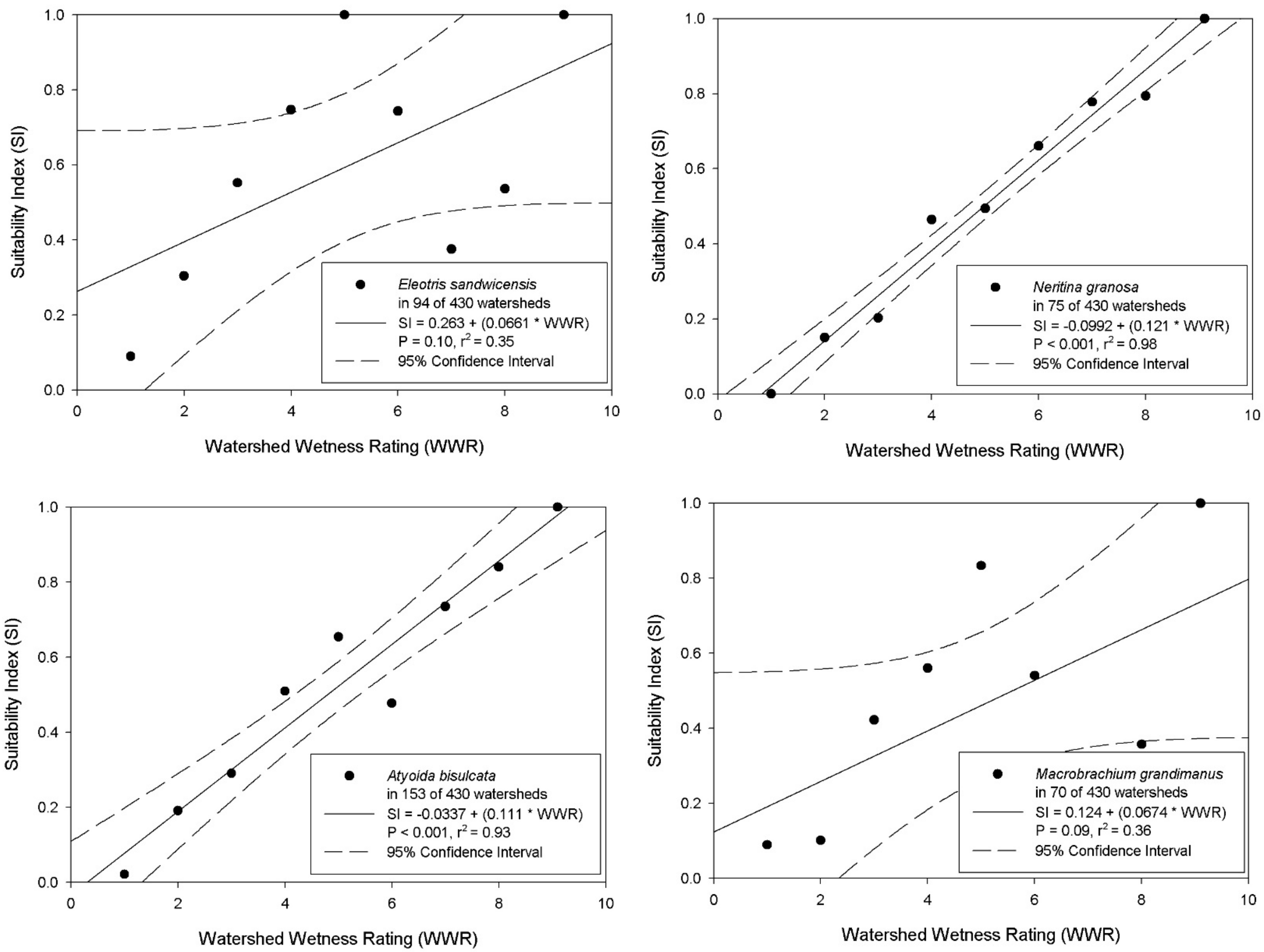


Figure 19: Suitability Indices for Watershed Wetness Rating for *Eleotris sandwicensis*, *Neritina granosa*, *Atyoida bisulcata*, *and Macrobrachium grandimanus*.

Watershed Stewardship Rating

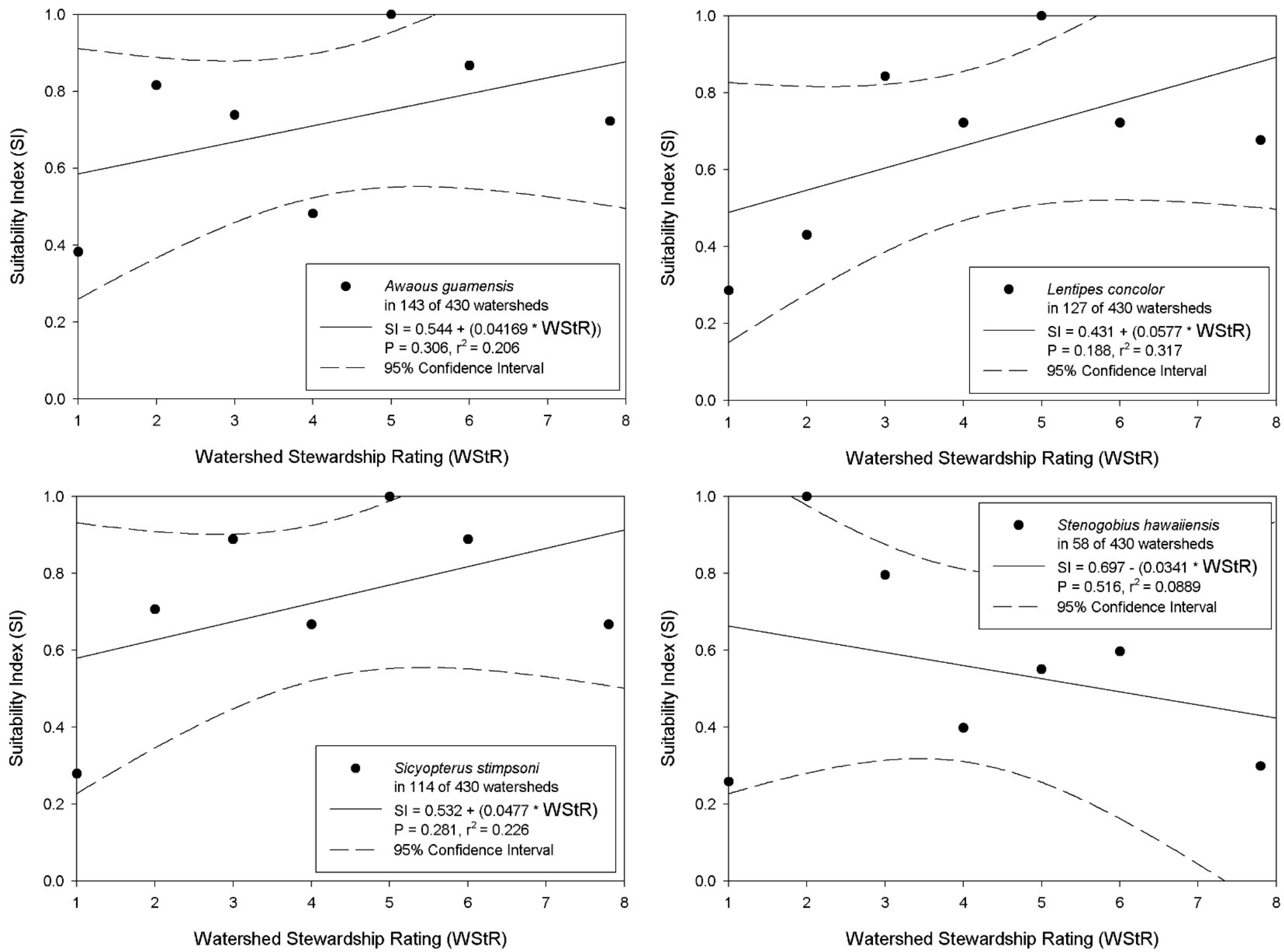


Figure 20: Suitability Indices for Watershed Stewardship Rating for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

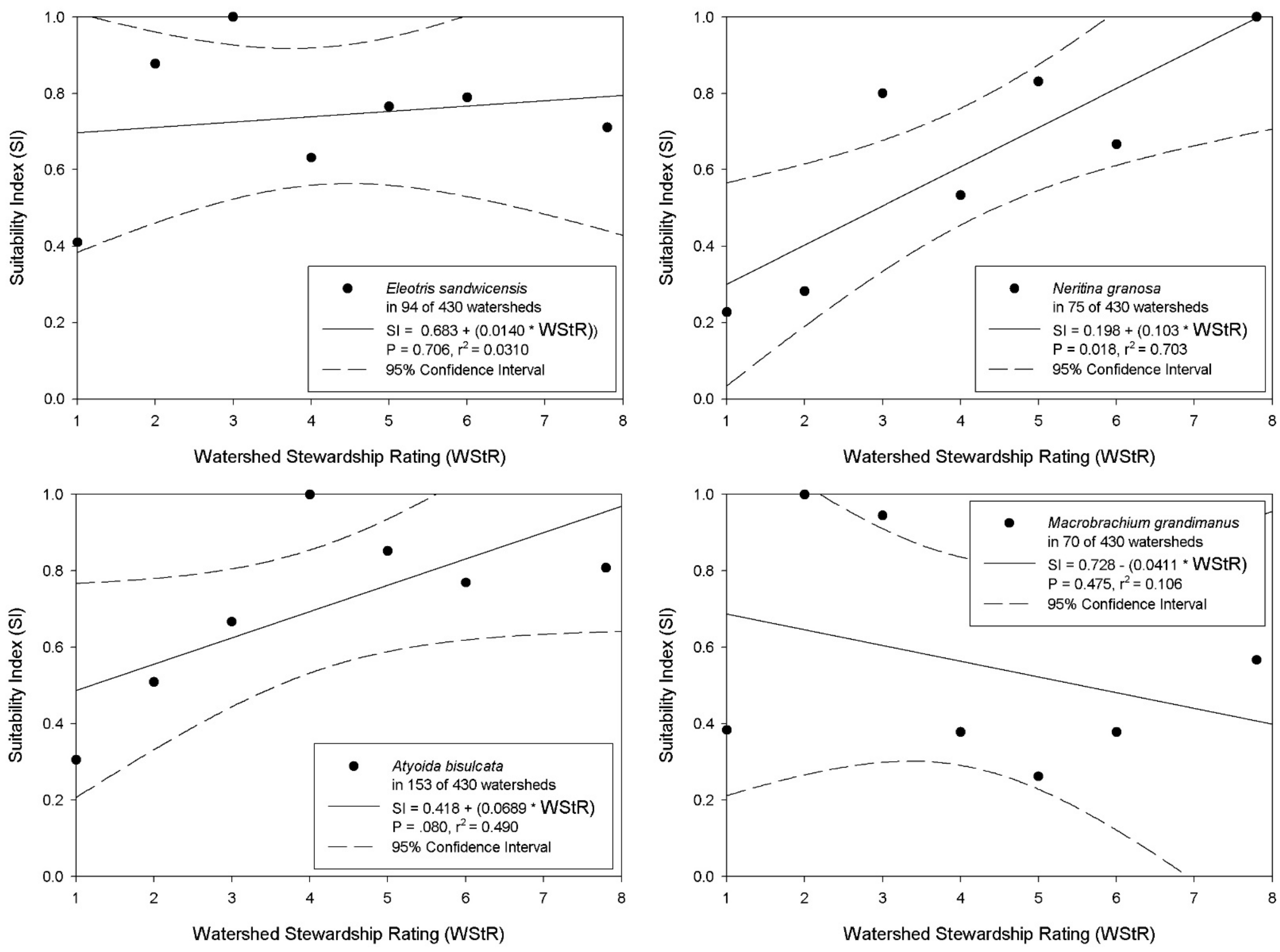


Figure 21: Suitability Indices for Watershed Stewardship Rating for *Eleotris sandwicensis, Neritina granosa, Atyoida bisulcata, and Macrobrachium grandimanus.*

Watershed Estuary and Nearshore Rating

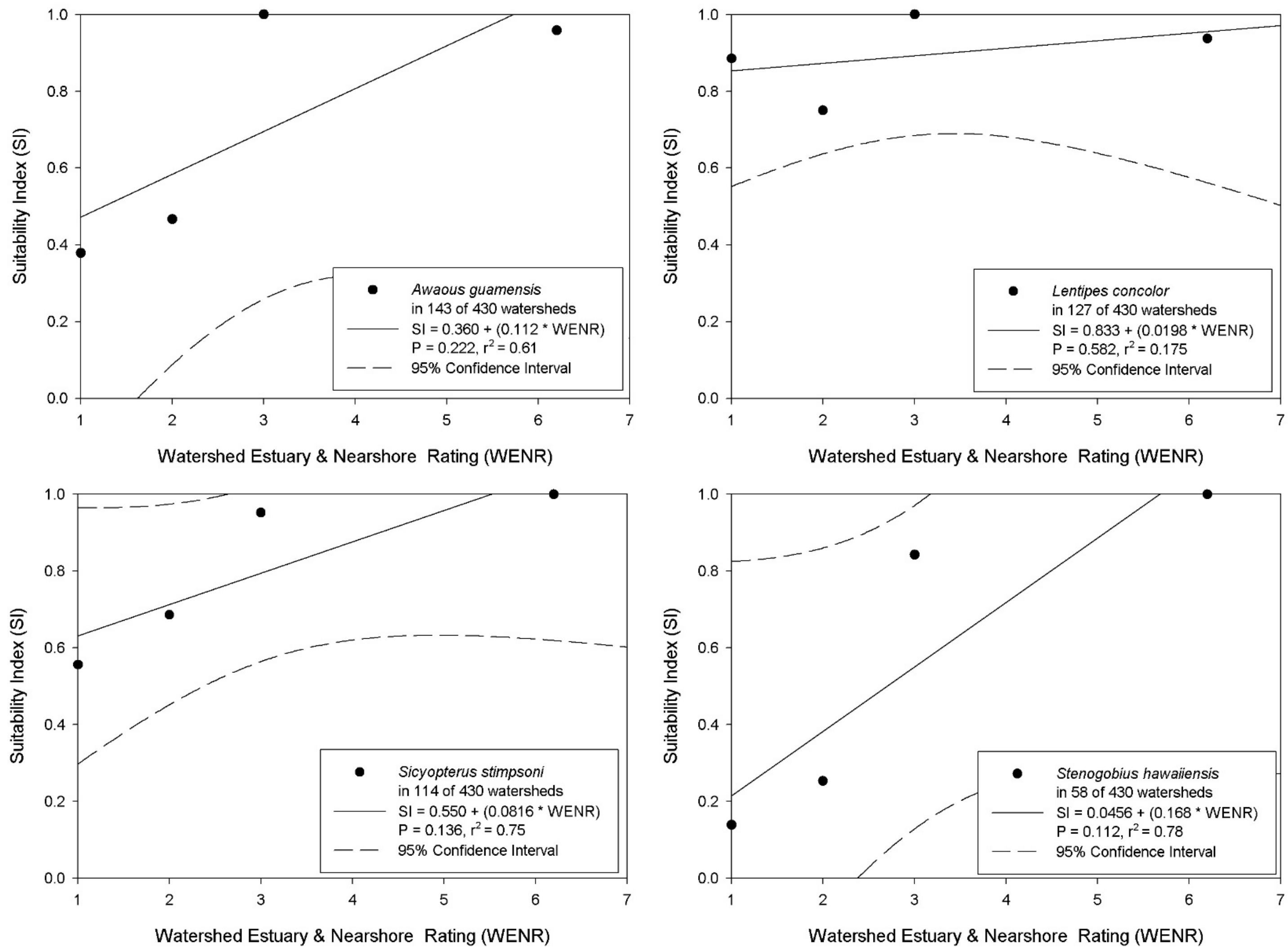


Figure 22: Suitability Indices for Watershed Estuary and Nearshore Rating for *Awaous stamenius*, *Lentipes concolor*, *Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

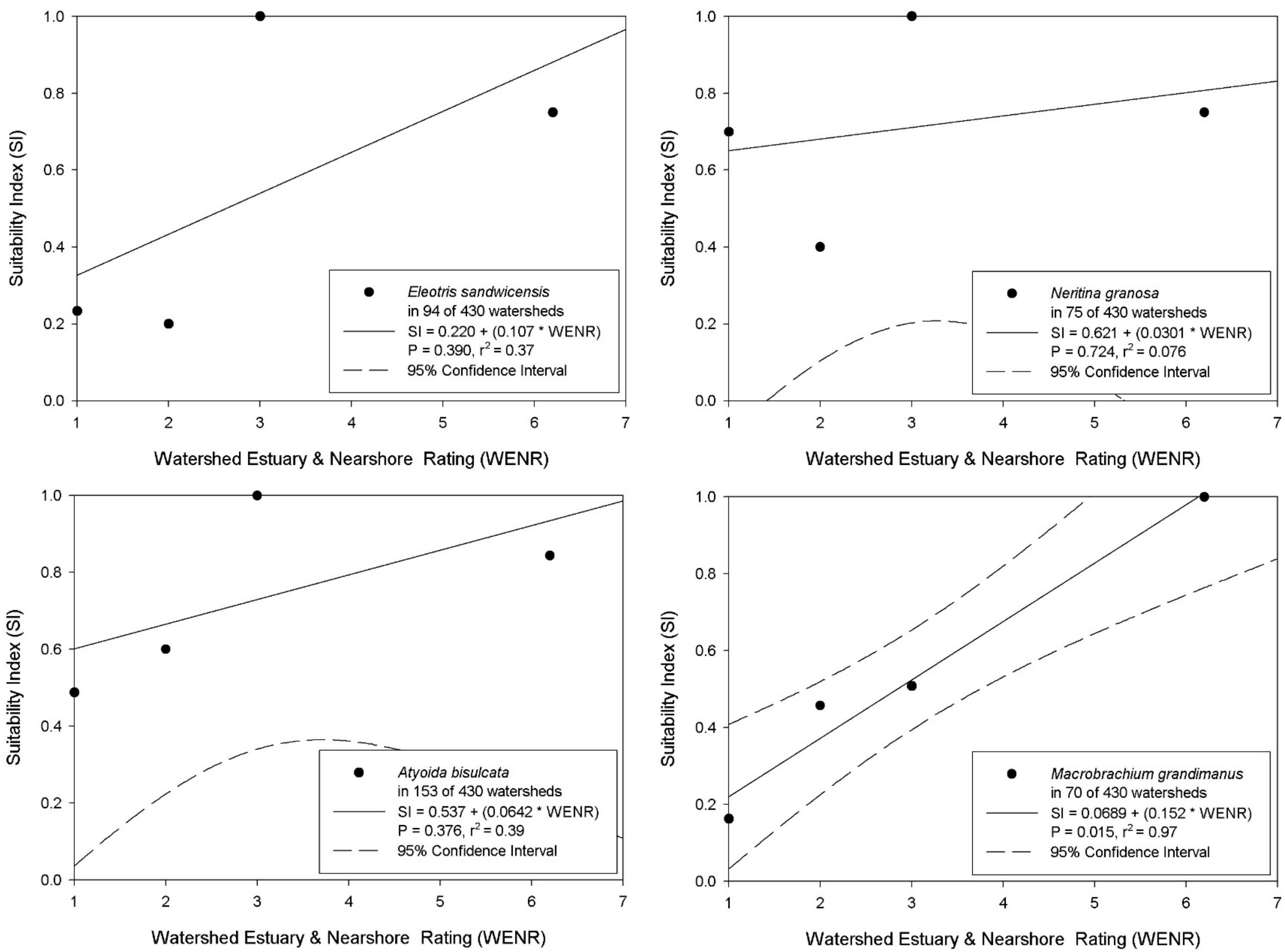


Figure 23: Suitability Indices for Watershed Estuary and Nearshore Rating for *Eleotris sandwicensis, Neritina granosa, Atyoida bisulcata, and Macrobrachium grandimanus.*

Watershed Land Quality Rating

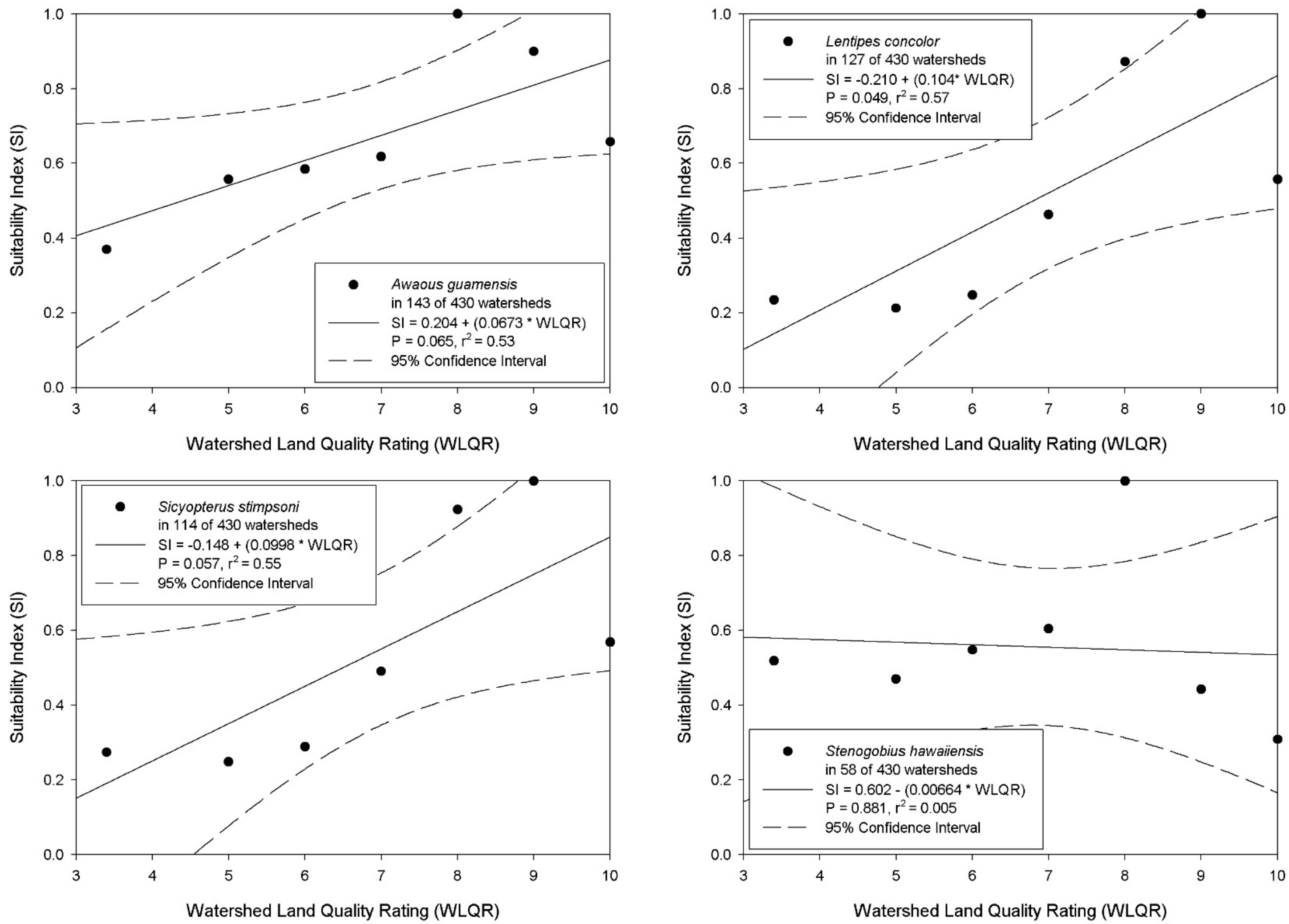


Figure 24: Suitability Indices for Watershed Land Quality Rating for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

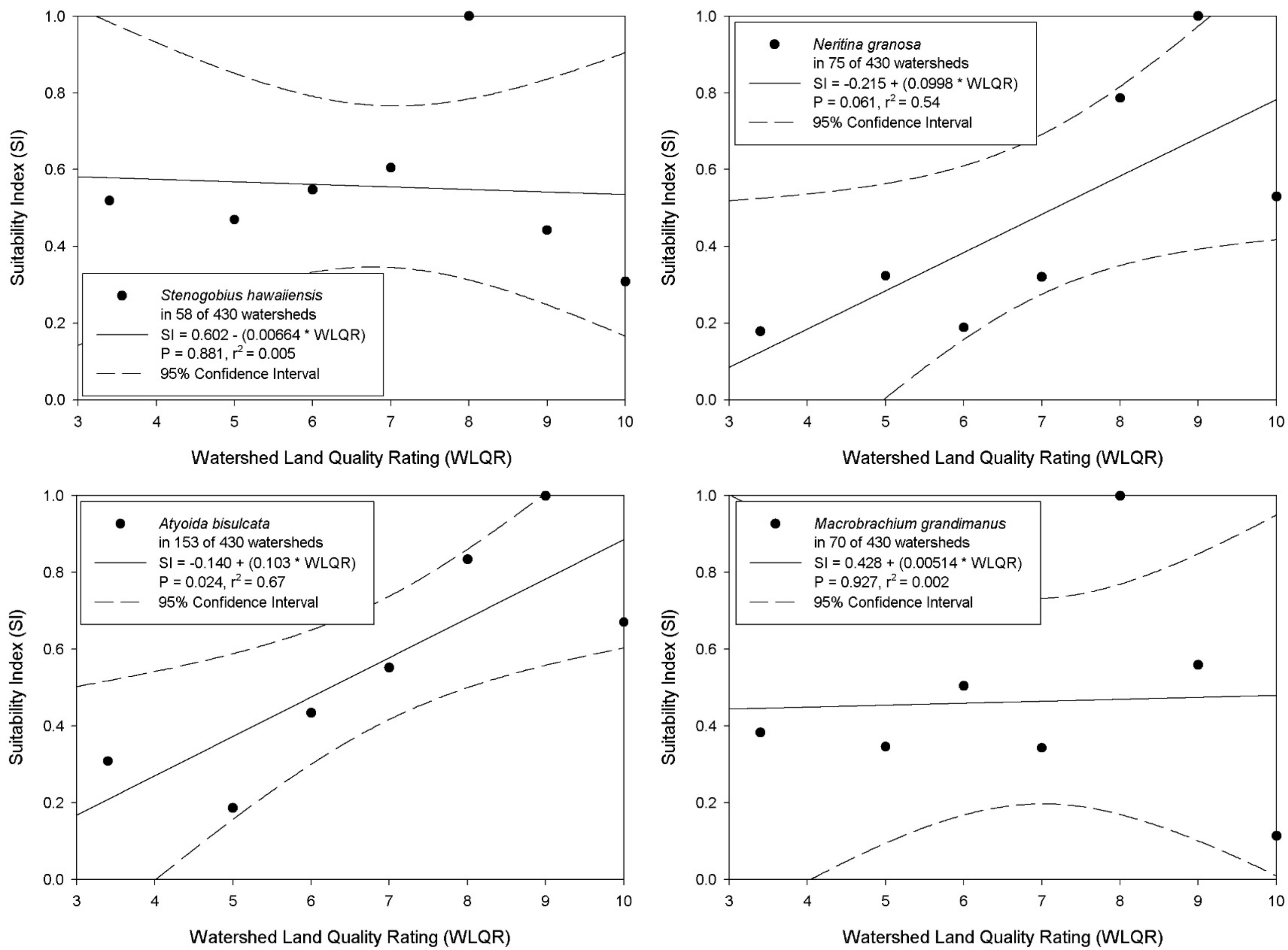


Figure 25: Suitability Indices for Watershed Land Quality Rating for *Eleotris sandwicensis, Neritina granosa, Atyoida bisulcata, and Macrobrachium grandimanus.*

<u>Watershed Suitability Models for each species</u>

Lentipes concolor:

The multiple logistic regression equation with the highest prediction accuracy was:

$$P = \frac{1}{1 + e^{-(-4.164 + (0.493 * \mathrm{WWR}) + (0.362 * \mathrm{WSR}) + (0.121 * \mathrm{WStR}))}}$$

where: WWR = Watershed Wetness Rating, ($p < 0.001$)

WSR = Watershed Size Rating, ($p < 0.001$)

WStR = Watershed Stewardship Rating, ($p = 0.025$).

This equation had a Likelihood Ratio Test Statistic of 117.8 ($P = <0.001$), and correctly predicted the presence or absence of *Lentipes concolor* in 322 of 430 watersheds (74.9 % correct) at a probability level of 0.5. To further confirm a positive relationship between the predicted watershed suitability value and the occurrence of *Lentipes concolor*, the proportion of samples within each 0.1 sized suitability bin was compared for all watersheds and those watersheds in which *Lentipes concolor* occurred (Figure 15).

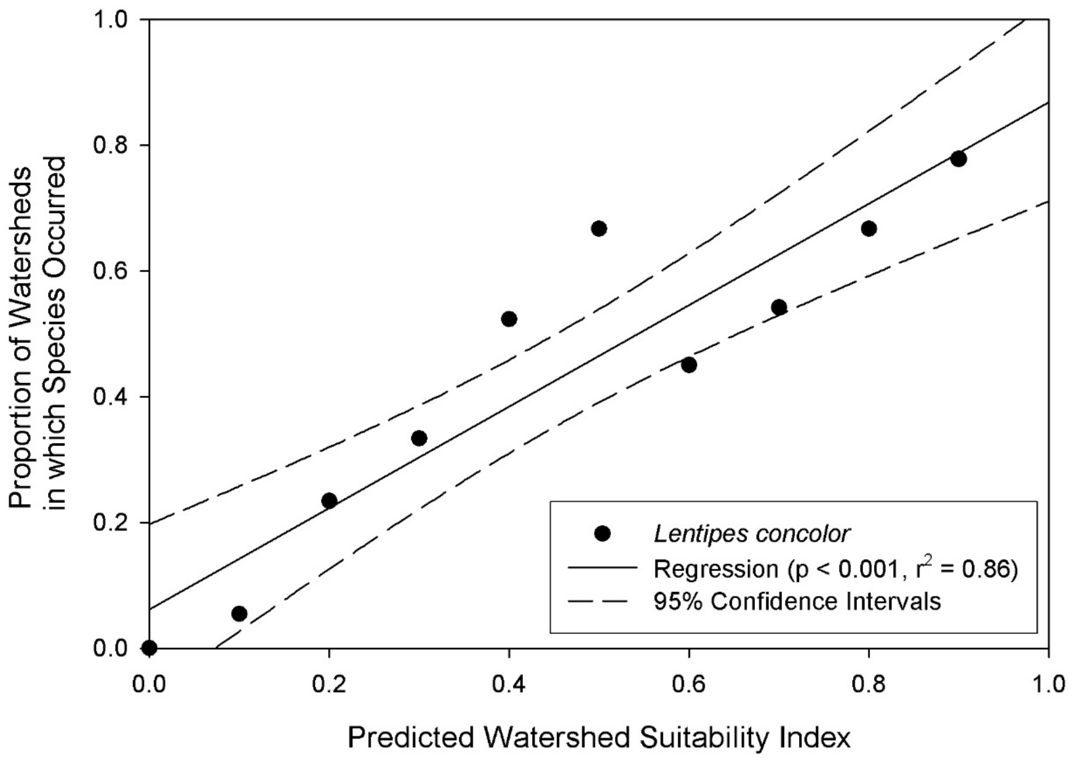


Figure 26: Proportion of the total watersheds where Lentipes concolor was observed within each 0.1 group of the Watershed Suitability Index equation for Lentipes concolor.

Sicyopterus stimpsoni:

The multiple logistic regression equation with the highest prediction accuracy was:

$$P = \frac{1}{1 + e^{-(-4.195 + (0.358 * \mathrm{WWR}) + (0.539 * \mathrm{WSR}) + (0.135 * \mathrm{WStR}))}}$$

where: WWR = Watershed Wetness Rating, ($p < 0.001$)

WSR = Watershed Size Rating, ($p < 0.001$)

WENR = Watershed Stewardship Rating, ($p = 0.012$).

This equation had a Likelihood Ratio Test Statistic of 97.1 (P = <0.001), and correctly predicted the presence or absence of *Sicyopterus stimpsoni* in 340 of 430 watersheds (79.1% correct) at a probability level of 0.5. To further confirm a positive relationship between the predicted watershed suitability value and the occurrence of *Sicyopterus stimpsoni*, the proportion of samples within each 0.1 sized suitability bin was compared for all watersheds and those watersheds in which *Sicyopterus stimpsoni* occurred (Figure 16).

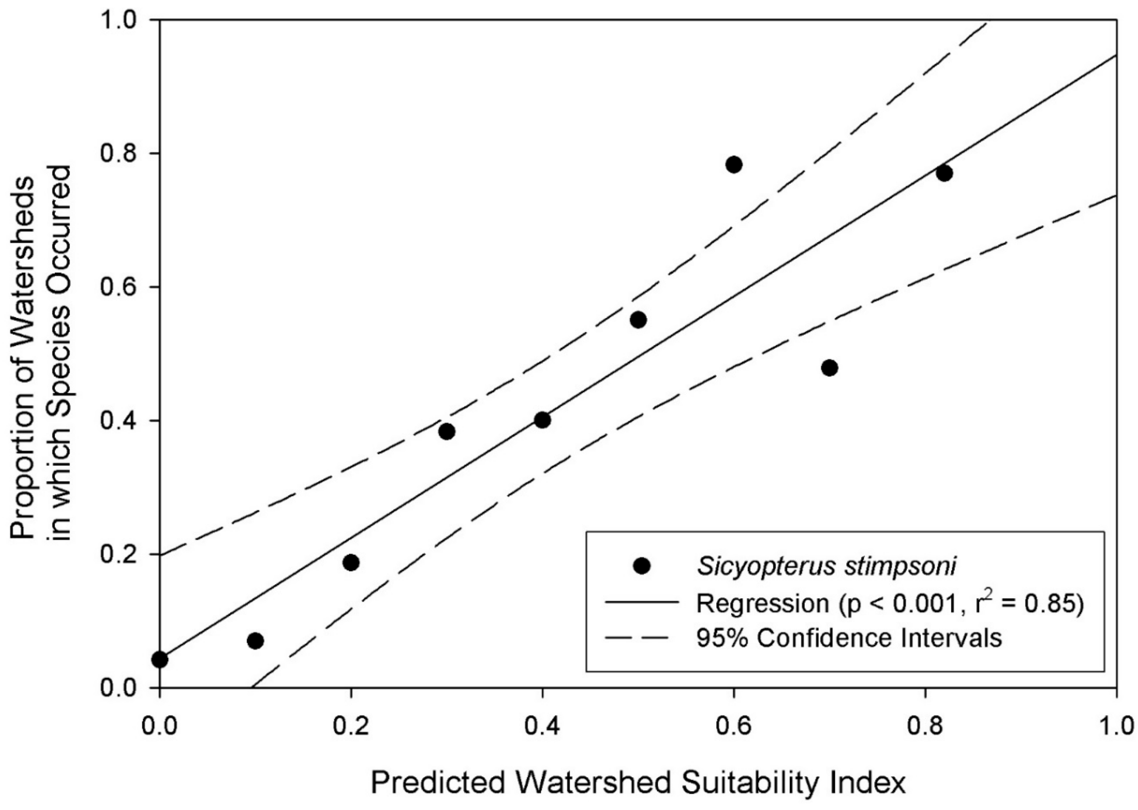


Figure 27: Proportion of the total watersheds where Sicyopterus stimpsoni was observed within each 0.1 group of the Watershed Suitability Index equation for Sicyopterus stimpsoni.

Atyoida bisulcata:

The multiple logistic regression equation with the highest prediction accuracy was:

$$P = \frac{1}{1 + e^{-(-4.458 + (0.508 * \mathrm{WWR}) + (0.497 * \mathrm{WSR}) + (0.179 * \mathrm{WStR}) + (0.165 * \mathrm{WENR}))}}$$

where: WWR = Watershed Wetness Rating, ($p < 0.001$)

WSR = Watershed Size Rating, ($p < 0.001$)

WStR = Watershed Stewardship Rating, ($p = 0.001$)

WENR = Watershed Estuary and Nearshore Rating, ($p = 0.04$).

This equation had a Likelihood Ratio Test Statistic of 153.3 (P = <0.001), and correctly predicted the presence or absence of *Atyoida bisulcata* in 336 of 430 watersheds (78.1% correct) at a probability level of 0.5. To further confirm a positive relationship between the predicted watershed suitability value and the occurrence of *Atyoida bisulcata*, the proportion of samples within each 0.1 sized suitability bin was compared for all watersheds and those watersheds in which *Atyoida bisulcata* occurred (Figure 20).

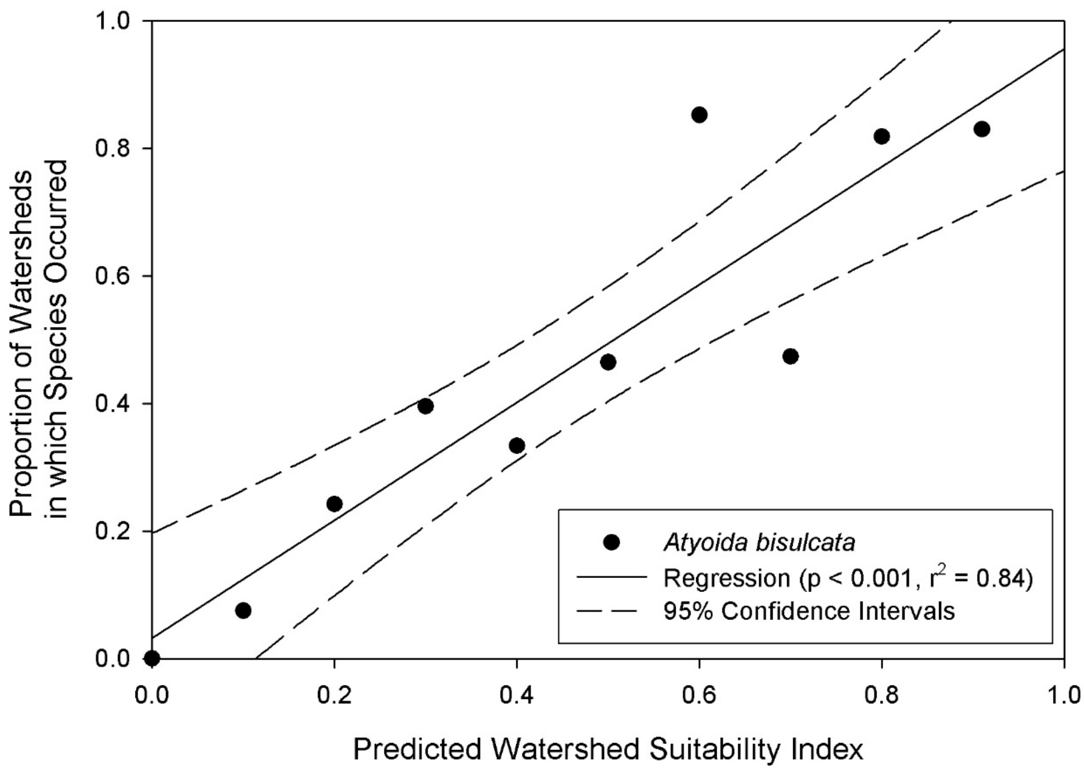


Figure 28: Proportion of the total watersheds where Atyoida bisulcata was observed within each 0.1 group of the Watershed Suitability Index equation for Atyoida bisulcata.

<u>Stream Reach Scale:</u> Elevation Suitability Indices

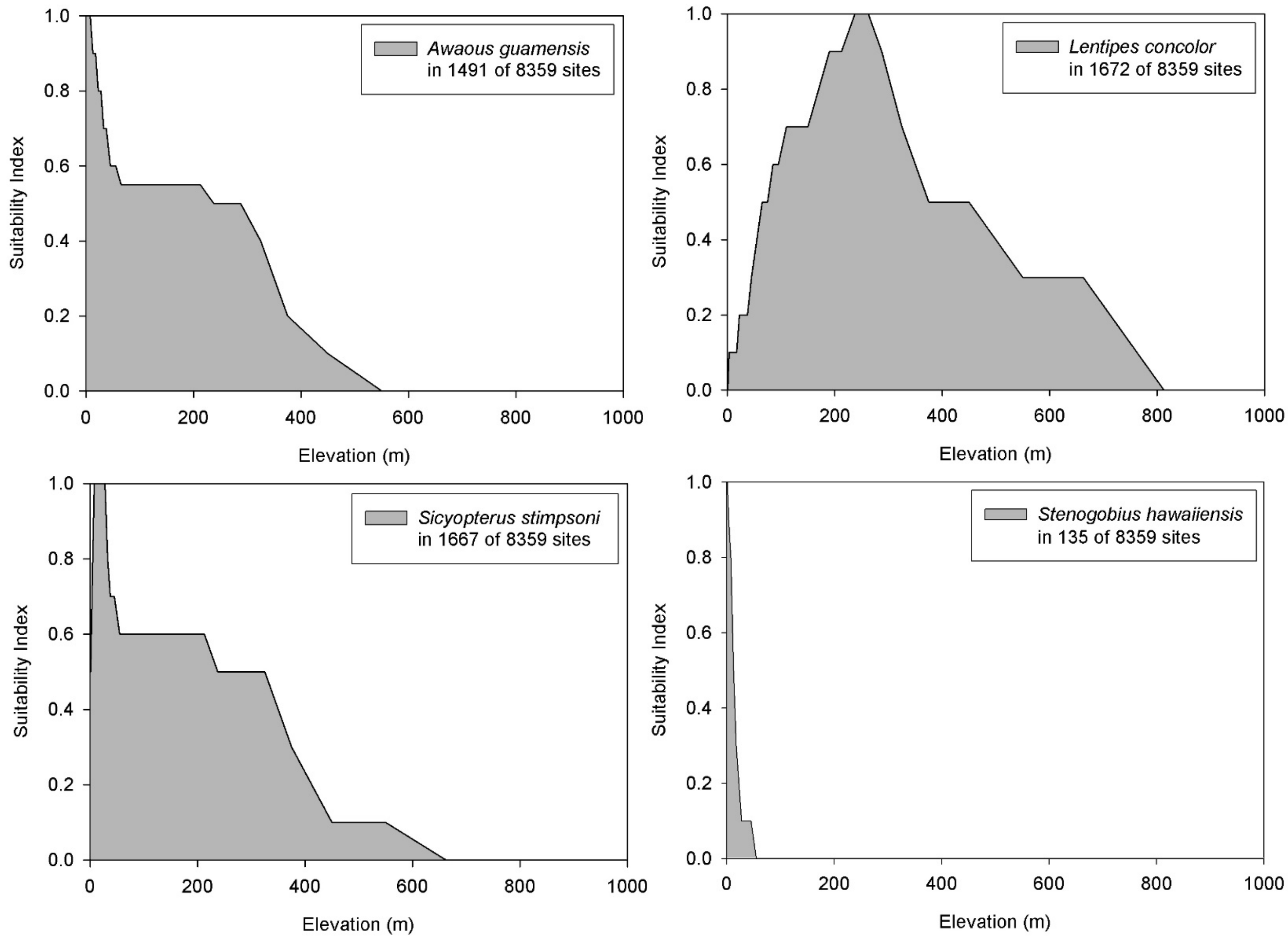


Figure 29: Suitability Indices for Elevation for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

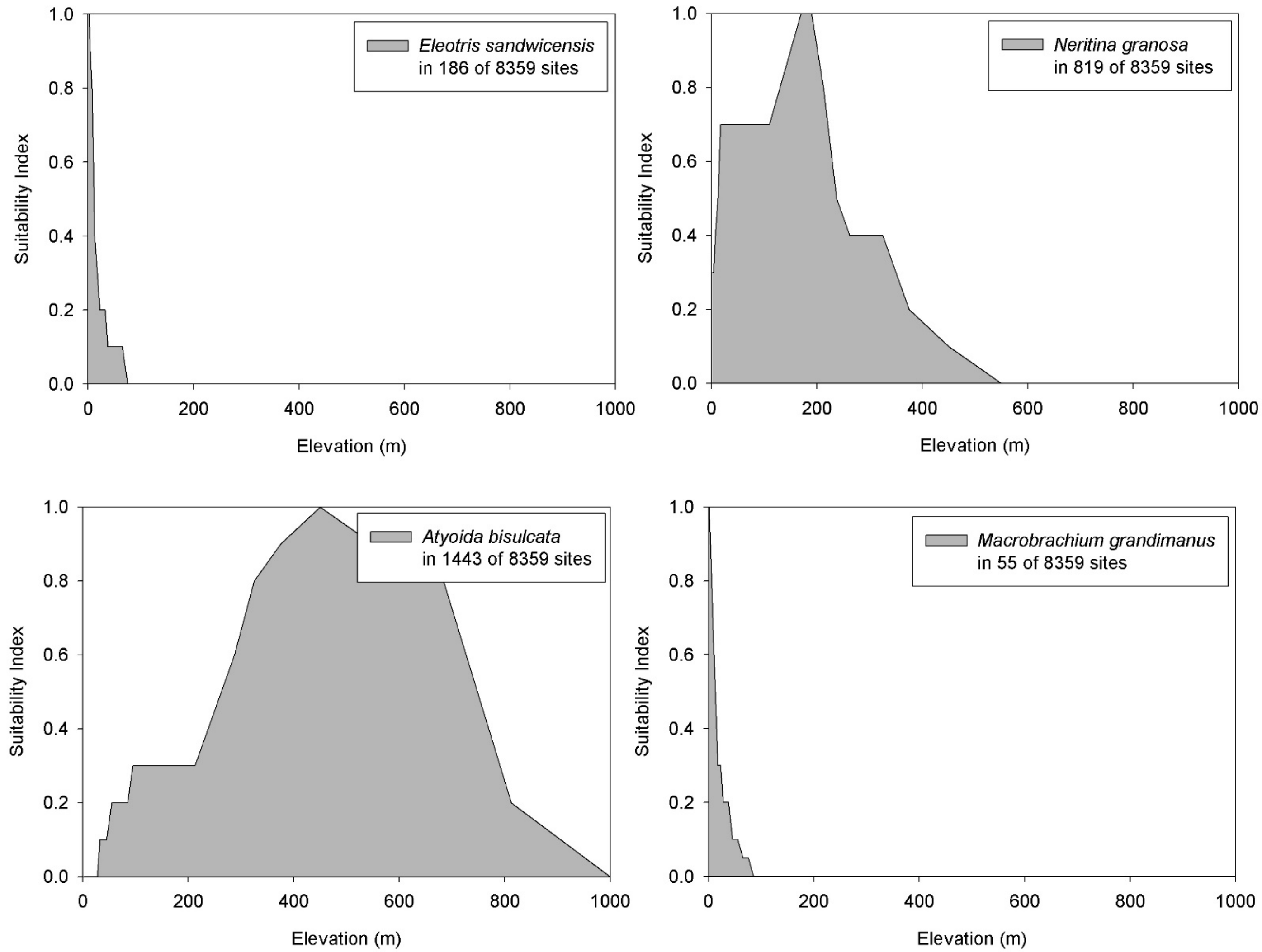


Figure 30: Suitability Indices for Elevation for *Eleotris sandwicensis, Neritina granosa*, *Atyoida bisulcata, and Macrobrachium grandimanus*.

Distance Inland Suitability Indices

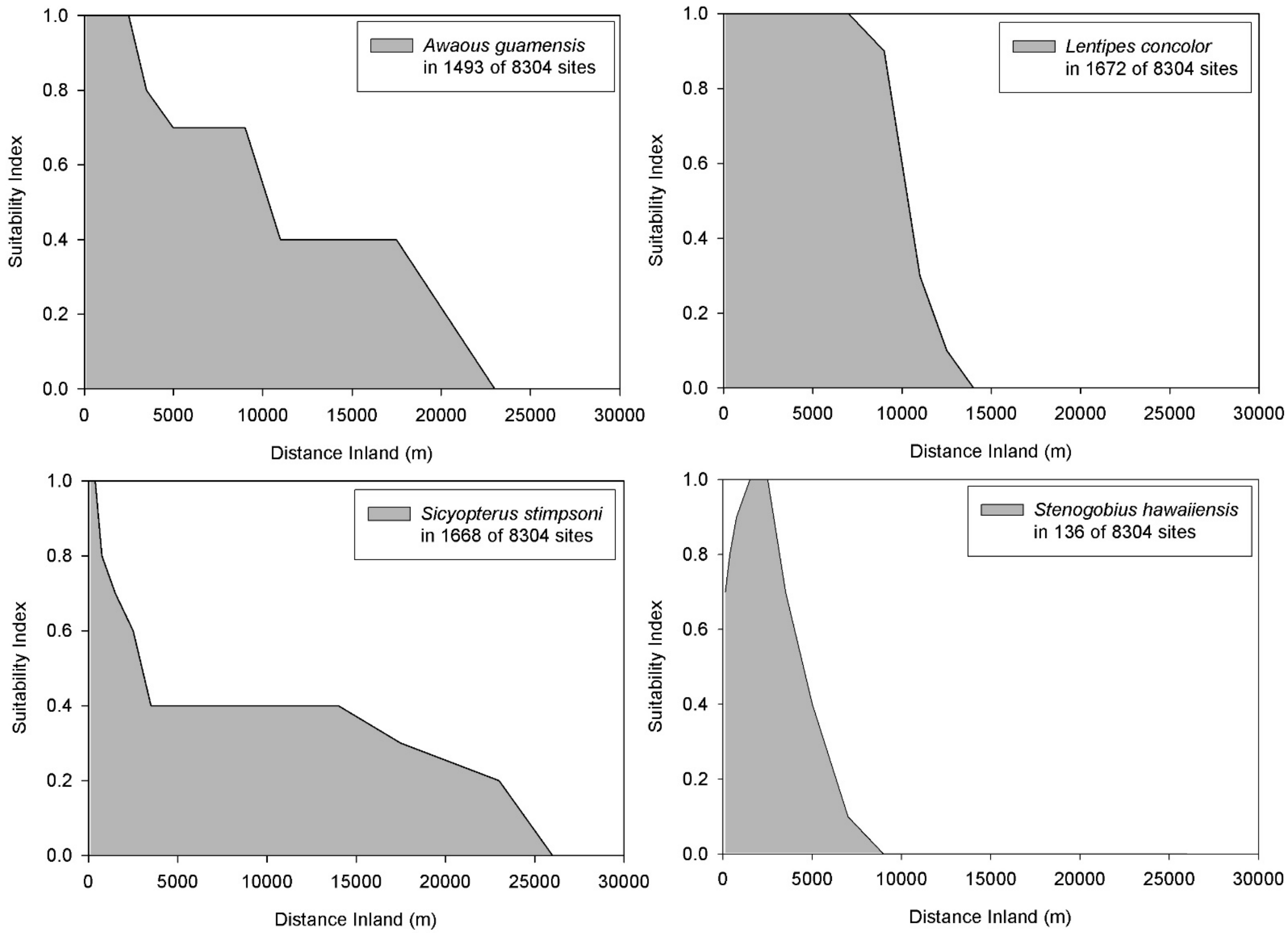


Figure 31: Suitability Indices for Distance Inland for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

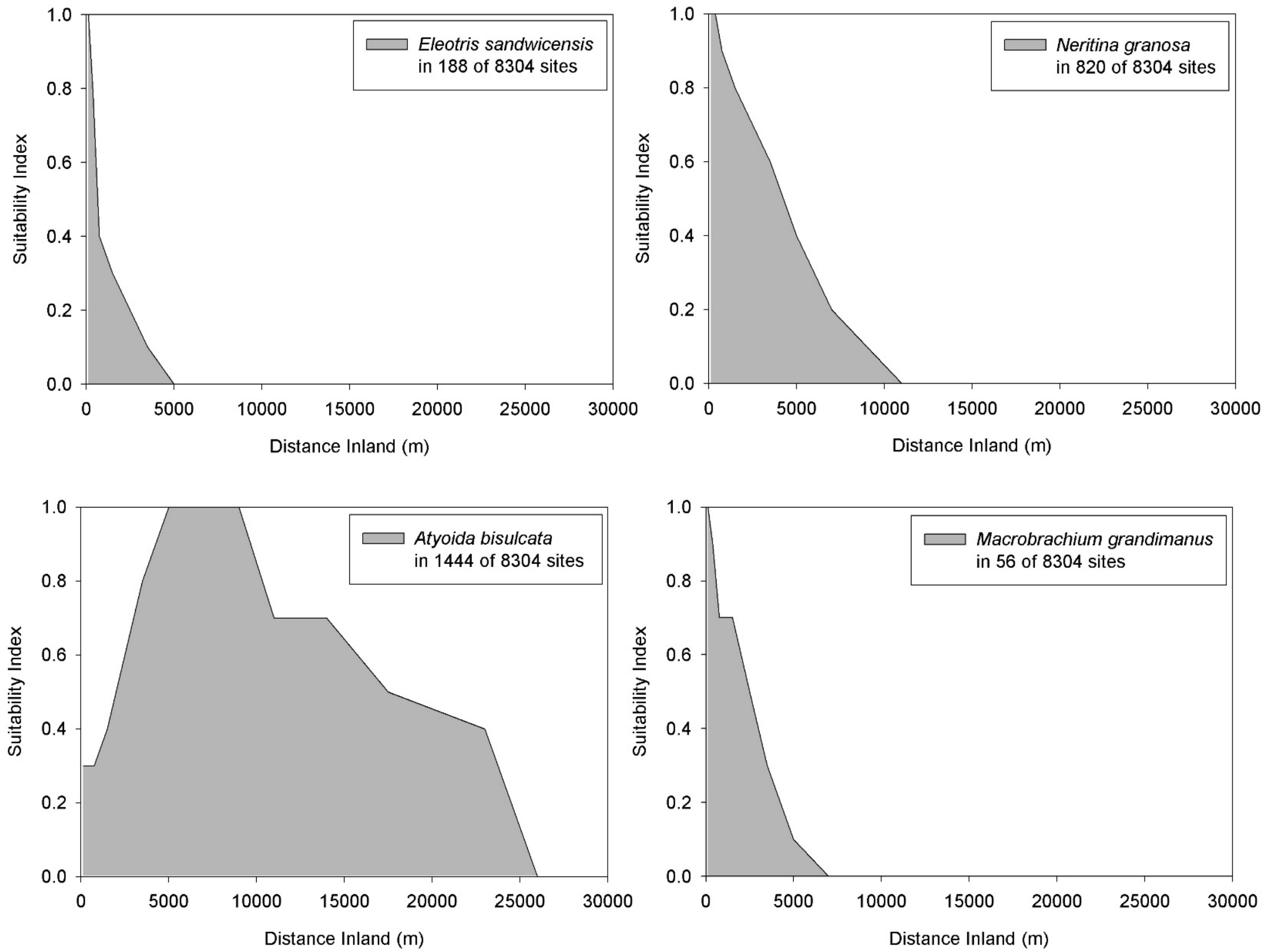


Figure 32: Suitability Indices for Distance Inland for *Eleotris sandwicensis, Neritina granosa, Atyoida bisulcata, and Macrobrachium grandimanus.*

Barrier Height Suitability Indices

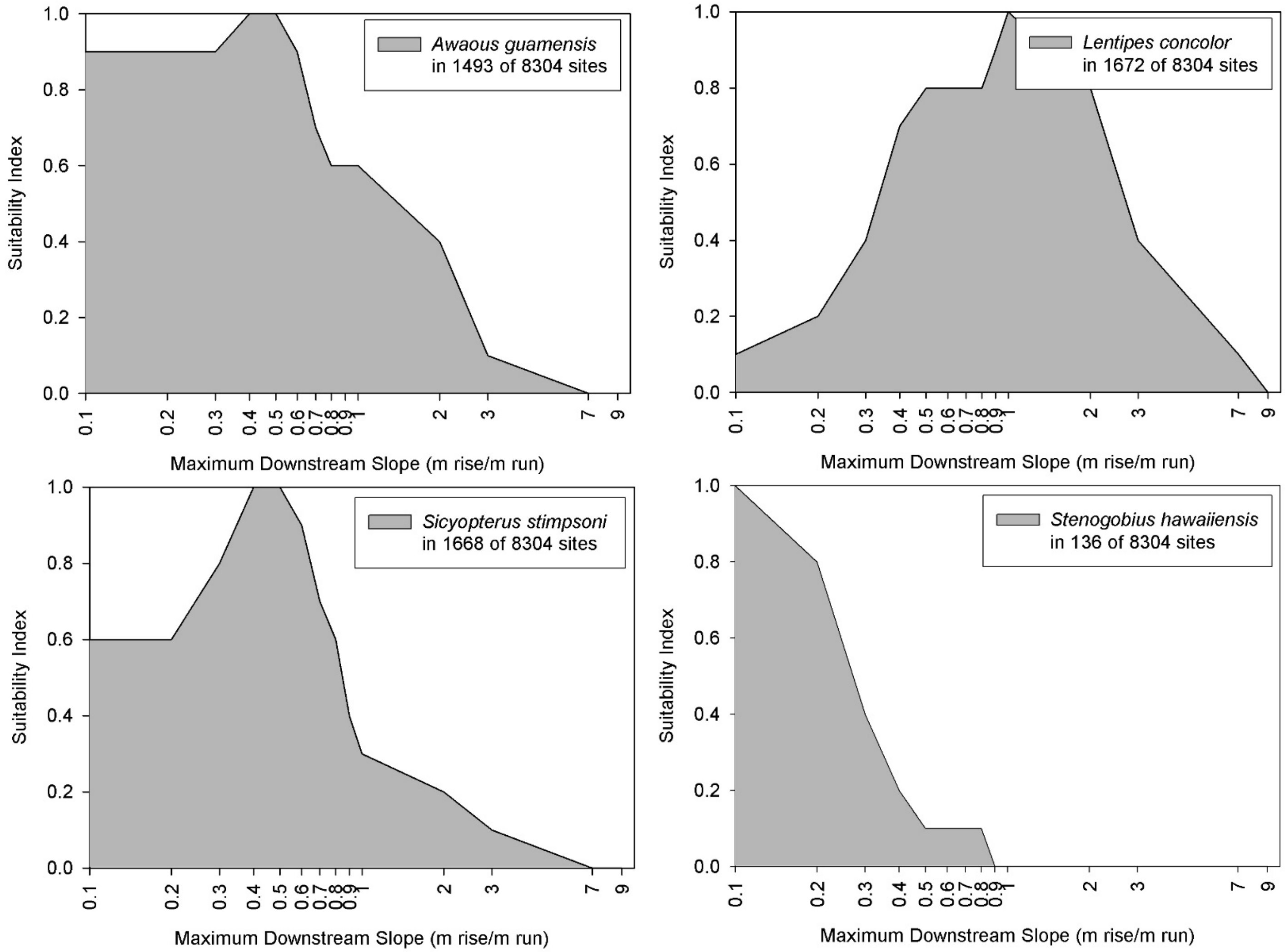


Figure 33: Suitability Indices for Barriers (maximum downstream slope over 10m distance) for *Awaous stamenius, Lentipes concolor, Sicyopterus stimpsoni, and Stenogobius hawaiiensis.*

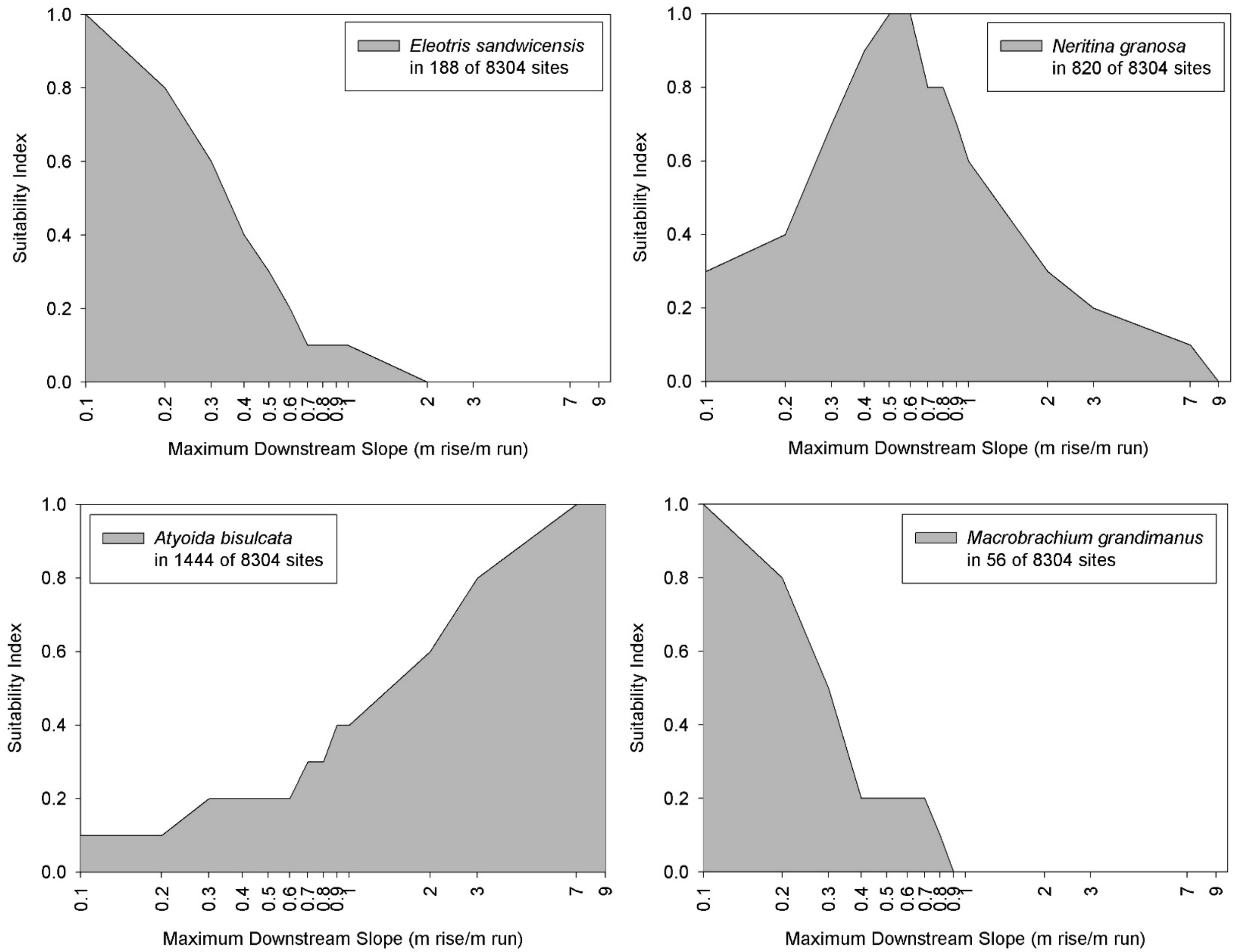


Figure 34: Suitability Indices for Barriers (maximum downstream slope over 10m distance) for *Eleotris sandwicensis, Neritina granosa, Atyoida bisulcata, and Macrobrachium grandimanus.*

Stream Reach Models

Unlike in the watershed models, the variables used in the stream reach models were not linear; therefore, multiple logistic regressions could not be used to select the relationship between the instream distribution of the animals and the reach variables. To determine the suitability index based on the instream distribution for each species, the variables for elevation, distance inland, and downstream barrier height were combined with two different relationships and then the more appropriate relationship was selected for use. The two relationships were:

1. Reach Suitability = (Elevation Suitability + Distance Inland Suitability + Downstream Barrier Height Suitability)

   where: if Elevation Suitability or Distance Inland Suitability or

   Downstream Barrier Height Suitability = 0, then Reach Suitability = 0

2. Reach Suitability = (Elevation Suitability * Distance Inland Suitability * Downstream Barrier Height Suitability).

Each relationship was range standardized with a minimum value of 0 and a maximum value of 1. To select the more appropriate relationship, the results of each relationship for all sites with all data for each variable in the database were calculated. The sites were grouped with the predicted results into bins from 0 to 1 by tenths, and the proportion of samples with the species of concern was determined for each group. In cases where too few samples occurred in a bin (usually fewer than 100 of the 8300 samples in a single bin), the results were averaged with the nearest bin containing the fewest samples. The results of the comparison of predicted suitability with the proportion of samples containing a species were plotted on a graph and analyzed using linear regression.

To select the more appropriate relationship, two criteria were used. First, the distribution of predicted results to observed proportions was visually compared. If predicted values between 0 and 1 resulted in a range of proportions between 0 and 1, the relationship was considered acceptable. If both relationships were acceptable to the first criteria, then the relationship with the higher r^2 value for the linear regression was chosen.

The selected relationship (to predict instream distribution of native stream animals) were as follows:

Lentipes concolor:

The most appropriate relationship was:

2. Reach Suitability = (Elevation Suitability * Distance Inland Suitability * Downstream Barrier Height Suitability).

Both relationships had adequate distributions and the equation with the higher r^2 was selected.

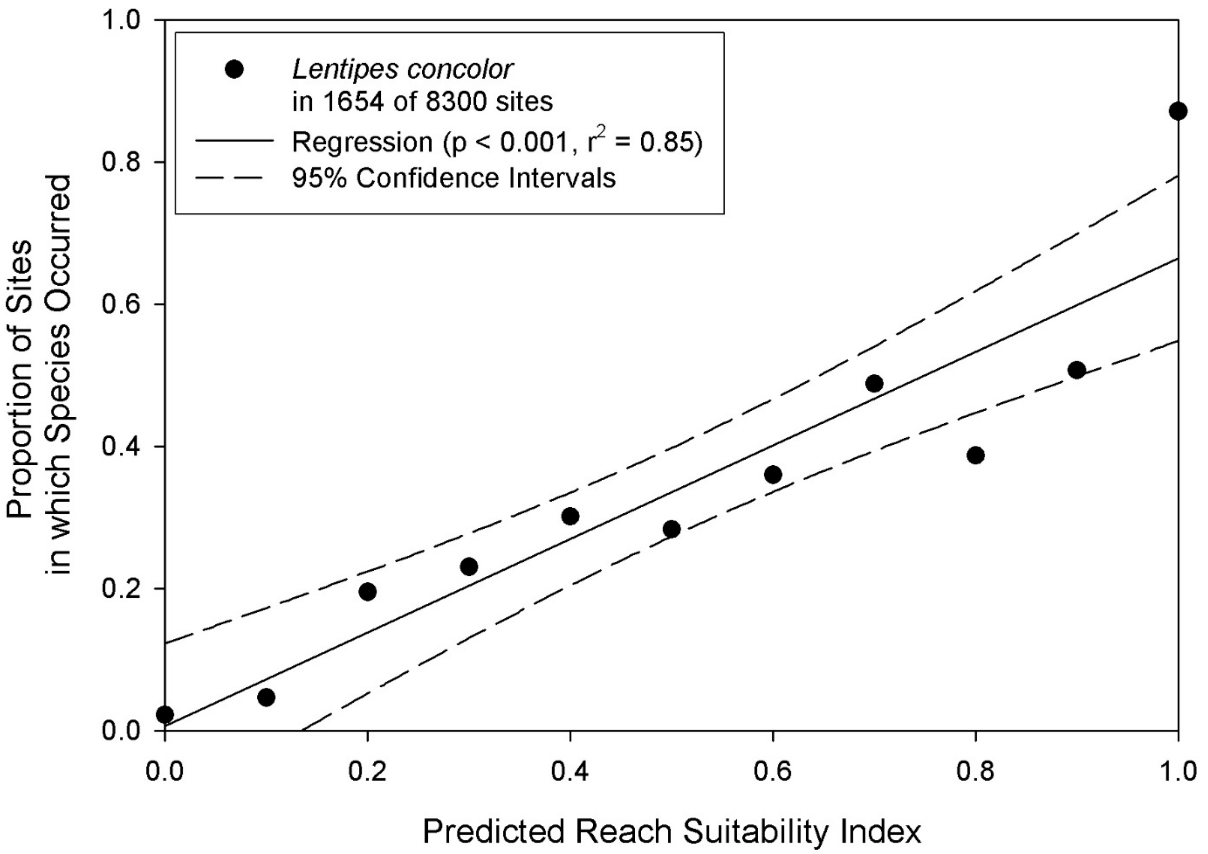


Figure 35: Proportion of the total sites where *Lentipes concolor* was observed within each 0.1 group of the Reach Suitability Index equation for *Lentipes concolor*.

Sicyopterus stimpsoni:

The most appropriate relationship was:

2. Reach Suitability = (Elevation Suitability * Distance Inland Suitability * Downstream Barrier Height Suitability).

Both relationships had adequate distributions and the equation with the higher r^2 was selected.

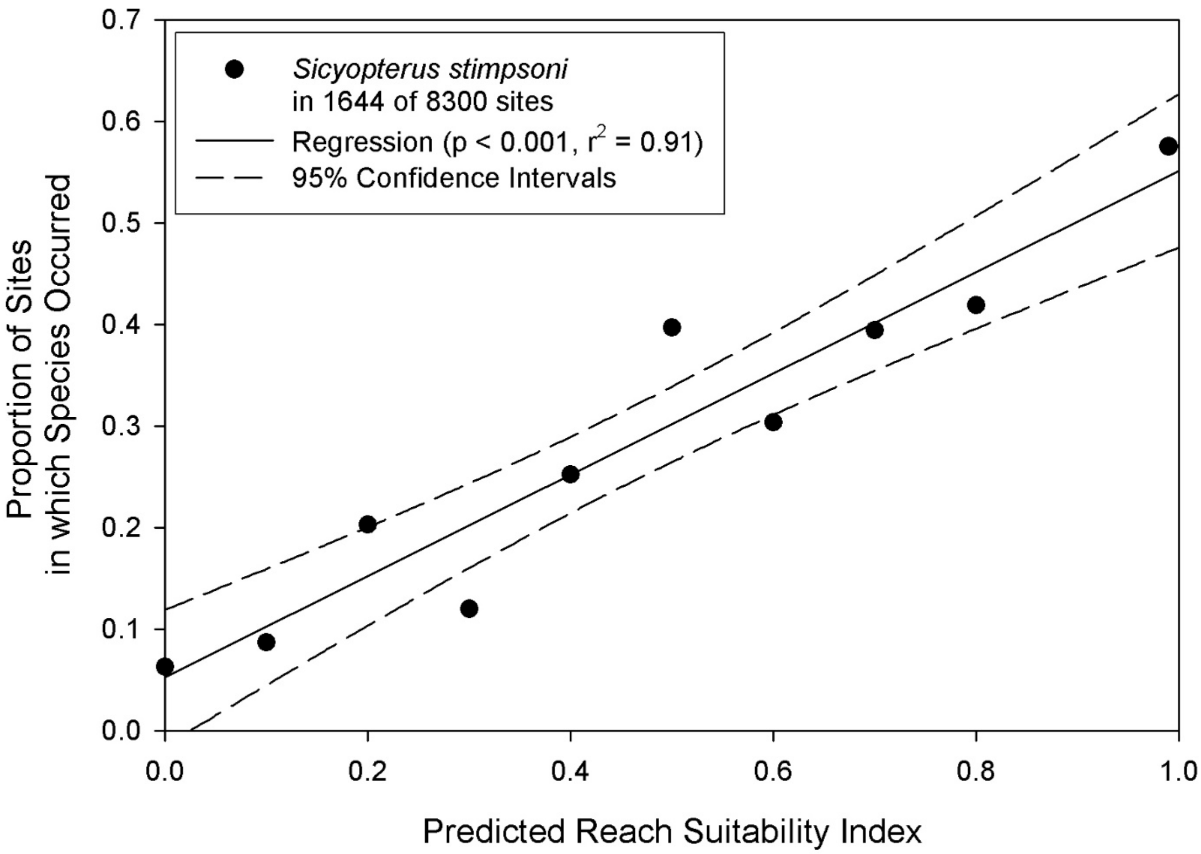


Figure 36: Proportion of the total sites where *Sicyopterus stimpsoni* was observed within each 0.1 group of the Reach Suitability Index equation for *Sicyopterus stimpsoni*.

Atyoida bisulcata:

The most appropriate relationship was:

1. Reach Suitability = (Elevation Suitability * Distance Inland Suitability * Downstream Barrier Height Suitability)

Both relationships had adequate distributions and the equation with the higher r^2 was selected.

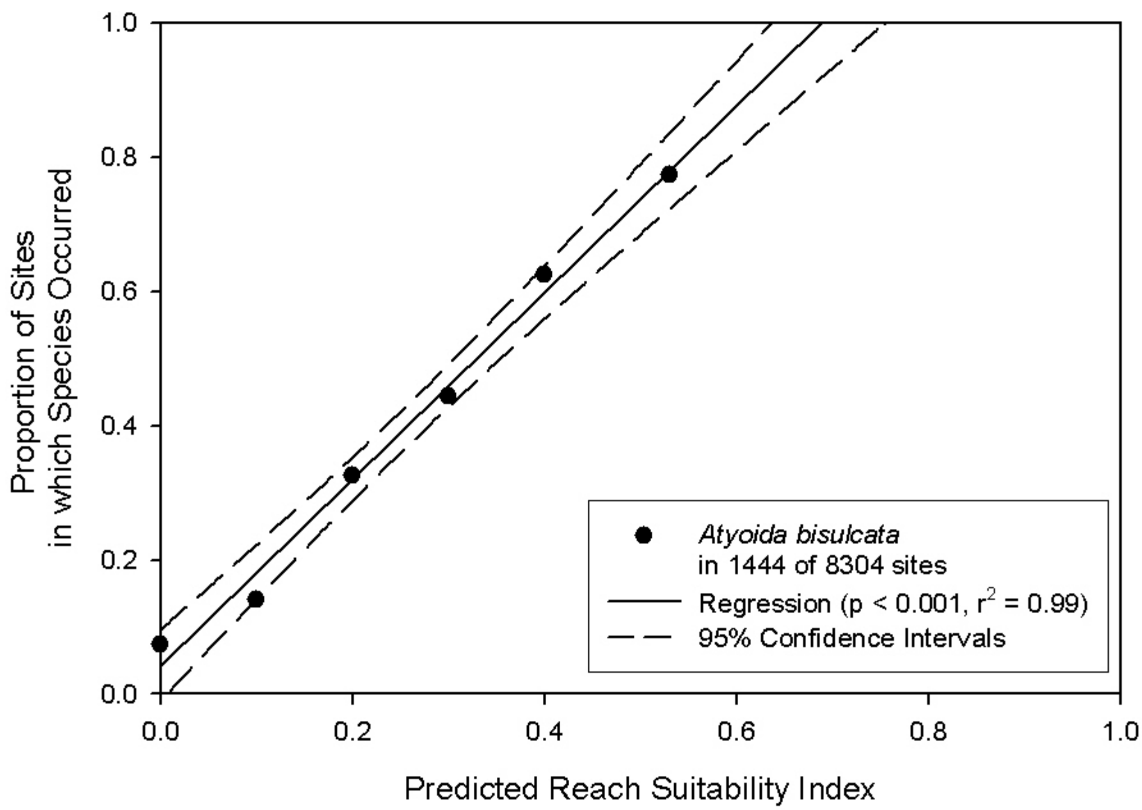


Figure 37: Proportion of the total sites where *Atyoida bisulcata* was observed within each 0.1 group of the Reach Suitability Index equation for *Atyoida bisulcata*.

Definition of model

Note: Much of the follow model definition comes from the HSHEP Model design report reviewed and accepted by the USACE as a suitable approach to assessing environmental impact on native stream animal habitat in Hawaiian streams. Some of the modeling steps have been modified to address specific methods associated with the Wailuku River Hydropower assessment.

Parham, J.E. 2015a. The Hawaiian Stream Habitat Evaluation Procedure (HSHEP) model: Intent, Design, and Methods for Project Impact Assessment to Native Amphidromous Stream Animal Habitat. Submitted to Civil and Public Works Branch, U.S. Army Corps of Engineers, Honolulu District, HI. 178 pages.

The final HSHEP model for Wailuku River combines the information at the site, stream segment, and watershed scales to predict changes in the habitat as a result of the Hydroelectric power plants and associated water collection systems. The model reflects the quality of the whole stream and its watershed, the location in a stream and the presence of any downstream barriers, changes in local habitat with respect to water diversion, and the loss of animals due to entrainment in the diversions and hydroelectric power houses.

To create the HSHEP models that compare the expected distribution and habitat suitability in the Wailuku River with and without proposed modification to the Hydroelectric power plants and associated water collection systems, a series of steps were required. The process followed the same steps for each species independently.

Watershed scale suitability:

1. Watershed scale metrics were created from available GIS data for variables that covered all 430 perennial streams statewide. The creation of these metrics is detailed in the *Atlas of Hawaiian Watersheds and their Aquatic Resources* (Parham et al. 2008 a,b,c,d,e). The watershed scale metrics included ratings for watershed size, wetness, stewardship, stream reach diversity, the amount of estuary and shallow nearshore marine habitat, and land cover. These metrics were intended to capture the range of the spatial variability for perennial streams in the state of Hawaii.

2. The complete set of 430 watershed suitability values was range standardized so that the range of all values had a minimum value of 0 and a maximum value of 1. This resulted in a comparable range of values for each species among the watersheds statewide.

3. For each species, the watershed scale suitability was determined by plotting the proportion of watersheds in which a species occurred against each watershed scale metric. The watersheds were grouped with the predicted results into bins from 0 to 1 by tenths, and the proportion of samples with the species of concern was determined for each group. In cases where too few samples occurred in a bin (usually fewer than 5 of the 430 samples in a single bin), the results were averaged with the nearest bin containing the fewest samples.

4. Multiple logistic regression was used to select the group of metrics that most appropriately predicted the occurrence of a species based on overall watershed characteristics.

5. The current modeled watershed scale suitability relationships are presented for each species that were provided in the prior report section. It is important to realize that these relationships can be updated based on new collection information stored in the DAR aquatic surveys database.

6. There are several assumptions implicit in the watershed scale suitability metrics.
    a. That the set of metrics including watershed size, wetness, stewardship, stream reach diversity, the amount of estuary and shallow nearshore marine habitat, and land cover have any influence on the occurrence of native stream animals. Generally, the concept that larger, wetter and undisturbed watersheds with streams containing a wide variety of habitats may potentially contain a wider variety of native species is well supported in the general fisheries literature and has been observed in Hawaii. Also, the use of multiple logistic regression eliminated metrics that did not aid in predicting a species occurrence within a watershed.
    b. The relationship also assumes that there is even sampling within all watersheds. This is clearly not the case. A rating strength metric is reported within the *Atlas of Hawaiian Watersheds and their Aquatic Resources* (Parham et al. 2008 a,b,c,d,e). The rating strength metric reflects the number of surveys, the type of surveys and the distribution of surveys within various stream reaches to estimate how confident we are with our underlying information. The rating strength metric is not currently used in the watershed suitability relationships but may be incorporated in subsequent versions of the HSHEP model.

Instream distribution suitability:

7. All native amphidromous stream animals share a common life history pattern and as a result migrate from the ocean to upstream habitats in each generation. As a result of differential climbing abilities among species, each species has its own characteristic instream distribution.

8. To account for this differential instream distribution within the HSHEP model, variables for site elevation, distance inland, and maximum downstream slope (a measure of waterfall or barrier height) are included.

9. The underlying data for these three variables comes from the USGS 10 m digital elevation model for each of the Hawaiian Islands. Digital flow models delineating watershed boundaries, stream channels, flow direction, and numerous other flow metrics were created for each Hawaiian island (Parham 2003a).

10. For each 10 m cell representing the path of the stream channel, each of the three variables was determined using ArcGIS software.

11. Elevation directly reflects the data from the underlying digital elevation model for each 10 m stream cell.

12. Distance inland is the reverse accumulation of distance against the downstream flow direction.

13. Maximum downstream slope is the reverse accumulation of the maximum change in elevation between two adjacent cells. In some cases of specific HSHEP model applications, maximum downstream slope is replaced by actual measurements of barrier height or the extent to which a barrier is undercut from actual field measures.

14. Unlike in the watershed models, the variables used in the stream reach models were not linear; therefore, multiple logistic regressions could not be used to select the relationship between the instream distribution of the animals and the reach variables. To determine the suitability index based on the instream distribution for each species, the variables for elevation, distance inland, and downstream barrier height were combined with two different relationships and then the more appropriate relationship was selected for use. The two relationships were:

- Instream Distribution Suitability = (Elevation Suitability + Distance Inland Suitability + Downstream Barrier Height Suitability)
    where: if Elevation Suitability or Distance Inland Suitability or Downstream Barrier Height Suitability = 0, then Reach Suitability = 0

- Instream Distribution Suitability = (Elevation Suitability * Distance Inland Suitability * Downstream Barrier Height Suitability).

15. Each relationship was range standardized with a minimum value of 0 and a maximum value of 1.

16. To select the more appropriate relationship, the results of each relationship for all sites with all data for each variable in the database were calculated. The sites were grouped with the predicted results into bins from 0 to 1 by tenths, and the proportion of samples with the species of concern was determined for each group. In cases where too few samples occurred in a bin (usually fewer than 100 of the 8300 samples in a single bin), the results were averaged with the nearest bin containing the fewest samples.

17. The results of the comparison of predicted suitability with the proportion of samples containing a species were plotted on a graph and analyzed using linear regression.

18. To select the more appropriate relationship, two criteria were used. First, the distribution of predicted results to observed proportions was visually compared. If predicted values between 0 and 1 resulted in a range of proportions between 0 and 1, the relationship was considered acceptable. If both relationships were acceptable to the first criteria, then the relationship with the higher r^2 value for the linear regression was chosen.

19. The selected instream suitability relationship for each species is shown in the prior report section.

20. The selected relationship for each species was used to combine the three underlying source data grids within ArcGIS.

21. The instream suitability for all sites statewide was range standardized from a minimum of 0 and the maximum was 1 for each species. This resulted in a comparable range of values for each species among all stream segments statewide.

22. There are several assumptions implicit in the development of the instream distribution suitability metric:
    a. Probably the largest assumption in the instream distribution suitability metric results from the calculation of maximum downstream slope as a representation of downstream barrier height. A digital elevation model only contains a single elevation value for each 10 m cell. As a result, slope is calculated as the change between the two adjacent cells. It is impossible to tell whether the slope change is an even percent change or an abrupt drop off. To decrease this issue, if field verified data exists, it should replace the digitally derived metric. With that said, maximum downstream slope has proved effective at finding larger barriers within the stream channels throughout the state of Hawaii.
    b. Like the watershed metric, the relationships assume even sampling within all conditions. This is not true. Sampling is clearly uneven within stream reaches, but the large number of samples (8300+ for this report around the state) has helped decrease the impact of the uneven sampling effort.

Combining Watershed and Instream Distribution Results:

23. The resulting values for each of the relationships (watershed and stream segment suitability for each species) were appended to separate 10 m grids for each island in ArcGIS.

24. Each grid (watershed and stream segment suitability) was weighted by the r^2 value for the linear relationship developed for the species. The r^2 value was used as an estimator of the strength of the watershed or stream segment suitability model's results in predicting a species occurrence.

25. The grids for each scale were multiplied together in ArcGIS into a multi-scale habitat suitability grid.

26. The GIS layer for DAR streams was converted from vector to grid format and all non-stream cells were set to 0 and all stream cells were set to 1 in ArcGIS.

27. The multi-scale habitat suitability grid was multiplied by the stream grid to remove non-stream cells from the analysis in ArcGIS.

28. The resulting range of values for the multi-scale habitat suitability grid was again range standardized so that the minimum value for grid cells statewide was 0 and the maximum was 1 for each species.

At this point, we have combined and range-standardized the watershed and stream scale model with the stream segment scale model and have the values for habitat suitability for each 10 m cell of 430 streams statewide. For each species, the values for the habitat units range from 0 to 1 to reflect suitability. This step results in predictions of the non-locally corrected amount of suitable habitat for each species within each watershed statewide.

Adjusting the HSHEP model for local conditions:

To adjust the HSHEP model for local habitat conditions found in various segments of the stream, several different options are possible. The selection of the input data is usually dependent on two factors. The first factor is the availability and detail of site surveys and the second factor is the type of scenario being modeled. In general, site level measures will include variables such as depth, velocity, substrate, habitat type, and water temperature. There are numerous additional variables that may be useful in describing instream animal habitat, but may or may not be available for a specific project area. Traditionally, the field data used to describe local conditions comes from either point samples, small area transect samples, or generalized reach scale estimates of conditions (Polhemus et al. 1992, Parham 2003b). In all of these cases, we assume that un-surveyed areas are similar to the habitats observed in our survey areas.

With any of the local condition sampling approaches, the application of the information to the model is similar. The stream is segmented into areas with similar instream habitat characteristics. These segments begin or end in locations where there is a change in habitat, a barrier, or at the location of a potential modification. This results in a series of connected stream segments that are assumed to react to changes in a similar fashion. For example, we may have survey sites located in the lower, middle, and upper reaches of the stream. From the survey data, we know the distribution and average amount of various habitat types found in each reach. We then apply the results from the surveyed amounts of habitat types to the rest of the appropriate stream reaches. This, of course, assumes that our survey area is representative of the rest of the reach. As with any model, greater sampling and a wider variety of locations will result in a more accurate output. Depending on the size and importance of the project, the amount of fieldwork to characterize local habitat conditions will vary.

Specific local habitat steps:

29. From a vector (line) representation of the stream in ArcGIS, separate the stream into its appropriate segments based on reach breaks, barriers, project locations, or any other appropriate division.

30. Link a table containing average habitat characteristics and stream width associated with each segment.

31. Determine local habitat suitability for individual species by applying appropriate weighting factors to the description of locally available habitat. The species-specific weighting factors are typically created from information contained in the DAR Aquatic Surveys Database. This database contains many thousands of samples and species observations from streams across the state of Hawaii and is considered the best source for this information.

32. Convert the stream segments (with their appropriate local habitat suitability score) into a grid of the same size and dimensions as used in the instream distribution portion of the model.

33. Multiply this local habitat suitability grid to the combined watershed and instream distribution suitability grid. This will result in a locally-corrected representation of habitat suitability for a species for each 10 m of stream. It also addresses its instream distribution and larger stream and watershed characteristics.

Scenario Models:

In general, the HSHEP model was designed to address the effects of two common instream modifications: the diversion or modification of stream flow and physical changes to the stream corridor. The impact of these two modification types can result in changes of a site's habitat suitability, changes to passage, and/or entrainment of animals during migratory events. The HSHEP model considers that not all actions will result in all possible impacts. Thus, the description and definition of the project impact must be clearly defined and related to available data describing local conditions.

To address specific project conditions and available local data, a graphical box model representing the modeling scenario features and their impacts is created. The following is a description of the box model process using an example from Iao Stream on Maui (Figure 38). Not all possibilities are shown in this example, but it highlights the conceptual approach well.

The box model for a stream contains the stream and its tributaries from the ocean upstream to the headwater reaches. The stream contains breaks at the various segments determined in the local habitat suitability section. It also contains representations for barriers or project modifications where appropriate. To the right of the stream representation are three additional columns. The first provides labels to each stream segment and is associated with available instream habitat. The second column describes impacts to downstream moving animals and the third column describes impacts to upstream moving animals. This box model provides a useful mechanism to track the label, type, location, and sequence for various possible scenario modifications.

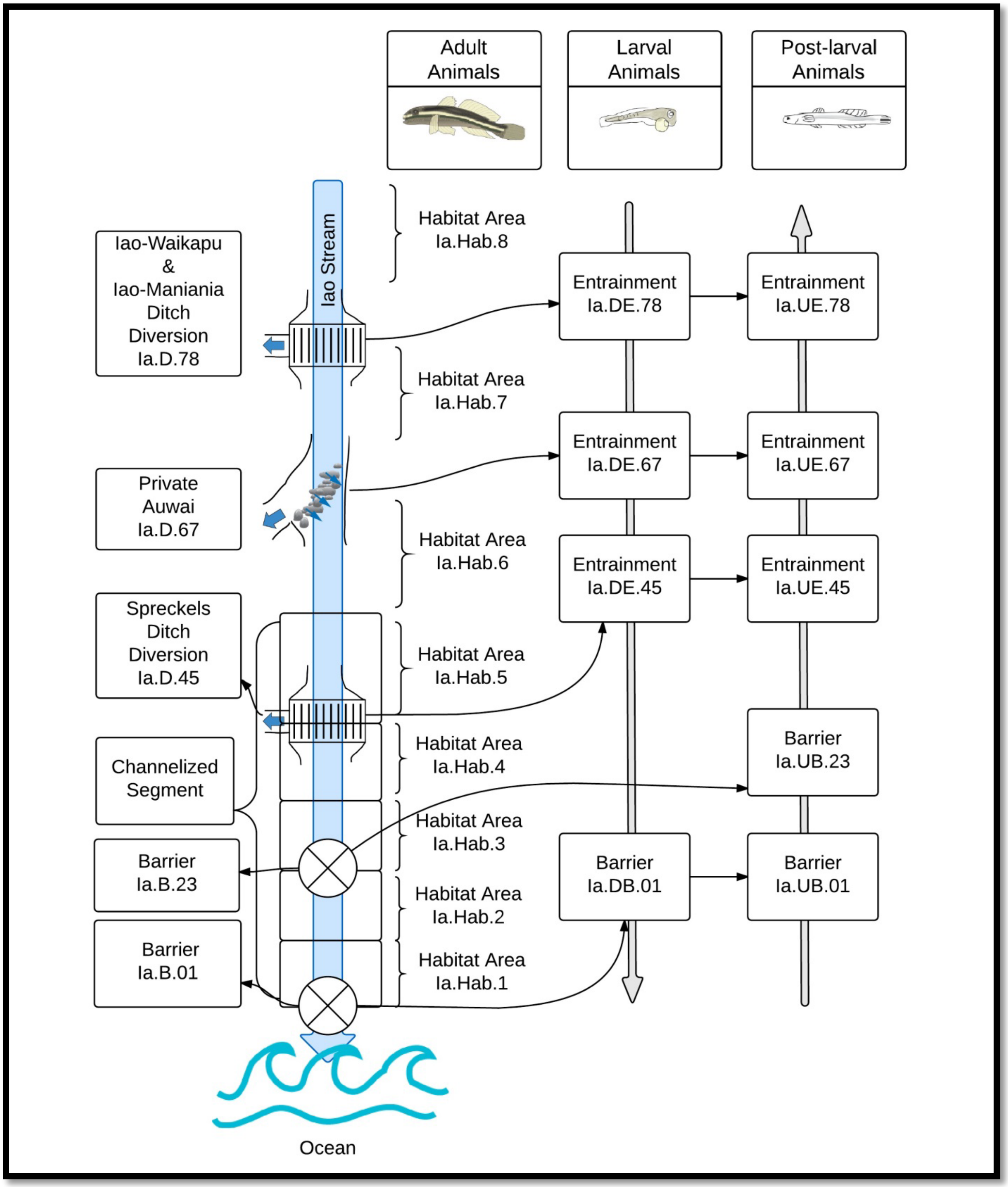


Figure 38: Example HSHEP graphic box model from Iao Stream, Maui. Box models are not to scale.

The impacts of stream diversions, barriers, and other instream modifications are estimated by describing a modification and then applying an impact factor based on the specific design criteria of the modification. In general, all of these potential modifications will share four possible impact factor criteria: (1) local habitat, (2) barrier, (3) upstream entrainment, and (4) downstream entrainment. An impact criterion can range from 0 to 1 with 0 representing the complete elimination of habitat and 1 representing no impact on habitat. In many cases, the specific modification will not influence a specific impact criterion and as a result will have that criterion set to one or no impact.

The intent was not to estimate pre-developed conditions within the Wailuku River system and potential habitat units for native species, but to estimate conditions with and without modifications to the hydropower facilities. Therefore, to further refine the predictions for the Wailuku River system additional steps were followed.

General Scenario Testing Steps:

1. Impact factors for the four criteria of instream habitat, barriers, downstream and upstream entrainment are determined for all potential impacted locations.
2. The barrier or entrainment impact value affects all upstream cells within the modeled stream network. For example, a barrier (A) that blocked 80% of fish passage would decrease suitable habitat in all cells above Barrier A by 80%. A second barrier (B), located upstream of Barrier A, may block an additional 50% of fish passage. Barrier B would decrease habitat suitability at sites upstream of Barrier B an additional 50%. The combination of passage impact values for both Barriers A (80%) and B (50%) would result in a total passage impact value of 90% at sites upstream of Barrier B. The inverse of the percent of fish blocked would be the percent of fish passing the barriers. In this case, 10% of fish would be expected to pass Barrier B (10% Fish pass = 20% fish pass Barrier A * 50% fish pass Barrier B).
3. If decreases in suitable habitat were the result of physical habitat modification, the estimated percent of lost habitat was multiplied with all habitat units within the affected area. This value did not impact upstream areas as described with passage impacts as it only affected the area where habitat was lost.
4. To address changes in habitat in response to changes in discharge (flow modification), we applied the results of the aerial imagery habitat availability vs. discharge assessment. In general, the flow to habitat relationships account for changes in microhabitat variables (water depth, velocity, and substrate) with respect to changes in discharge. The microhabitat variables are weighted by their suitability to a species or species life stage, and as a result, changes in suitable habitat can be predicted from changes in discharge.
5. The amount of suitable habitat derived from the flow to habitat equations are intended to represent the average conditions for the segment downstream of the diversion. There may be less available habitat immediately downstream of the diversion and more available habitat near the end of the stream segment after the stream has regained water. For example, to estimate the width of any stream segment, several cross-sectional widths were measure at different locations in the stream segment from aerial imagery and averaged to represent the average widths for the entire segment.
6. The impacts associated with habitat loss due to water diversion (flow modification) were calculated within the specific area in which they occurred and did not impact areas up or

downstream of the segment.

7. For each species in each area, the amount of habitat units lost due to changes in passage, entrainment, physical habitat modification, and flow modification were calculated. This approach allowed impacts associated with each type of impact to be considered separately as well as combined.

8. To assess the impact of the various modeled scenarios, the model was repeated with the appropriate scenario values changed.

9. Results for each scenario were created to show Habitat Units available to each species within each stream segment and the whole streams, as well as Habitat Units lost due to specific modifications within each scenario.

RESULTS

Habitat Assessment

Aerial imagery of an approximately 1 km segment of the Wailuku River downstream of Rainbow Falls collected on five different dates were used to understand changes in habitat types in response to stream discharge. Discharge on the five dates range from a high of 122 cfs to a low of 12.8 cfs. These images provided an excellent range of discharge to better understand changes in habitat availability at low to moderate flow. The diversion of water into the hydropower facilities would be expected to have greater impacts at lower discharges as a greater percentage of overall stream flow would be diverted into the hydropower facility.

The results show that the pool habitat type is the most frequently observed type in this reach of the Wailuku River. Dry stream bed is the next most common with runs similar in amount to riffles and cascades (Table 3). In terms of percent frequency, approximately 50% of this reach is classified as stream pools and around 10% are classified as runs over all discharge rates (Table 4). There is some variance in these two categories but they do not appear to be tightly linked to stream discharge. As discharge in the Wailuku falls, there is a decrease in the riffle/cascade category and an increase in the amount of dry streambed. When looking at the change of the moving water habitat types (runs and riffle/cascade) in response to decreasing discharge, we observed a rapid decrease from approximately 32% at 122 cfs to approximately 25% at 53.0 cfs. Below 53.0 cfs, we observed only a small decrease in these habitat types down to 23% at 12.8 cfs. Unlike many small streams in Hawaii, the Wailuku River is a large stream with deep plunge pools and these deep pools and the runs that connect them persist even at low stream discharge.

Though we were not able to measure water depth from the aerial imagery at the different discharge rates, it was obvious from the imagery that extensive areas with water depths exceeding several feet occurred at all discharges. Shallow water, especially in sites with a maximum depth less than approximately 18 inches deep, can decrease suitability for a range of native species. This does not appear to be a limiting factor with respect to stream discharge in the Wailuku River.

During our underwater video surveys, we observed several other habitat conditions to see if they may be limiting the availability of suitable habitat for native stream animals. For the climbing amphidromous stream animals, hard substrates (boulder, bedrock and cobble) with low embeddedness are more suitable than highly embedded or fine substrates. We observed extensive amounts of hard substrates with very low embeddedness in both survey sites, although all substrates types could be found in the sites (Figure 39-Figure 42)

In discussions with DAR biologists about instream conditions observed in Wailuku River, there was some concern that the torrential flows commonly observed may scour the substrate free of any epiphytic algae and thus limit food availability for native stream animals. We did not observe this in our surveys. Even though our surveys were conducted after a high discharge event, we observed algae on most hard substrate except in the swiftest cascade areas (Figure 43 and Figure 44). Epiphytic algae were more common in pools than runs or riffles but it was observed in all habitat types and thus was unlikely limiting as a food resource for native species. Overall, instream habitat appeared excellent in the Wailuku River for native stream species.

Table 3: Information on historical aerial imagery, discharge and habitat availability for the Wailuku River study segment.

	Aerial Image Date, Discharge and number of points in each habitat type				
Habitat Type	1/21/2013 @122 cfs	8/28/2015 @60.6 cfs	6/9/2012 @ 53.0 cfs	11/2/2012 @ 37.1 cfs	5/13/2012 @ 12.8 cfs
Pool	52	50	52	44	44
Run	8	14	9	11	8
Riffle/Cascade	14	14	16	10	16
Dry	20	10	24	25	18
N/A	8	14	1	12	16

Table 4: Information on historical aerial imagery, discharge and percent habitat availability for the Wailuku River study segment.

	Aerial Image Date, Discharge and % of points in each habitat type				
Habitat Type	1/21/2013 @122 cfs	8/28/2015 @60.6 cfs	6/9/2012 @ 53.0 cfs	11/2/2012 @ 37.1 cfs	5/13/2012 @ 12.8 cfs
Pool	56.8%	51.2%	51.5%	55.3%	48.9%
Run	15.9%	9.3%	8.9%	8.5%	12.2%
Riffle/Cascade	15.9%	18.6%	15.8%	14.9%	11.1%
Dry	11.4%	20.9%	23.8%	21.3%	27.8%

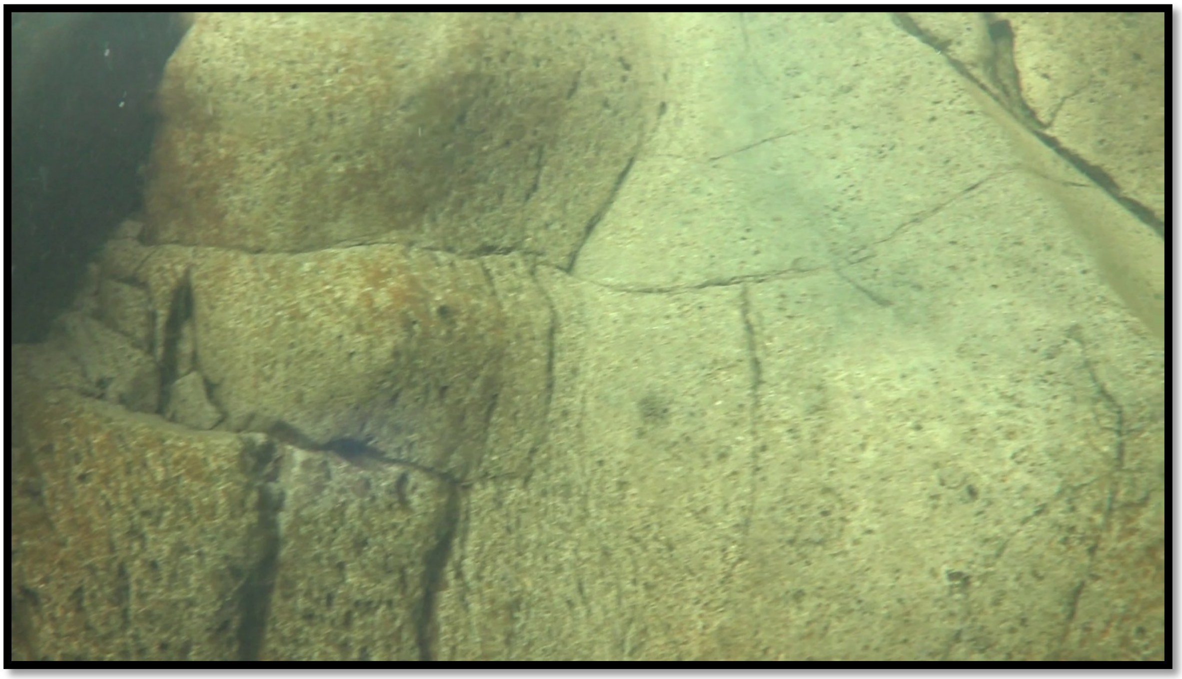


Figure 39: Bedrock substrate in Wailuku River.

Figure 40: Boulder and cobble substrate in Wailuku River.

Figure 41: Gravel and boulder substrate in Wailuku River.

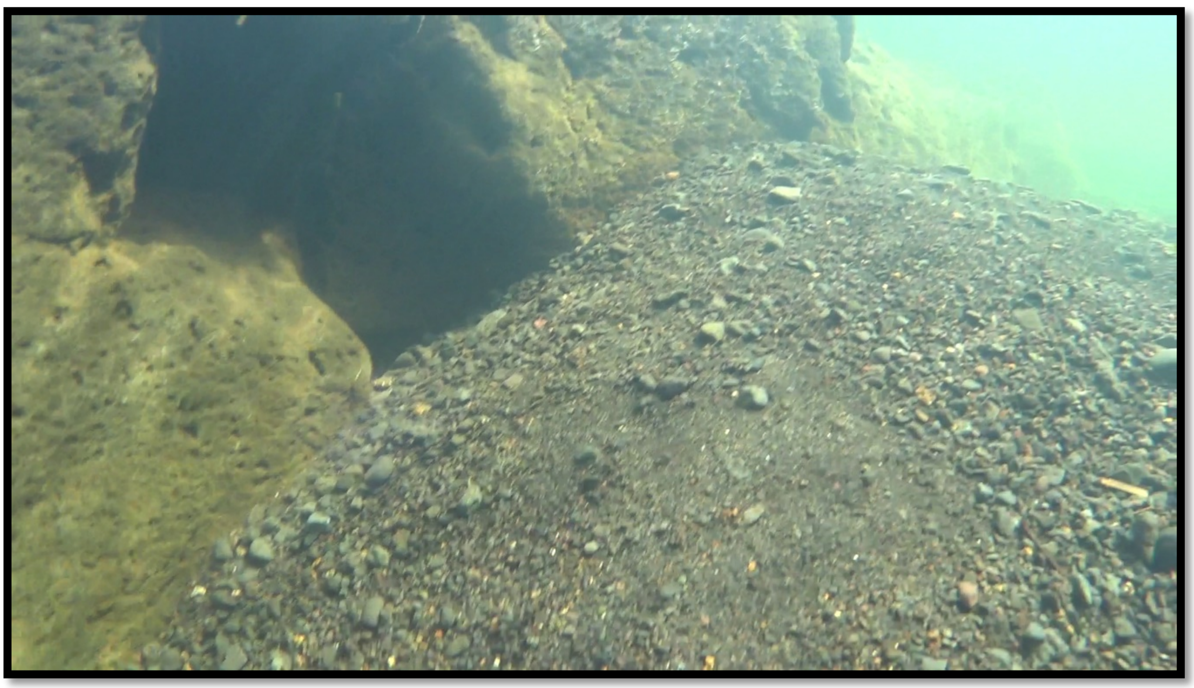


Figure 42: Sand and small gravel substrate in Wailuku River with bedrock.

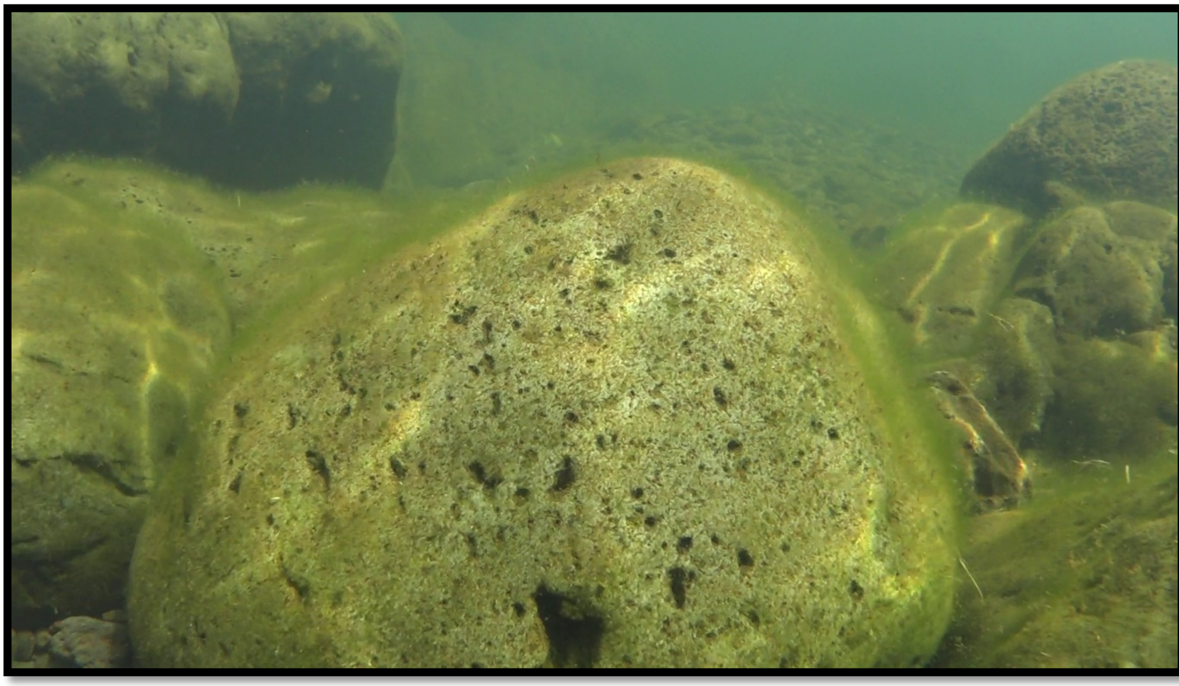


Figure 43: Filamentous green algae growing on boulder in Wailuku River.

Figure 44: Boulders in Wailuku River. Note the fine layer of algae on the rocks. Algae was present on most rocks except in the swiftest cascade areas.

Biotic Surveys

Biotic surveys using the High Definition Fish Survey (HDFS) approach were completed in two areas of the Wailuku River. The first area was upstream of the waterfall above Piihonau Bridge and the second area was downstream near the low-water bridge crossing at the upper intake for the hydropower facility (Figure 45). We investigated other access areas on the Wailuku River but most of the river is either private property, posted with no access signs, or has extremely steep and dangerous streambanks. HELCO had access to only a few locations and all but the low-water bridge (Site 2) were into steep waterfall and cascade sections unsafe for survey access. I spoke with Darrell Kuamo'o of the Hawaii Division of Aquatic Resources, a member of the last full survey of Wailuku River conducted in the early 1990s. He said that in the 1990s much of the streambank was not forested and sugar cane roads paralleled the river, providing much greater access than is available today. The banks of the Wailuku River are now heavily forested and the cane fields roads are behind gated private property. The two areas we surveyed were relatively typical for much of the Wailuku River although we did not survey any large or deep waterfall plunge pools. However, were did complete numerous surveys of smaller pools which was the most frequent habitat type encountered.

The first survey site (Site 1) was just upstream of the waterfall above Piihonau Bridge (Figure 45). The area was characterized by a large cascade down the center left of the river prior to flowing over the waterfall and smaller riffles in pools on the right-hand side (Figure 46). We surveyed approximately 98 m^2 in a total of 52 sample locations on 1/26/2017. Green swordtails were the most common species and we observed three of the native shrimp, ‘Ōpae kala‘'ole, clinging to bedrock near swift flows (Table 5). While instream habitat appeared good throughout the section, stream animals were present at low densities (Table 6).

The second survey site (Site 2) was located just above the upper intake in the area of the low-water bridge downstream of Site (Figure 47). This site was characterized by a cascade on the right side of the river and pools and runs on the left side (Figure 48). We surveyed approximately 253 m^2 in a total of 116 sample locations on 1/26/2017. Again, green swordtails and guppies were the most common species observed and white cloud mountain minnows were more abundant than at Site 1 (Table 5). In general, densities of most species were at least twice as high as compared to Site 1, but we did not observe any of the native shrimp ‘Ōpae kala‘'ole at this location (Table 6).

We observed no native stream gobies at either site during the survey, although we surveyed numerous locations with excellent habitat conditions for the species. Figure 49 to Figure 55 show examples of the species observed from the underwater video.

Figure 45: Biotic sampling site 1 upstream of Waianuenue Avenue. Site 1 is upstream of Site 2.

Figure 46: An image of the Site 1 conditions. This site had large cascades to the left and smaller runs, pools and falls on the right side.

Figure 47: Biotic sampling site 2 at low water bridge crossing at end of Manaolana Place and just upstream of the upper intake site.

Figure 48: An image of Site 2 conditions. The right side of the river was swift with numerous cascades while the left side was slower with a mix of runs and pools.

Table 5: Species observations, habitat types, and area sampled for the two sites on the Wailuku River.

				Number Observed						
Site	Habitat type	Number Sampled	Area Sampled (m^2)	White Cloud Mountain Minnow	Green Swordtail	Guppy	Dojo	Crayfish	Atyid Shrimp	Bullfrog Tadpole
1	Pool	15	39	2	10	1	0	0	0	0
1	Run	22	35.6	1	4	0	0	0	3	0
1	Riffle	8	6.9	0	0	0	0	0	0	0
1	Cascade	7	16.2	0	0	0	0	0	0	0
2	Pool	54	129.8	13	101	58	4	3	0	2
2	Run	32	75.6	3	32	7	0	2	0	0
2	Riffle	12	22.8	0	0	0	0	0	0	0
2	Cascade	18	24.7	0	1	0	0	0	0	0

Table 6: Species density, habitat types, and percent area sampled for the two sites on the Wailuku River.

				Density (#/m^2)						
Site	Habitat type	Number Sampled	% of Area Sampled	White Cloud Mountain Minnow	Green Swordtail	Guppy	Dojo	Crayfish	Atyid Shrimp	Bullfrog Tadpole
1	Pool	15	39.9%	0.05	0.26	0.03	0.00	0.00	0.00	0.00
1	Run	22	36.4%	0.03	0.11	0.00	0.00	0.00	0.08	0.00
1	Riffle	8	7.1%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	Cascade	7	16.6%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Pool	51	51.3%	0.10	0.78	0.45	0.03	0.02	0.00	0.02
2	Run	32	29.9%	0.04	0.42	0.09	0.00	0.03	0.00	0.00
2	Riffle	12	9.0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Cascade	18	9.8%	0.00	0.04	0.00	0.00	0.00	0.00	0.00

Figure 49: A pair of introduced White Cloud Mountain Minnows in Wailuku River.

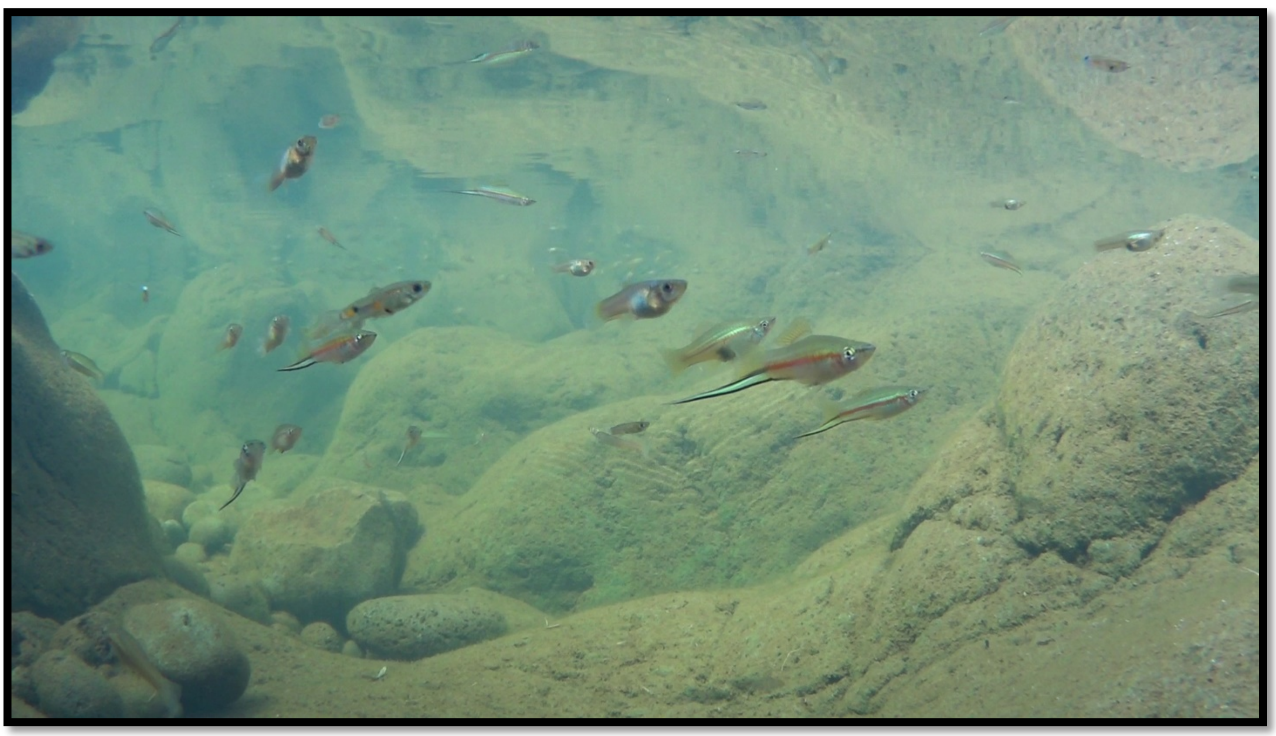


Figure 50: A mixture of introduced Green Swordtails and Guppies in Wailuku River.

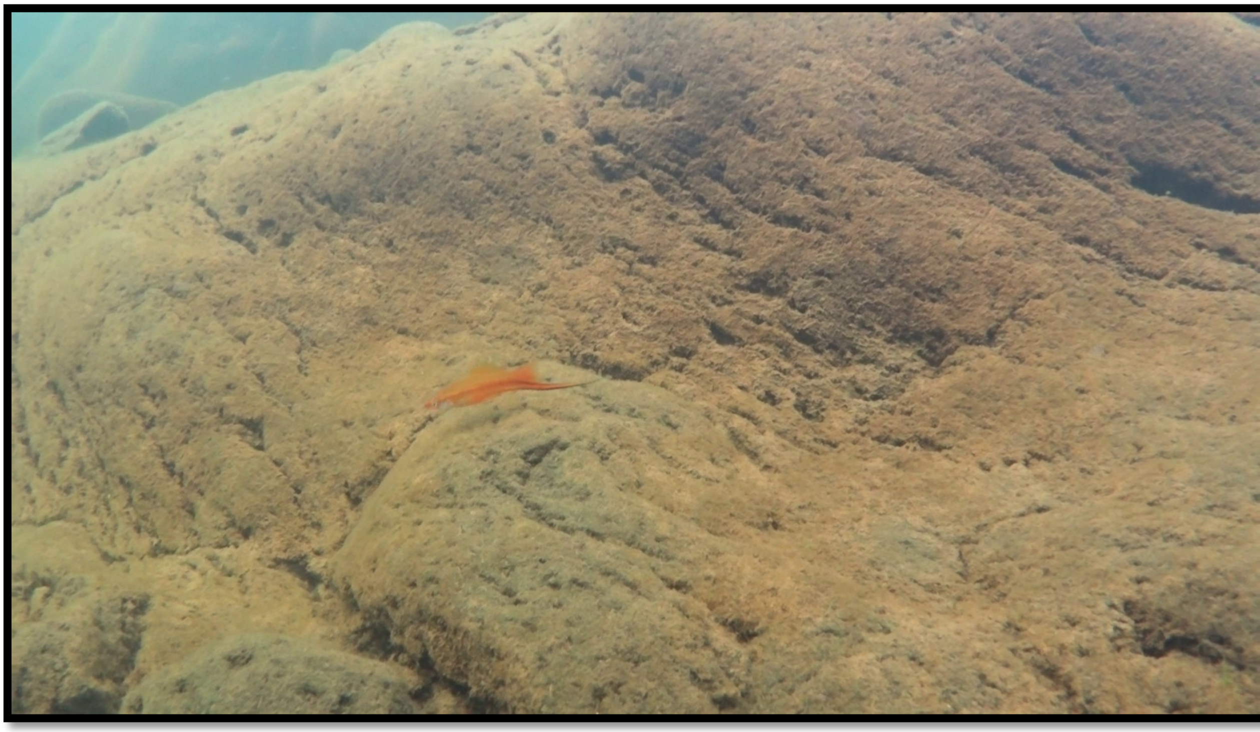


Figure 51: An introduced Green Swordtail male in red phase in Wailuku River.

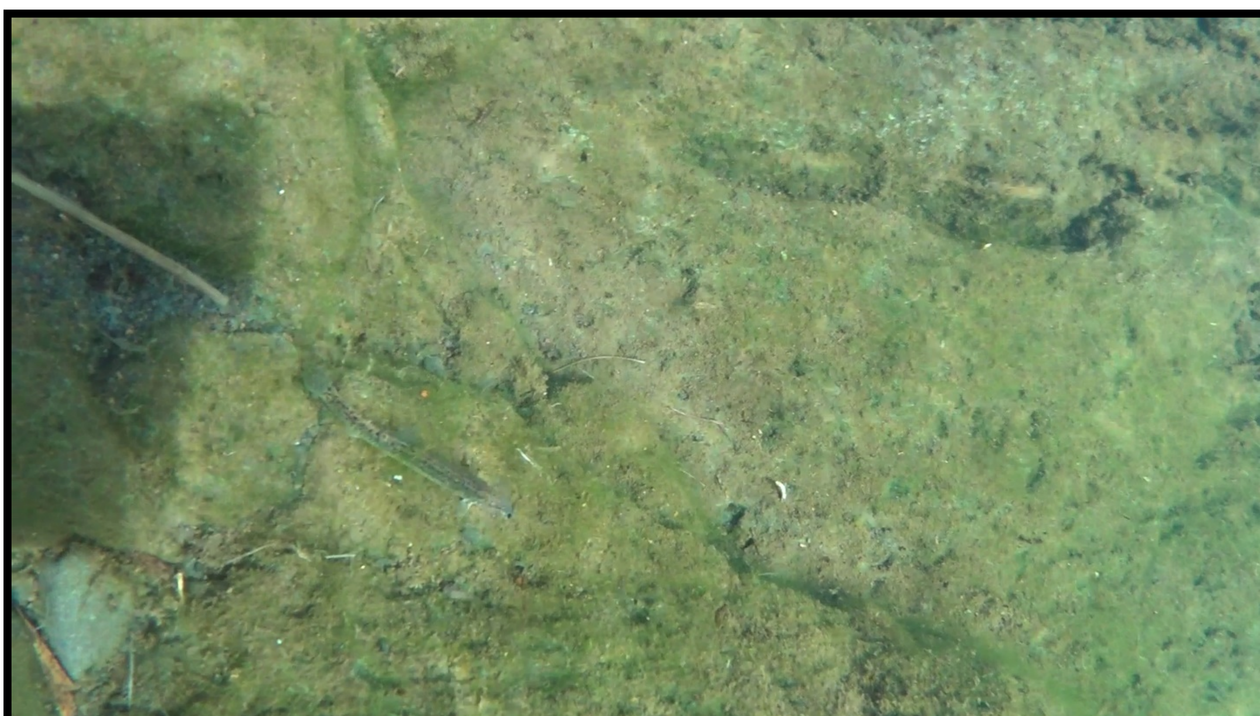


Figure 52: An introduced Dojo in Wailuku River.

Figure 53: An introduced Crayfish in Wailuku River.

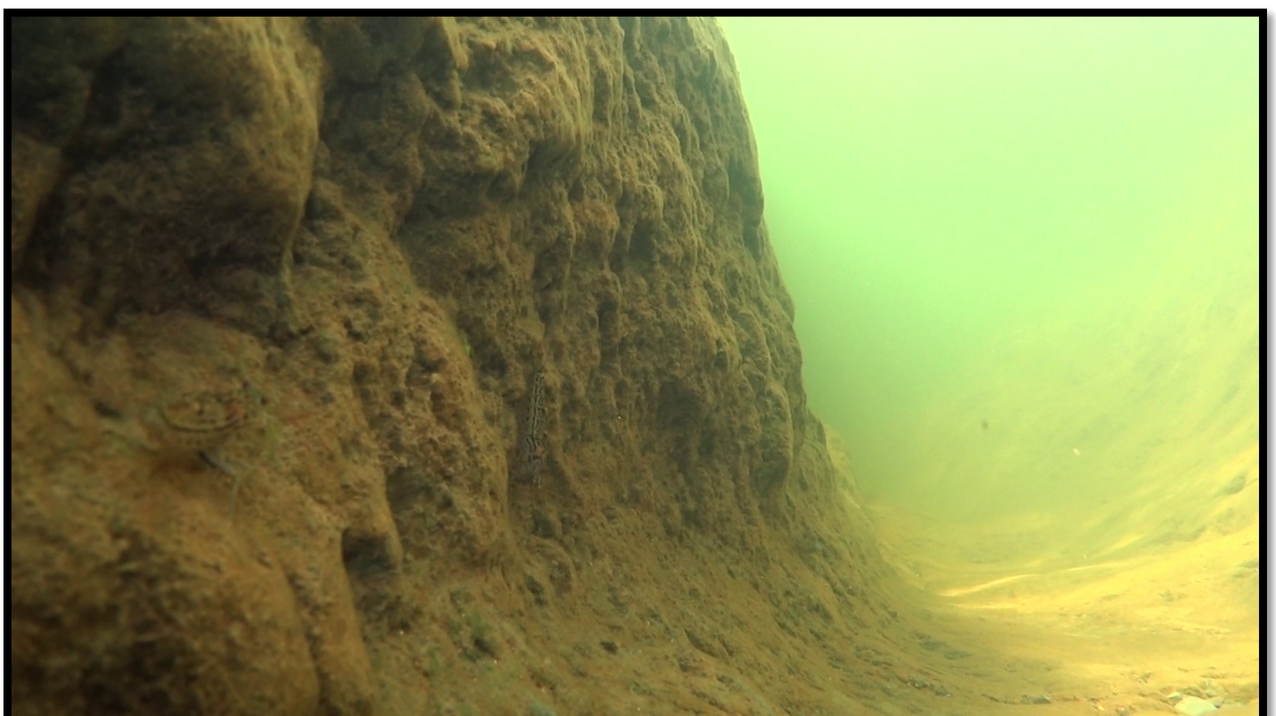


Figure 54: A pair of native Atyid shrimp (Mountain 'Opae) in Wailuku River.

Figure 55: An introduced Bullfrog tadpole in Wailuku River.

HSHEP Model Results

To create HSHEP model for the Wailuku River, the digital line representation of the Wailuku River was downloaded from the National Hydrograph Dataset (NHD) and from the DAR stream layer. The DAR stream layer provided perennial and intermittent segments for the NHD Wailuku River file (Figure 56). For the purposes of the HSHEP model, the intermittent segments were removed and we only modeled perennial stream segments as suitable habitat for native stream animals. For each segment, river width was estimated by averaging the measurement of multiple cross-sections from the aerial imagery using the ArcGIS ruler tool. Wailuku River is a large river by Hawaii standards with average widths in the lower reaches of 50 m and average widths in the upper reaches approximately 4 m wide. The HSHEP model calculates habitat units (HU) in m^2 for each 10 m stream segment. Inclusion of river width reflects that more streambed area exists in a wider segment than a narrower segment.

The Wailuku River line file was then labeled to reflect key modeling locations and river segment groups (Figure 57). The three key points added were the location of Rainbow Falls and the location of the two hydropower intakes. The primary segments of the main stem of the Wailuku River were numbered in an upstream direction (Figure 58). The first segment (10) started at the mouth of the river and ended upstream at the base of Rainbow Falls. The second segment (20) began above Rainbow Falls and ended upstream at the Pu’u’eo hydropower intake. The third segment (30) began at the Pu’u’eo hydropower intake and ended upstream at the Waiau Hydropower water return. The fourth segment (40) began at the

Waiau Hydropower water return and ended upstream Waiau Hydropower water intake. The final mainstem segment (50) began at the Waiau Hydropower water intake and ended where the river split into multiple tributaries. Tributaries entering the main stem of the Wailuku River were numbered so that they could be grouped and that the main stem river segment could be identified (Figure 59). For example, a tributary that flowed into the first segment (10) would be labeled (11) to denote the receiving mainstem segment (10) and tributary number (1). Some of the larger tributaries were further broken down into additional groups to help group like-sized segments for estimating River width. These segments were lumped back together in the results of the Wailuku River HSHEP model as they were not differentially impacted by the hydropower facility.

Next, we ran the HSHEP model with watershed, reach and site level habitat variables included for each species to estimate their amount of suitable habitat units within each river segment group. We used the watershed and reach scale variables presented in the methods and included the site level for habitat type is the primary site level indicator of habitat suitability. We used habitat type as we were able to delineate it from the aerial imagery and the site variables for water depth, substrate, substrate embeddedness, flow, and water temperature all appeared excellent for native stream animals during our surveys and were unlikely to be limiting habitat variables. For this version of the HSHEP model, the site variables could have been removed as they do not change between the current hydropower model in the proposed modification model. Changes to instream habitat were included as separate variables modifying the stream segments where water is removed by the intake. Thus, the site level variable merely improves the overall estimate of HU in the river, but is insensitive to changes between current conditions and proposed modifications. This model design choice was made for a second reason. The Wailuku River, the largest river in the state, is relatively unique in terms of the size and depth of the instream habitat. While there are many observations of native species and smaller Hawaiian streams, few microhabitat studies have been conducted in the large plunge pools and deep cascades typical of the Wailuku River in the area near the hydropower facilities. Table 7 shows percent habitat suitability for each species for each habitat type and an overall percent suitability based on the proportion of each habitat type determined from our habitat assessment.

At this point, we calculated HU (m^2) for each species within each river segment group. These estimates of HU area are considered locally-uncorrected as important features such as barriers to upstream migration (i.e. Rainbow Falls) are not yet accounted for in the model. The maps in Figure 60, Figure 61 and Figure 62 represent the results for the step in the model and show areas that the species may occur but does not represent Rainbow Falls as an upstream barrier.

The next step in the modeling process was to determine impact factors for the three key locations in the model. For Rainbow Falls, we estimated what portion of animals reaching the barrier would be able to surmount it in comparison to those that would normally be able to climb a waterfall of that height if it was not undercut. In past HSHEP models, a value of 0.2 has been used for undercut barriers (Parham 2013b). Rainbow Falls is the largest and most completely undercut waterfall modeled and past surveys have noted its likelihood as a barrier (Baker 1995). As a result, a value of 0.1 was applied to this variable suggesting that only 10% of animals can pass the barrier. Other values ranging up to 0.3 were tested but these values did not change the overall trends observed or the conclusions based on them.

For the two hydropower intakes, we estimated the amount of habitat lost in the segment between the intake and the outfall, the potential for the intake structure to act as a barrier to upstream movement, and the effect of entrainment on downstream drifting larvae. To estimate the amount proportion of water in the river channel and diverted into the intake, the USGS gage discharge was scaled and proportioned to the length of upstream perennial stream channel. Approximately 64.2% of the perennial stream channel was above the USGS gage with an additional 15.8% between the gauge and the Waiau intake and another 20.0% between the Waiau intake and the Pu'u'eo intake (Table 9). From the USGS long-term gage data (1929 to 2015), the average annual discharge was 260.7 cfs. Therefore, there is approximately 325 cfs at the Waiau intake and 406 cfs at the Pu'u'eo intake. Under the current hydropower operation, Waiau diverts 55 cfs and Pu'u'eo diverts 130 cfs or 16.9% and 32.0% respectively (Table 10). Under the proposed modification of the hydropower, the Waiau intake would increase to 100 cfs or approximately 31%. These values are only general estimates as scaling discharge to upstream perennial stream length does not take into account differences within the watershed for rainfall patterns, geology, gaining or losing reaches, or other variables influencing stream discharge. However, in the absence of actual stream discharge gage information, this is an appropriate approach.

To determine the changes in instream habitat due to the water diverted into the intakes, I accounted for losses of habitat at low flow and at higher flows. Approximately 10% of the habitat was modeled lost at low flows under all scenarios. This accounts for the bypass of some minimum flow at each diversion. There are numerous large deep pools in the main Wailuku River channel and these would provide a refuge for stream animals during times of low flow. Providing some minimum flow would keep the connection between these pools open and likely provide good instream habitat. Unlike small streams where the diversions may dry the majority of the stream bed, the Wailuku River will contain substantial habitat even at the lowest stream discharge. In our habitat assessment, dry stream channel increased only 16% when discharge decreased from 122 cfs to 12.8 cfs. and only 10% when discharge decreased to 37.1 cfs. With nearly 50% of the river channel in large, deep pools the lower Wailuku River is resistant to drying up even at low discharge. The second part of habitat loss is related to the greater number of low flow versus moderate flow days when comparing diverted conditions to undiverted condtions. An additional 10% loss of suitable habitat was attributed to the approximate 30% high flow diversion at Pu'u'eo intake and 5% loss of suitable habitat at Waiau intake under current conditions. Under proposed conditions, 10% of suitable habitat loss at Waiau intake reflected a similar portion of the flow diverted at both Waiau and Pu'u'eo intakes. Analyzing daily discharge at each intake and in the stream channel below the intakes would improve these estimates but was outside the scope of this study. From a sensitivity analysis perspective, when I increased the habitat loss associated with minimum flow issues, there is no change in the trends as this condition is not supposed to change between current and proposed hydropower operations. When I increased habitat loss associated with the diversion of higher flows there was a greater impact observed with the proposed modifications, but the overall loss of HU were still relatively small.

There was no planned change between current and proposed channel intakes and neither presented a barrier. Therefore, no impact was modeled as a result of barriers to upstream movement in either scenario.

To address entrainment of downstream drifting larvae, the proportion of flow diverted was again important. The downstream drifting larvae of native stream animals is mostly passive and the proportion that will pass through the hydropower turbines is likely closely related to the proportion of water that flows through the hydropower systems. It is possible to model larvae mortality at 100% for all larvae that pass through the hydropower turbines, but that is an unlikely scenario. Studies on fish passage mortality through the hydropower turbines have reported successful passage between 70% and 97%, with higher success for smaller or younger fishes (Jacobson et al 2012). The larvae of native stream animals are small and have evolved to survive the turbulent passage down waterfalls and cascades of Hawaiian streams. It is likely they face some mortality just drifting down the stream to the ocean. Given their size and natural ability to pass turbulent conditions, it is likely many larval native stream animals can pass through the hydropower system successfully. As a result, entrainment mortality was set to 10% for each turbine. From a variable sensitivity perspective, increasing passage mortality increases the proposed project impacts. However, the proposed increase in water diversion is only approximately 20% of the total diverted and it only affects animals that have traveled far upstream, therefore, overall effects are not great.

With impact variables determined, the full HSHEP model was completed. Table 11, Table 12, and Table 13 show the model results for Opae kala’ole (*Atyoida bisulcata*), O’opu alamo’o (*Lentipes concolor*), and O’opu nopili (*Sicyotperus stimponi*) respectively. Table 14 provides a summary of this information. The overall pattern is similar for all three species in that there is relatively minor impact associated with the proposed hydropower modifications (1.4% to 0.1% range of estimated HU lost). The impacts were greatest for Ōpae kala’ole (1.4%) as they are found further upstream and interact most with the hydropower and lowest for O’opu nopili (0.1%) as the majority of their habitat was predicted to occur below Rainbow Falls.

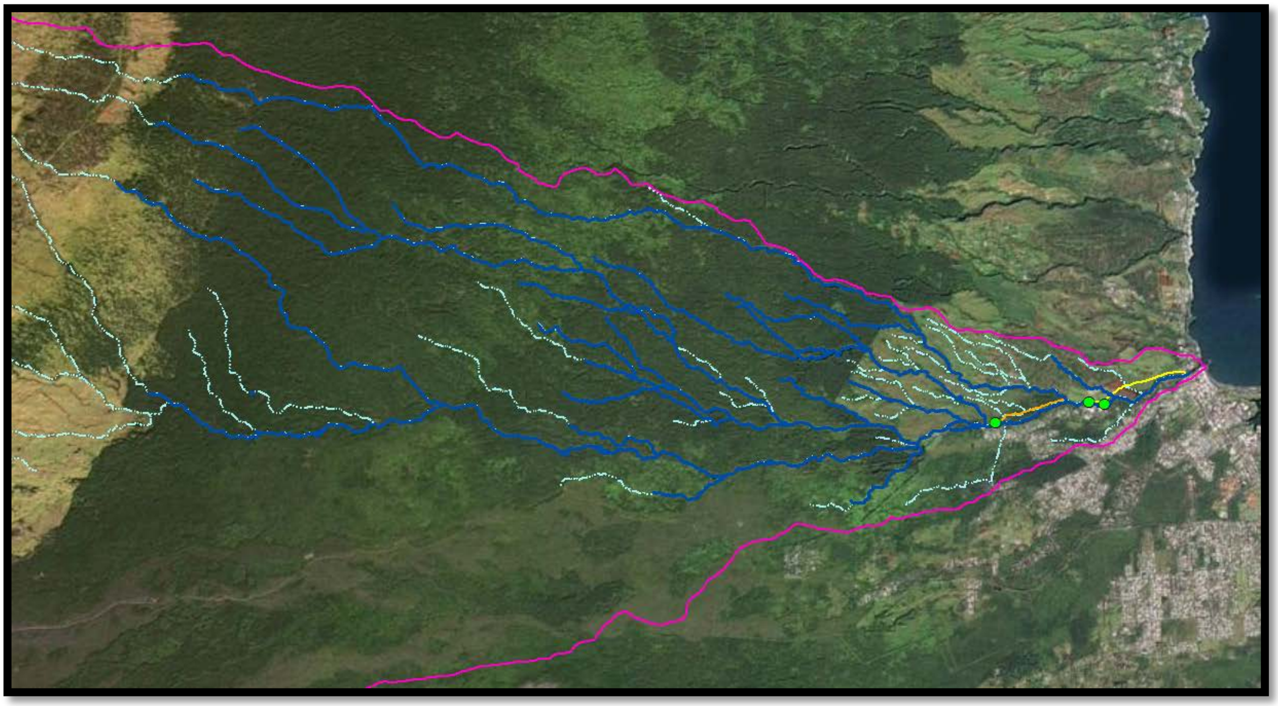


Figure 56: Wailuku watershed (pink) with perennial stream segment (blue) and intermittent segments (light blue).

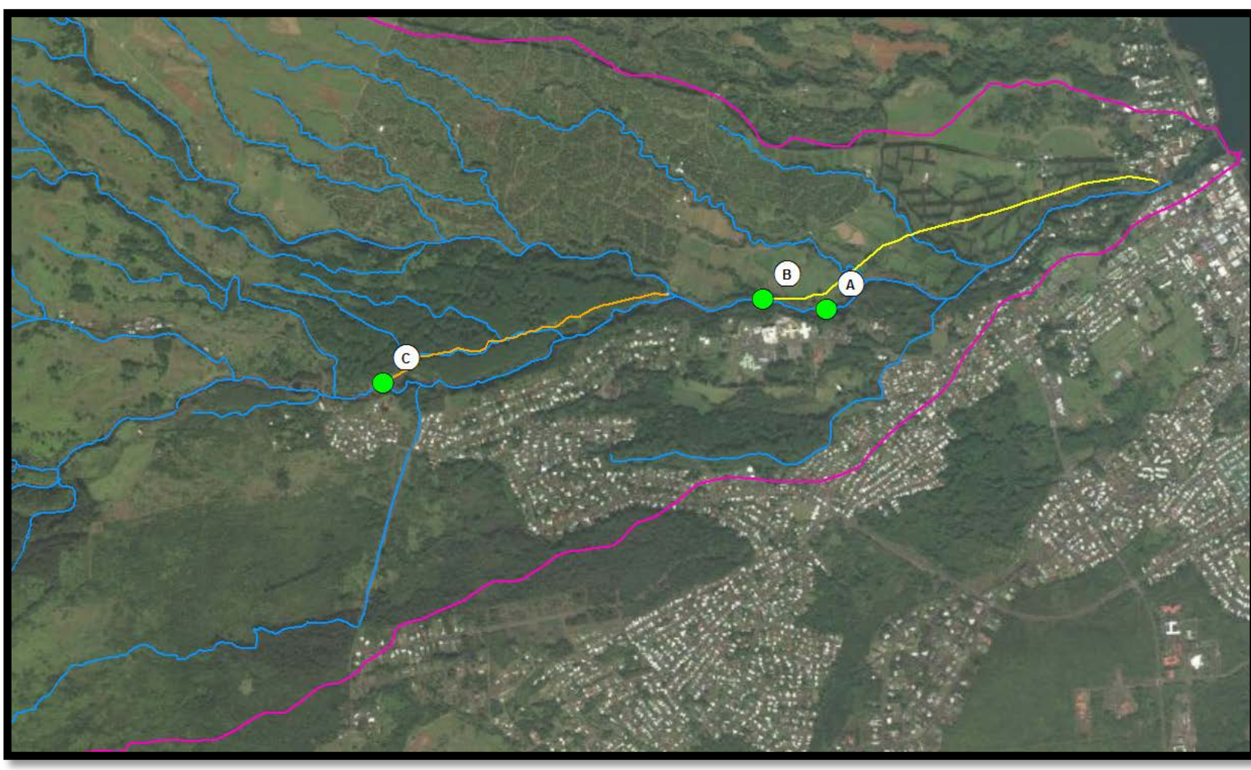


Figure 57: Close-up of Wailuku River with Key Points labeled. (A) is Rainbow Falls, (B) is the Pu'u'eo Intake, and (C) is the Waiau Intake. The penstocks for each hydropower plant are shown in orange and yellow respectively.

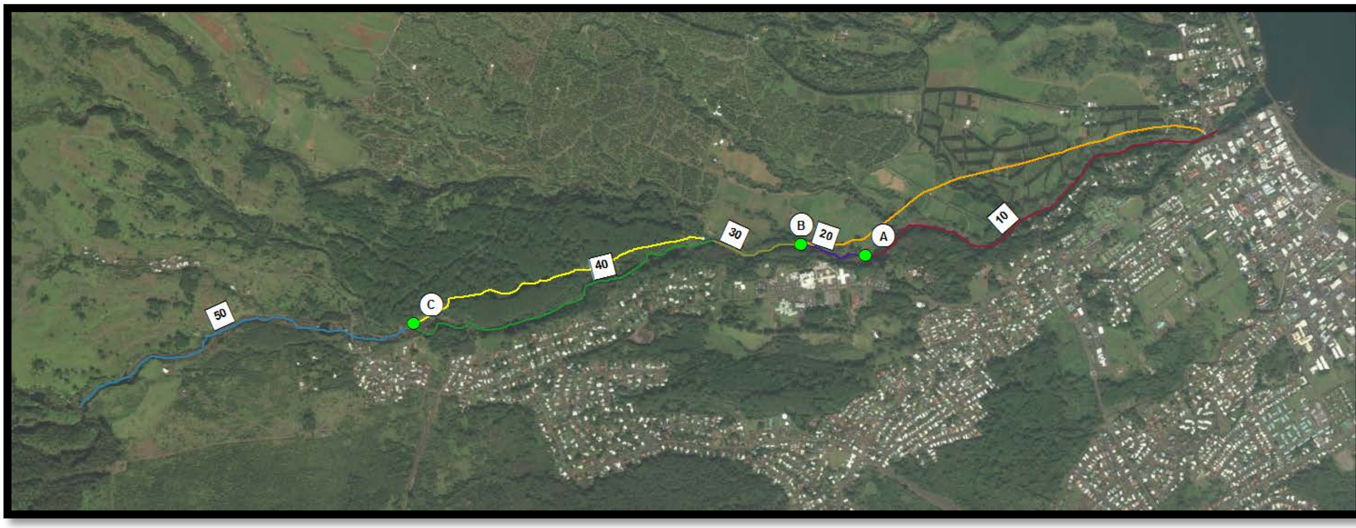


Figure 58: Primary river segment coding for the Wailuku River HSHEP model.

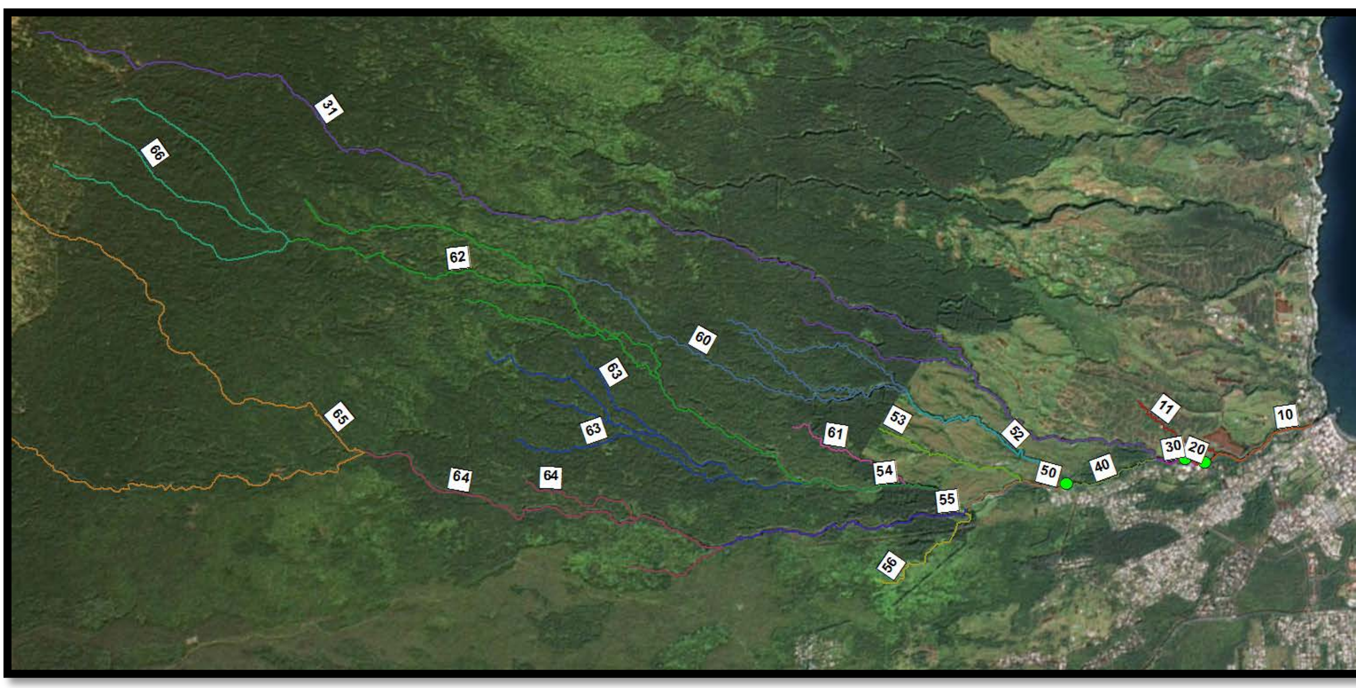


Figure 59: Overall river segment coding for the Wailuku River HSHEP model.

Table 7: Habitat type suitability for modeled species adapted from data in the DAR Aquatic Surveys Database.

Habitat Type	% Habitat Type	% suitable		
		Atyoida bisulcata	*Lentipes concolor*	*Sicyopterus stimpsoni*
Pool	52.7%	38%	51%	39%
Run	11.0%	100%	97%	82%
Riffle	10.0%	42%	35%	55%
Cascade	5.3%	30%	10%	20%
Dry	21.0%	0%	0%	0%
Total	100%	37%	42%	36%

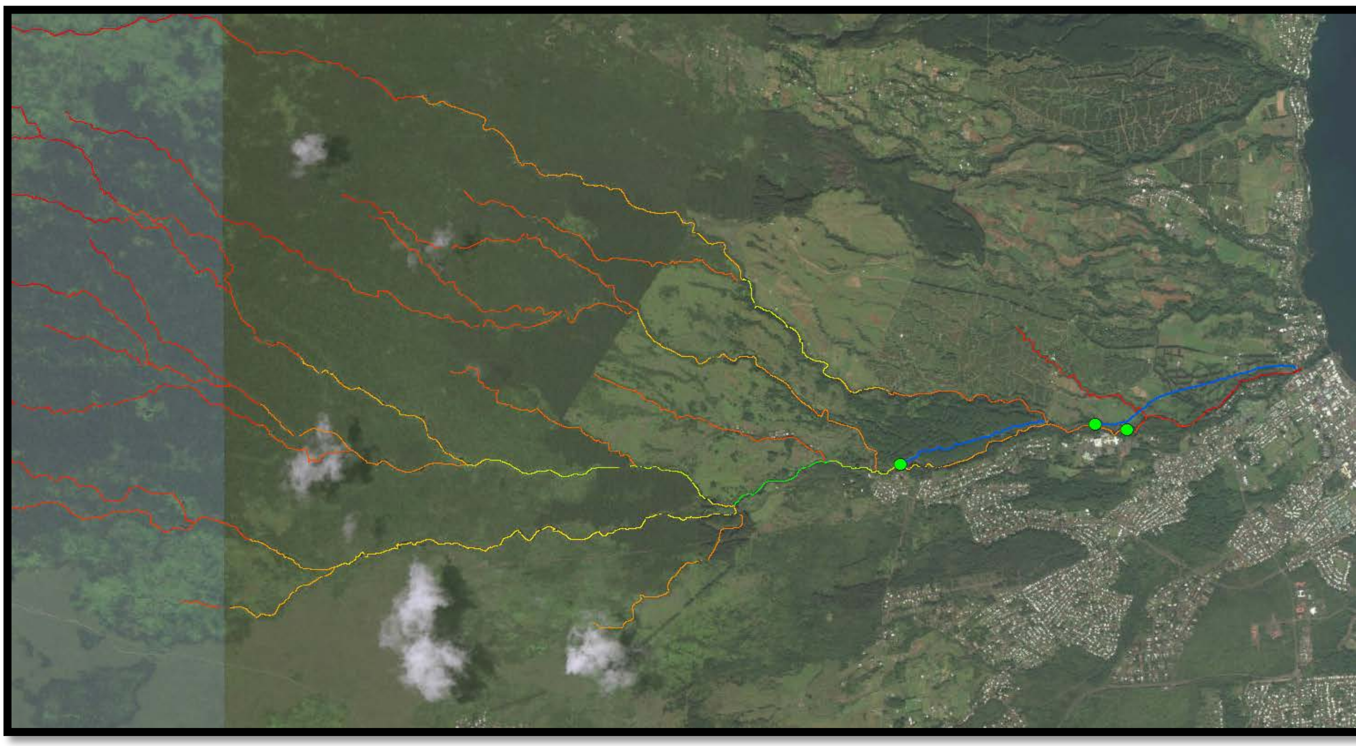


Figure 60: Locally-uncorrected results for *Atyoida bisulcata* habitat suitability in the Wailuku River. Green color is suitable and red is least suitable.

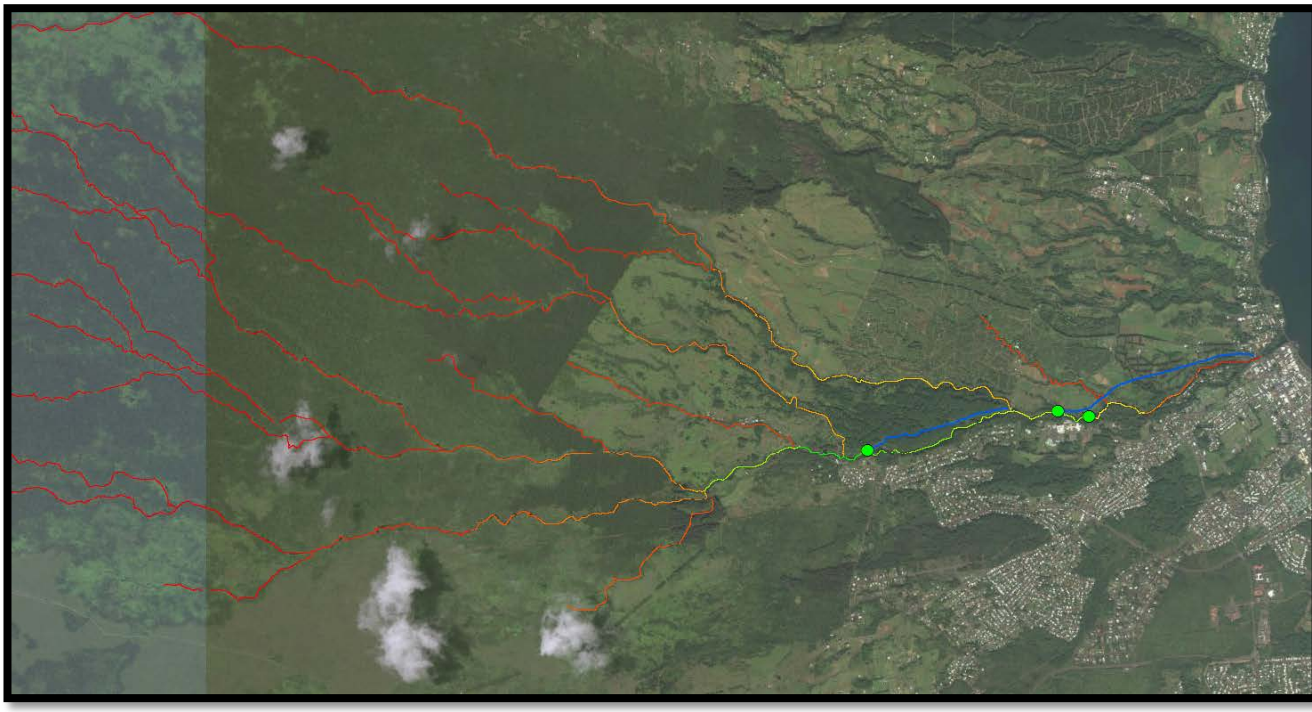


Figure 61: Locally-uncorrected results for *Lentipes concolor* habitat suitability in the Wailuku River. Green color is suitable and red is least suitable.

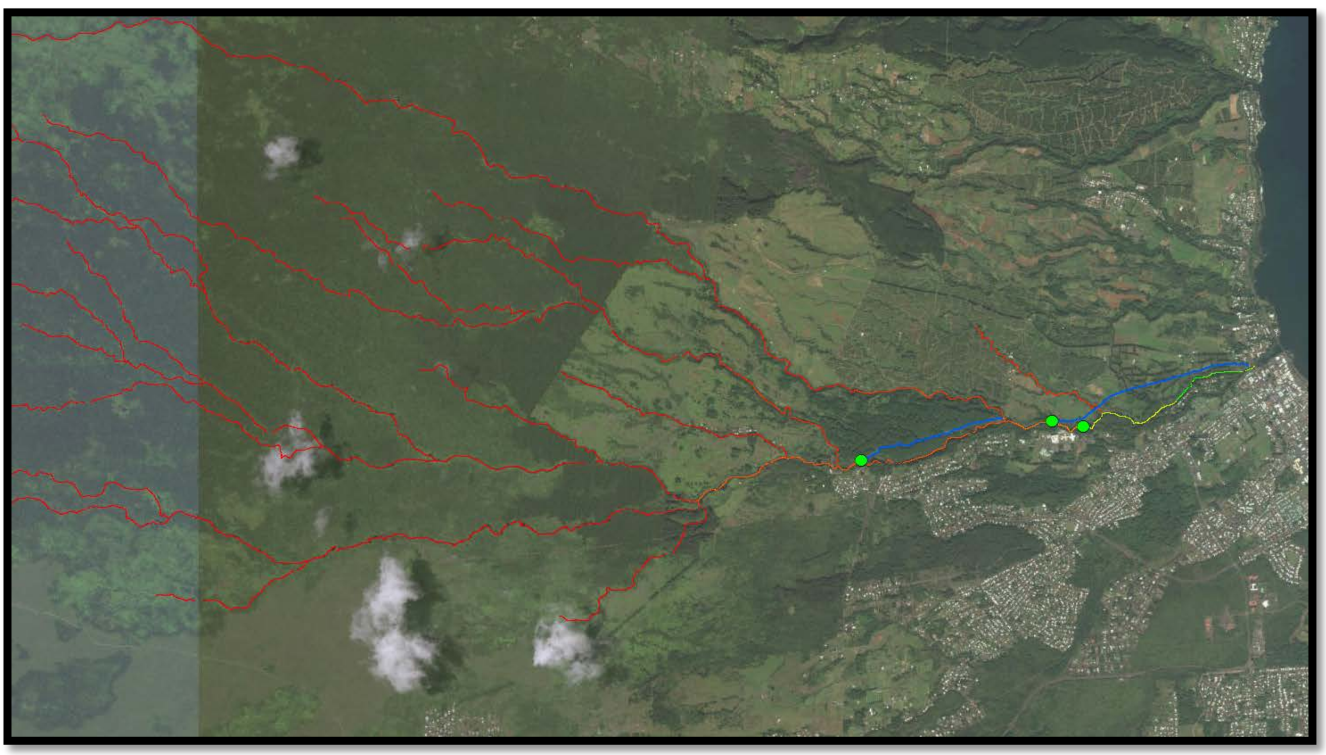


Figure 62: Locally-uncorrected results for *Sicyopterus stimpsoni* habitat suitability in the Wailuku River. Green color is suitable and red is least suitable.

Table 8: Impact variables and values used in the Wailuku River HSHEP model. Value of 1.0 means no impact and a value of 0.0 means elimination of any suitable habitat for segments associated with that variable.

Natural Impacts	
Rainbow Falls	0.10
Current Hydro Impact	
Puueo Habitat Impact	0.80
Waiau Habitat Impact	0.85
Puueo Intake Barrier	1.00
Waiau Intake Barrier	1.00
Puueo Entrainment Impact	0.97
Waiau Entrainment Impact	0.98
Proposed Hydro Impact	
Puueo Habitat Impact	0.80
Waiau Habitat Impact	0.80
Puueo Intake Barrier	1.00
Waiau Intake Barrier	1.00
Puueo Entrainment Impact	0.97
Waiau Entrainment Impact	0.97

Table 9: Area and Estimated Discharge for important model locations.

Location	Upstream Perennial Stream length (m)	% Length	Estimated Average Discharge (cfs)
USGS gage	131,640	64.2%	260.7
Waiau	32,380	15.8%	64.1
Puueo	41,020	20.0%	81.2
Total	205,040	100.0%	406.1

Table 10: Estimated amount and percent diverted at each hydropower intake.

Diversion	Estimated Avg. Discharge (cfs)	Currently Diverted (cfs)	Proposed Diverted (cfs)	% Diverted Currently	% Diverted Proposed
Waiau	324.8	55.0	100.0	16.9%	30.8%
Puueo	406.1	130.0	130.0	32.0%	32.0%

Table 11: Wailuku River HSHEP results for *Atyoida bisulcata*.

Modeled Conditions		Natural Conditions		Current Conditions				Proposed Conditions				% Change from Proposed Hydro
Region ID	HU Modeled	Rainbow Falls Barrier Impact	HU local correction	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Current Hydro HU	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Proposed Hydro HU	
10	310	1.0	310	0.80	1.00	1.00	248	0.80	1.00	1.00	248	0.0%
11	170	1.0	170	1.00	1.00	1.00	170	1.00	1.00	1.00	170	0.0%
20	451	0.1	45	0.80	1.00	1.00	36	0.80	1.00	1.00	36	0.0%
30	564	0.1	56	1.00	1.00	0.97	55	1.00	1.00	0.97	55	0.0%
31	18,034	0.1	1,803	1.00	1.00	0.97	1,746	1.00	1.00	0.97	1,746	0.0%
40	2,964	0.1	296	0.85	1.00	0.97	244	0.80	1.00	0.97	230	5.9%
50	9,993	0.1	999	1.00	1.00	0.95	951	1.00	1.00	0.94	937	1.4%
51	11,181	0.1	1,118	1.00	1.00	0.95	1,064	1.00	1.00	0.94	1,049	1.4%
52	1,805	0.1	181	1.00	1.00	0.95	172	1.00	1.00	0.94	169	1.4%
54	22,056	0.1	2,206	1.00	1.00	0.95	2,099	1.00	1.00	0.94	2,069	1.4%
55	18,426	0.1	1,843	1.00	1.00	0.95	1,753	1.00	1.00	0.94	1,728	1.4%
56	3,298	0.1	330	1.00	1.00	0.95	314	1.00	1.00	0.94	309	1.4%
Total	89,253		9,357				8,850				8,745	1.2%
			10.5%				94.6%				93.5%	

Table 12: Wailuku River HSHEP results for *Lentipes concolor*.

Modeled Conditions		Natural Conditions		Current Conditions				Proposed Conditions				% Change from Proposed Hydro
Region ID	HU Modeled	Rainbow Falls Barrier Impact	HU local correction	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Current Hydro HU	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Proposed Hydro HU	
10	9,123	1.0	9,123	0.80	1.00	1.00	7,299	0.80	1.00	1.00	7,299	0.0%
11	2,467	1.0	2,467	1.00	1.00	1.00	2,467	1.00	1.00	1.00	2,467	0.0%
20	5,220	0.1	522	0.80	1.00	1.00	418	0.80	1.00	1.00	418	0.0%
30	5,868	0.1	587	1.00	1.00	0.97	568	1.00	1.00	0.97	568	0.0%
31	29,653	0.1	2,965	1.00	1.00	0.97	2,870	1.00	1.00	0.97	2,870	0.0%
40	23,994	0.1	2,399	0.85	1.00	0.97	1,974	0.80	1.00	0.97	1,858	5.9%
50	31,117	0.1	3,112	1.00	1.00	0.95	2,961	1.00	1.00	0.94	2,919	1.4%
51	17,219	0.1	1,722	1.00	1.00	0.95	1,638	1.00	1.00	0.94	1,615	1.4%
52	2,952	0.1	295	1.00	1.00	0.95	281	1.00	1.00	0.94	277	1.4%
54	11,126	0.1	1,113	1.00	1.00	0.95	1,059	1.00	1.00	0.94	1,044	1.4%
55	10,280	0.1	1,028	1.00	1.00	0.95	978	1.00	1.00	0.94	964	1.4%
56	4,299	0.1	430	1.00	1.00	0.95	409	1.00	1.00	0.94	403	1.4%
Total	153,319		25,764				22,923				22,702	1.0%
			16.8%				89.0%				88.1%	

Table 13: Wailuku River HSHEP results for *Sicyopterus stimpsoni*.

Modeled Conditions		Natural Conditions		Current Conditions				Proposed Conditions				% Change
Region ID	HU Modeled	Rainbow Falls Barrier Impact	HU local correction	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Current Hydro HU	Hydro Habitat Impact	Hydro Barrier Impact	Hydro Entrainment Impact	Proposed Hydro HU	from Proposed Hydro
10	23,294	1.0	23,294	0.80	1.00	1.00	18,635	0.80	1.00	1.00	18,635	0.0%
11	1,438	1.0	1,438	1.00	1.00	1.00	1,438	1.00	1.00	1.00	1,438	0.0%
20	1,211	0.1	121	0.80	1.00	1.00	97	0.80	1.00	1.00	97	0.0%
30	1,230	0.1	123	1.00	1.00	0.97	119	1.00	1.00	0.97	119	0.0%
31	2,292	0.1	229	1.00	1.00	0.97	222	1.00	1.00	0.97	222	0.0%
40	2,749	0.1	275	0.85	1.00	0.97	226	0.80	1.00	0.97	213	5.9%
50	3,590	0.1	359	1.00	1.00	0.95	342	1.00	1.00	0.94	337	1.4%
51	1,592	0.1	159	1.00	1.00	0.95	152	1.00	1.00	0.94	149	1.4%
52	262	0.1	26	1.00	1.00	0.95	25	1.00	1.00	0.94	25	1.4%
54	218	0.1	22	1.00	1.00	0.95	21	1.00	1.00	0.94	20	1.4%
55	350	0.1	35	1.00	1.00	0.95	33	1.00	1.00	0.94	33	1.4%
56	237	0.1	24	1.00	1.00	0.95	23	1.00	1.00	0.94	22	1.4%
Total	38,463		26,105				21,332				21,310	0.1%
			67.9%				81.7%				81.6%	

Table 14: Summary of Wailuku River HSHEP results for native stream animals.

Region ID	Opae kala'ole (*Atyoida bisulcata*)				O'opu alamo'o (*Lentipes concolor*)				O'opu nopili (*Sicyotperus stimponi*)			
	Natural HU	Current Hydro HU	Proposed Hydro HU	% Change from Proposed Hydro	Natural HU	Current Hydro HU	Proposed Hydro HU	% Change from Proposed Hydro	Natural HU	Current Hydro HU	Proposed Hydro HU	% Change from Proposed Hydro
10	310	248	248	0.0%	9,123	7,299	7,299	0.0%	23,294	18,635	18,635	0.0%
11	170	170	170	0.0%	2,467	2,467	2,467	0.0%	1,438	1,438	1,438	0.0%
20	45	36	36	0.0%	522	418	418	0.0%	121	97	97	0.0%
30	56	55	55	0.0%	587	568	568	0.0%	123	119	119	0.0%
31	1,803	1,746	1,746	0.0%	2,965	2,870	2,870	0.0%	229	222	222	0.0%
40	296	244	230	0.0%	2,399	1,974	1,858	5.9%	275	226	213	5.9%
50	999	951	937	5.9%	3,112	2,961	2,919	1.4%	359	342	337	1.4%
51	1,118	1,064	1,049	1.4%	1,722	1,638	1,615	1.4%	159	152	149	1.4%
52	181	172	169	1.4%	295	281	277	1.4%	26	25	25	1.4%
54	2,206	2,099	2,069	1.4%	1,113	1,059	1,044	1.4%	22	21	20	1.4%
55	1,843	1,753	1,728	1.4%	1,028	978	964	1.4%	35	33	33	1.4%
56	330	314	309	1.4%	430	409	403	1.4%	24	23	22	1.4%
Total	9,357	8,850	8,745	1.4%	25,764	22,923	22,702	1.0%	26,105	21,332	21,310	0.1%

CONCLUSIONS

Overall, the use of the HSHEP model appeared to be an excellent choice for assessing the impact of the Wailuku River hydropower. The HSHEP model accounted for the natural stream conditions as well as the specific location of the hydropower facilities and their intakes. Thus, it was possible to document natural limiting factors to native species as well as the potential impacts of the hydropower facilities. When assessing the impact of the hydropower facilities on a native species habitat within the Wailuku River, we were concerned with three main areas: loss of instream habitat, creation of barriers to upstream movement, and the entrainment of downstream drifting larvae.

Loss of instream habitat

The Waiau diversion decreases flow for approximately 1 mile between the intake and the return and the Pu'u'eo diversion decreases instream flow for approximately 1.25 miles between the intake and its return (HELCO 2016b). We focused our habitat assessment within the Waiau diversion area to better account for low flow conditions. While stream diversion in other Hawaiian streams can result in a dewatered stream bed, the conditions around the hydropower facility appeared to be relatively unique in Hawaiian streams. Wailuku River is a large river by Hawaii standards with extensive deep pools, runs and cascades. The instream habitat is excellent but native species are rare, likely due to the large undercut waterfalls limiting upstream migration not habitat quality. Baker (1995) strongly considered that Rainbow Falls represents nearly an impassable barrier to goby migration. With consistent flows in the river, the presence of large deep pools provide stream animals a refuge even during times of drought. Including a minimum flow past the diversions at all times will likely keep instream conditions highly suitable native stream animals and provide a pathway between habitat units open for native species that to reach this area.

Current instream habitat conditions were excellent in the areas we surveyed. We observed a range of substrates with very little substrate embedded by fine sediment. This is different than was observed in the similar area during surveys in 1983. The U.S. Fish and Wildlife report noted the area from Rainbow Falls to above Piihonua Bridge had substantial silt covering gravel and cobble substrates and filling rock interstices. The silt observed was from agricultural lands (predominantly sugar cane fields).

Our species observations were similar to both the U.S. Fish and Wildlife 1983 survey and in the early 1990 surveys by Baker (1995). In the segment above Rainbow Falls to above Piihonua Bridge the most common species were green swordtails and guppies with the introduced crayfish and bullfrog also present. The shrimp o'pae kala'ole was the most common native species but were still rare. We did not observe any native gobies and did observe a few additional introduced species but the general pattern is very similar to past surveys. Thus, it is unlikely that instream habitat quality has declined since the 1983 surveys and habitat quality has probably improved with the decrease in sediment coming from sugarcane fields.

Creation of barriers to upstream movement

Although issues with stream access somewhat limited the areas we could survey, the pattern we observed is similar to those observed during the 1990s surveys (Baker 1995). Darrell Kuamo’o of DAR who assisted Baker with the surveys, hypothesized that many of the native species upstream of the hydropower facilities may be finding their way to the upper tributaries through the ditch system and not directly up Wailuku River. The areas we surveyed had excellent instream habitat yet the only native stream animal we observed was the mountain o’pae and even these were rare. It is unlikely the areas around the hydropower intake structures have large populations of native fish as both of these intakes are upstream of the large undercut Rainbow Falls. Rainbow Falls and other possible undercut waterfalls may naturally restrict upstream migration of native species. The presence of the hydropower facilities is unlikely to be the cause for the rarity of native species observed in Wailuku River as instream habitat conditions are highly suitable for native species.

In addition, we observed the intake structures for both the lower and upper hydropower units and neither would prevent movement of stream animals in their current configuration. According to supporting documentation provided by HELCO (2016a), no changes to the intakes are planned and thus the proposed modifications will not cause creation of a barrier to upstream movement.

Entrainment of downstream drifting larvae into the hydropower facility

The lack of native species present upstream of the hydropower limits the potential impact of entrainment on native animals. Additionally, given the “run of the river” design of the hydropower, many newly-hatched larval animals may pass through the hydropower facility successfully. The hydropower facilities are non-consumptive use of water with no water lost in the process and all being returned to the river. Therefore, with the exception of mortality of larval stream animals due to physical injury during passage through the turbine, downstream passage through the penstock pipe is unlikely to be more rigorous than passage down the numerous waterfalls in the Wailuku River.

Differences between current conditions and proposed hydropower modifications

The primary differences between the current hydropower facility and the proposed hydropower modifications will be increased operating efficiencies with the new turbines and the resultant changes in water diversion amount through the turbines (HELCO 2016a). Maintenance of a minimum flow in the natural streambed should effectively minimize habitat lost due to increased water run through the hydropower facilities. Maintenance of minimum flow would protect against long periods of low or no flow in the segments downstream of the intakes and that may cause unsuitable habitat conditions.

With changes in water diversion quantity at higher flows for the Waiau Diversion after modification, the potential for increased mortality on downstream drifting larvae entrained in the hydropower system exists. Given the low numbers of native species above the intakes this is unlikely cause for great concern. Additionally, downstream drifting larvae normally pass over numerous waterfalls and through highly turbulent cascades and thus many may pass through the turbines unharmed. Direct evidence to determine mortality for downstream drifting larvae is outside the scope of this study and I assumed it is unlikely to be substantially different than the mortality for the current turbine conditions.

There are no proposed changes to the intake structures, and therefore, is an unlikely that a barrier to upstream movement will be created where none exists currently (HELCO 2016b).

Thus, the three main areas of concern that may decrease the suitability of a stream to native animals: loss of instream habitat, creation of barriers to upstream movement, and entrainment of downstream drifting larvae, are all likely minimized by the natural stream conditions in the location of the hydropower intakes and the proposed modifications are unlikely to cause substantial impact to native stream animal populations in Wailuku River.

Unstudied possibilities

It is possible that water quality is poor either chronically or episodically in the Wailuku River. It is possible that water passing through the hydropower facilities picks up some pollutant that renders the Wailuku River unsuitable to native species. It is also possible that land-use practices or some other source of pollution not associated with the hydropower facility may make the Wailuku River unsuitable for native species. These possibilities appear unlikely as we observed a range of introduced species in the river including White Cloud Mountain minnows, green swordtails, and guppies in breeding condition and with multiple size classes present suggesting long-term suitable water quality. We also observed the native shrimp, Mountain o'pae which is infrequently found in poor water quality streams. In the supporting documentation provided by HELCO (2016a), they state the hydropower will cause no water pollution as no foreign objects or chemicals are introduced to the water during its passage through the hydropower penstock pipe or turbine.

Another possibility for the lack of native species could be competition with introduced species. This possibility is also unlikely as there was extensive high-quality habitat available that was unoccupied by any species. We have observed native species co-occur with similar introduced species during surveys on Maui and Oahu where introduced species densities were much higher than observed in the Wailuku River (Parham, 2013a; Parham, 2015c).

An additional possibility may be that we did not adequately survey the area and missed large numbers of native species that were present in the area. This, too, is unlikely for several reasons. The use of the geo-referenced underwater video cameras linked to a digital display meant that we could see the animals during the surveys and could make sure the cameras were correctly aimed to see if species were present. The use of a video light on the survey cameras meant that we could look underneath boulders and into crevices to see if any stream animals were hiding. We did observe crayfish and young of the year poecilids (green swordtails and guppies) hiding under and within cover. Also, we collected 168 different video survey points covering approximately 350 m^2. Similar number of points using the DAR's standard point-quadrat methodology would have taken nearly a week for two surveyors (Higashi and Nishimoto, 2007), thus the speed of the HDFS approach allowed us to see a lot of instream habitat in a short amount of time.

Finally, Baker (1995) hypothesized that recruitment of juveniles into the Wailuku River may be rare. While this is a possibility, it would further minimize the impact of the hydropower system due to the natural lack of native species in the Wailuku River. If recruitment failure is the reason for the lack of adult native species observed in the Wailuku River, the mechanism causing this recruitment failure is unlikely associated with the hydropower system as these animals drift for several months in the ocean before recruiting back to the stream.

Overall, the proposed modifications to the Wailuku River hydropower facilities may cause a slight decrease in habitat units as a result of increased entrainment at higher flows. This may be offset somewhat by the automation of intake bypass minimum flows. Ensuring consistent and suitable minimum flows would protect the excellent habitat found in the Wailuku River.

Based on my professional opinion, the primary reason for the lack of native species in the vicinity of the hydropower intakes was their inability to migrate upstream past Rainbow Falls. Rainbow Falls is a natural feature on the Wailuku River and stream segment above the falls are unlikely to have substantial populations of native species. Fortuitously, the intakes for the hydropower facility are located above the falls and therefore have less interaction with native species habitats. Continued operation of the hydropower plants with proposed changes are unlikely to limit the population of native stream animals observed in the Wailuku River.

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Appendix C

Cultural Impact Assessment

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A Cultural Impact Assessment for the Renewal of Hawaiʻi Electric Light's Wailuku River Water Lease

TMK: (3) 2-6-009 (por.)

Piʻihonua and Puʻuʻeo *ahupuaʻa*
South Hilo District
Island of Hawaiʻi

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A Cultural Impact Assessment for the Renewal of Hawai‘i Electric Light’s Wailuku River Water Lease

TMK: (3) 2-6-009 (por)

Pi‘ihonua and Pu‘u‘eo *ahupua‘a*
South Hilo District
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1. INTRODUCTION

At the request of Jennifer Scheffel of SSFM International, on behalf of Hawaiʻi Electric Light. (HEL), ASM Affiliates (ASM) has prepared this Cultural Impact Assessment (CIA) to accompany a renewal application for a water lease along a portion of the Wailuku River in Puʻuʻeo and Piʻihonua *ahupuaʻa*, South Hilo District, Island of Hawaiʻi (Figures 1 and 2). The lease of State-owned water rights triggers compliance with both Hawaiʻi Revised Statues (HRS) Chapter 343 and HRS Title 12 §171-58. Thus, the current study was prepared in support an Environmental Assessment conducted in compliance with HRS Chapter 343; 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 Hawaiʻi, on November 19, 1997. As stated in Act 50, which was proposed and passed as Hawaiʻi 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 Hawaiʻi. 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." Additionally, HRS §171-58 contains the following stipulations:

> (f) Upon renewal, any lease of water rights shall contain a covenant that requires the lessee and the department of land and natural resources to jointly develop and implement a watershed management plan. The board shall not renew any lease of water rights without the foregoing covenant or a watershed management plan. The board shall prescribe the minimum content of a watershed management plan; provided that the watershed management plan shall require the prevention of the degradation of surface water and ground water quality to the extent that degradation can be avoided using reasonable management practices.
>
> (g) The department of land and natural resources shall notify the department of Hawaiian home lands of its intent to execute any new lease, or to renew any existing lease of water rights. After consultation with affected beneficiaries, these departments shall jointly develop a reservation of water rights sufficient to support current and future homestead needs. Any lease of water rights or renewal shall be subject to the rights of the department of Hawaiian home lands as provided by section 221 of the Hawaiian Homes Commission Act.

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.

STUDY AREA DESCRIPTION

The current study area is a roughly 3.28-mile (5.28 kilometer) long section of the Wailuku River extending *mauka* from the Wainaku Street Bridge to a former river crossing near Manaolana Place, roughly 0.19 miles (0.30 kilometers) east of where Waiānuenue Street crosses the Wailuku River. This stretch of the Wailuku River is situated between the HEL Puʻuʻeo Plant and Substation and the uppermost extreme of the HEL Waiau Plant, Penstock, and Diversion (see Figure 3) Elevation within the study area increases gradually, ranging from 13 feet above sea level at its *makai* end to 868 feet above sea level at its *mauka* end. Undeveloped forest land borders the westernmost 1.13 miles of the study area to the north, while mixed agricultural lots comprise the remaining northern boundary. In contrast, most of the land to the south of the river has undergone development, primarily for residential use; but includes the Hilo Medical Center campus and the undeveloped Wailuku River State Park, located roughly 1 mile upriver from the Wainaku Street Bridge.

Mean annual rainfall within the study area is approximately 4303.5 millimeters, with most of the rainfall occurring during the winter months (Giambelluca et al. 2013). The climate is relatively cool, with a mean annual temperature ranging from 72 to 77 degrees Fahrenheit (Web Soil Survey 2017).

Figure 1. Study area location plotted on USGS 2013 Hilo and Pi‘ihonua quadrangles.

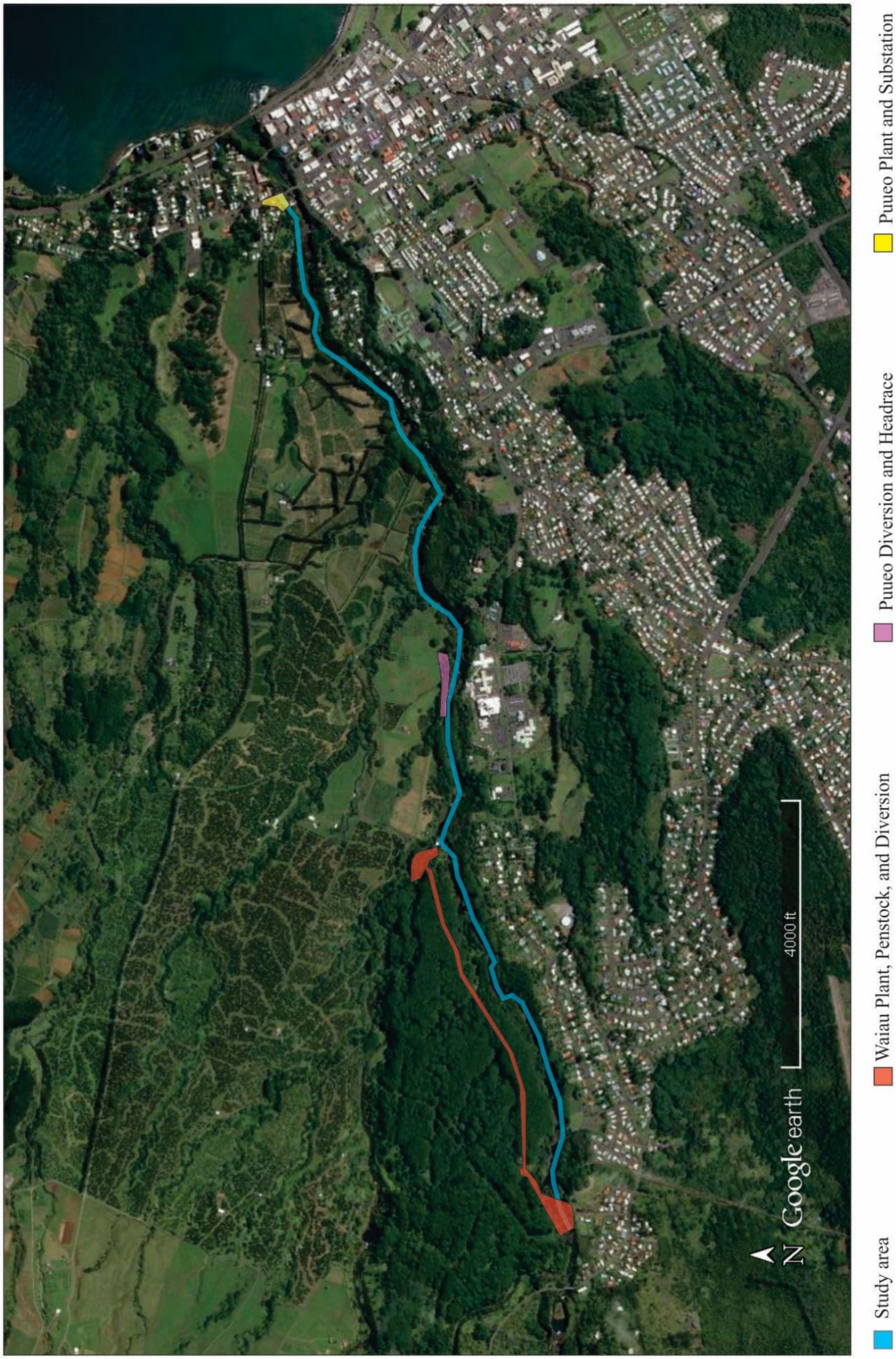

Figure 2. Satellite image showing location of study area and HEL hydroelectric facilities.

2. BACKGROUND

This section of the report includes a discussion of the cultural-historical background for the study area as well as a synthesis of relevant prior research. This information is presented in order to provide a comprehensive understanding of the significance of the area and to establish an analytical basis for the assessment of any potential cultural impacts.

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 summary of Historic events in the Hawaiian Islands after the arrival of foreigners. The discussion continues with a collection of legendary and historical references to Piʻihonua and Puʻuʻeo *ahupuaʻa*, the Wailuku River, and the greater Hilo District. This summary includes oral traditions and first-hand Historic accounts recorded by visitors and missionaries related to the Wailuku River and beyond. Land use practices in the study area vicinity are also presented, including commercial sugar cultivation as well as the development of the railroad and electricity in Hilo.

A Generalized Model of Hawaiian Prehistory

While the question of the timing of the first settlement of Hawaiʻi 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). The three most popular theories place the first settlement at around A.D. 300, A.D. 600, and A.D. 1000, respectively. 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 Hawaiʻi is believed to have occurred from the southern Marquesas Islands (Emory in Tatar 1982). In these early times, Hawaiʻi'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 (1969), 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 *ʻaumakua* 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 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 too did societal conflict, the result was hostility and war between neighboring groups (Kirch 1985). Soon, large areas of Hawaiʻi were controlled by a few powerful chiefs.

As time passed, a uniquely Hawaiian culture developed. The portable artifacts found in archaeological sites of this period reflect not only an evolution of the traditional tools but some distinctly Hawaiian inventions. The adze (*koʻi*) evolved from the typical Polynesian variations of a plano-convex, trapezoidal, and reverse-triangular cross-section to a very standard Hawaiian rectangular quadrangular tanged adze. A few areas in Hawaiʻi produced quality basalt for adze production. Mauna Kea, on the island of Hawaiʻi, possessed a well-known adze quarry. The two-piece fishhook and the octopus-lure breadloaf sinker are Hawaiian inventions of this period, as are *ʻulu 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 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. Additional migrations to Hawaiʻi 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 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), adding 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 seventeenth 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 and spent time in Hilo during the Precontact Period (Cordy 1994).

History 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 arrival 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 (Kirch 1985; Kent 1983). Religious practices associated with the god Kū were at their peaks, although western influence was already altering the cultural fabric of the Islands (Kirch 1985; Kent 1983). By 1796, with the aid of foreign weapons and advisors, Kamehameha conquered all of the island kingdoms except Kauaʻi and the foreign concept of trade for profit initiated the beginnings of a market system economy in Hawaiʻi (Kent 1983). Some of the work of the commoners 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, guava, and grapes (Wilkes 1845). In 1810, when Kaumualiʻi of Kauaʻi 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 *kapu* system. In 1819 Kamehameha I died, and the succeeding *aliʻi* failed to reinstate the *kapu* system which put an end to the practices associated with this age old system in addition to creating a religious void. Shortly after their arrival in 1820, Christianity began to establish a firm foothold in the islands and introduced diseases and global economic forces began to have a devastating impact on traditional lifeways in the Hawaiian Islands, which marked the end of the era of uniquely Hawaiian culture.

PIʻIHONUA AND PUʻUʻEO AHUPUAʻA, THE WAILUKU RIVER, AND GREATER SOUTH HILO

The current study area is comprised of a portion of the Wailuku River as it flows between Piʻihonua and Puʻuʻeo *ahupuaʻa* in the present-day district of South Hilo, and the traditional *moku* (district) of Hilo, one of six *moku* of Hawaiʻi Island. As described by Handy et al.:

> Hilo as a major division of Hawaiʻi included the southeastern part of the windward coast most of which was in Hamakua, to the north of Hilo Bay. This, the northern portion, had many scattered settlements above streams running between high, forested kula lands, now planted with sugar cane. From Hilo Bay southeastward to Puna the shore and inland are rather barren and there were few settlements. The population of Hilo was anciently as now concentrated mostly around and out from Hilo Bay, which is still the island's principal port. The Hilo Bay region is one of lush tropical verdure and beauty, owing to the prevalence of nightly showers and moist warmth which prevail under the northeasterly trade winds into which it faces. Owing to the latter it is also subject to violent oceanic storms and has many times in its history suffered semidevastation from tidal waves unleashed by earthquake action in the Aleutian area of the Pacific. (1991:538)

Traditionally, the *moku* of Hilo was divided into three *ʻokana* (land divisions) with place names that have their origins in legendary times. The three divisions are (from north to south): Hilo Palikū, Hilo One, and Hilo Hanakahi. The location of the current study area coincides best with Hilo-pali-kū or "Hilo of the upright cliff" (Pukui et al. 1974:46), which extends north from the Wailuku River to Kaʻula Gulch (Maly and Maly 2006). In *Pele and Hiʻiaka*, Emerson recounts the following *mele* that Hiʻiaka sang while journeying between Hilo and Puna through the forest territory of the *moʻo* Panaʻewa, which mentions the study area vicinity:

Pau ke aho i ke kahawai lau o Hilo:	One's strength is exhausted, climbing, climbing
He lau ka puʻu, he mano ka ihoʻna;	The countless valleys and ridges of Hilo,—
He mano na kahawai o Kulaʻi-po;	The streams without number of Ku-laʻi-po,
He wai Honoliʻi, he pali o Kama-eʻe,	The mighty water of Hono-liʻi
	The precipice walls of Kama-eʻe
He pali no Koolau ka Hilo-pali-ku;	And the pali of Koʻolau:
	Such a land is Hilo-pali-ku.
He pali Wailuku, he one ke hele ia;	The banks of Wailuku are walls;
	The road to its crossing but sand;
He one e keʻehia la i Wai-olama.	Sandy the way at Wai-o-lama. (1993:32-33)

Kepā and Onaona Maly provide additional information pertaining to the ancient land division of Hilo Palikū in the following translation of an excerpt from a legendary account called "*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki"* ("The Heart Stirring Story of Ka-Miki"). This legend was originally published in Hilo's Hawaiian Language newspaper *Ka Hōku o Hawaiʻi*:

> Of Hilo Paliku it is said, one becomes short of breath traveling through Hilo, for there are many (400) hills, many (4,000) areas to descend, and many (40,000) streams, indeed while swimming through the waters of Hilo one becomes out of breath, but one is never out of water at Hilo! (Maly and Maly 2006:13)

The other two ancient land divisions are located to the south of the current study area. Hilo-one, or sandy Hilo, extends along the shoreline of Hilo Bay between the Wailoa and Wailuku rivers (Edith Kanakaʻole Foundation 2012); while Hilo Hanakahi, "Hilo, [land of] chief Hanakahi" (Pukui and Elbert 1986:129), extends from the Wailoa River to include Keaukaha.

During Prehistory, the lands of Hilo were further divided into *ahupuaʻa* that today retain their original names (Kelly et al. 1981). These include the subject *ahupuaʻa* of Piʻihonua and Puʻuʻeo in addition to Punahoa, Ponahawai, Kūkūau, and Waiākea (Figure 3). Of the Hilo *ahupuaʻa*, only Piʻihonua and Waiākea provided access to the full range of resources stretching *mauka* from the sea up to 6,000 feet along the slopes of Mauna Kea. Thus, the western extreme of Puʻuʻeo is truncated by Piʻihonua and does not extend *mauka* into the forested uplands (see Figure 3). Another land division that is relevant to the current study area is the *ahupuaʻa* of Humuʻula, which is the site of the headwaters of the Wailuku River. Humuʻula cuts off all of the Hilo district *ahupuaʻa* at elevations between 6,000 to 7,000 feet (see

Figure 3). Humu‘ula extends along the northeastern face of Mauna Kea and Mauna Loa and serves as the northern boundary between Hilo and Hāmākua districts.

The abundant marine resources of Hilo Bay, extensive spring-fed fishponds and waterfowl, and wetland and dryland agricultural resources sustained the population of the *moku* of Hilo. This rich land also served as one of Hawai‘i Island’s royal seats with chiefly residences that lasted up through the time of Princess Ruth Ke‘elikōlani in the 1870s (Kelly et. al. 1981; Cordy 2000). The names of the legendary rulers of the area were identified with the place names for several land units (both the *ahupua‘a* and their component *‘ili*) that comprise portions of the Hilo District. Many of these names survive today, but only as localities or street names; their cultural and contextual meanings are rarely if ever conveyed. One name of a legendary ruler that survives is Pi‘ihonua-a-ka-lani, brother of Waiākea-nui-kumuhonua and namesake of the *ahupua‘a* in which the current study area is located (Rechtman 2009).

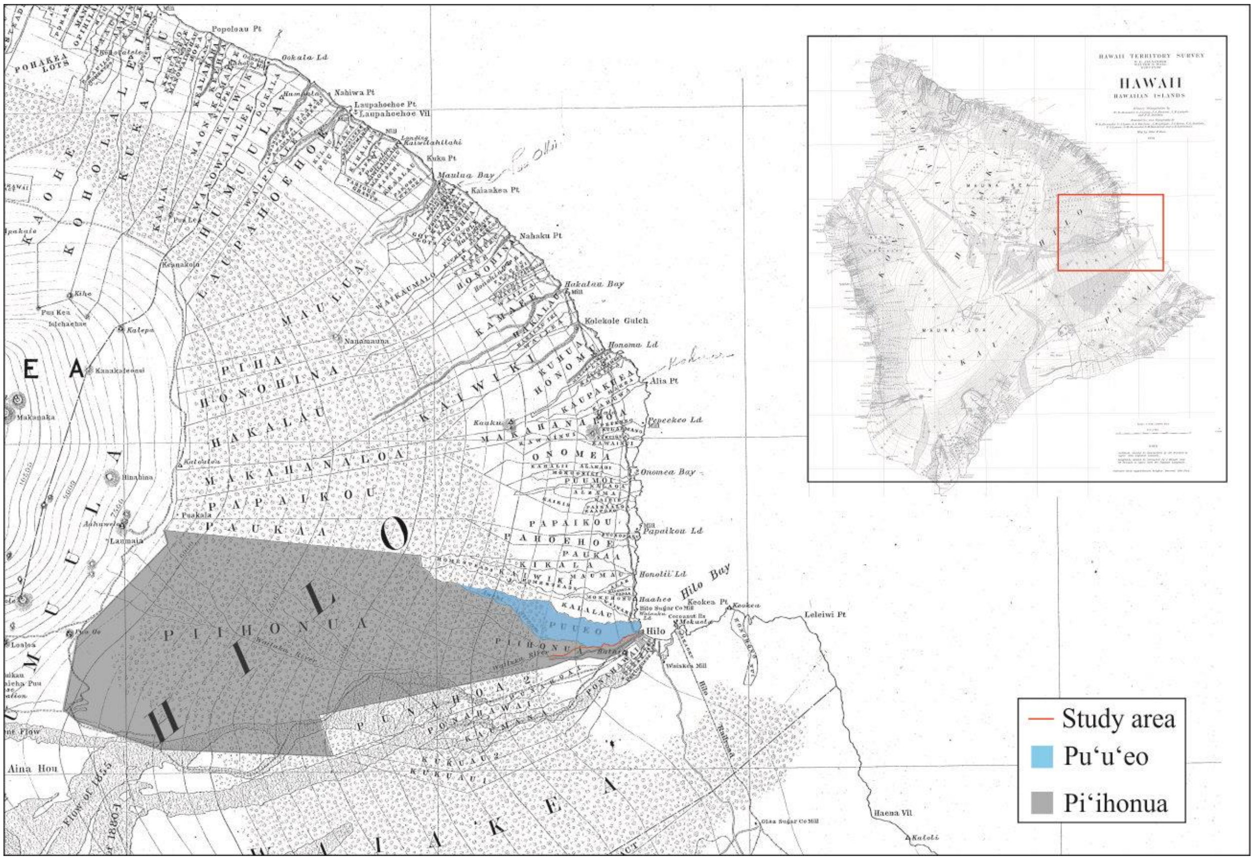

Figure 3. Portion of Hawai‘i Registered Map 2060 by J.M. Donn showing study area location, ca. 1901.

The literal translation of Pi‘ihonua is “ascending earth,” which Maly suggests might be a reference to the “slope of Pi‘ihonua rising to Mauna Kea” (1996a:A-2). According to Maly, Pi‘ihonua is named for Pi‘ihonua-a-ka-lani, the brother of Waiākea-nui-kumu-honua and their sister Pana‘ewa-nui-moku-lehua, and the father of the chiefesses ‘Ohele and Waiānuenue (ibid.:A-4). Pukui et al. provide the following literal translation of Pi‘ihonua:“land incline” (1974:184), and further qualify the place name as a Hilo “village, upland area, and ancient surfing place” (ibid.). Pi‘ihonua extends *mauka* from Hilo Bay until it reaches the large *ahupua‘a* of Humu‘ula, and is bounded to the south by Punahoa 2nd Ahupua‘a and to the north by the other subject ahupua‘a of Pu‘u‘eo. Pukui et al. define Pu‘u‘eo as an “elevated place in Hilo qd., where Kalani‘ōpu‘u built the heiau of Kanoa” (ibid.:196). Pu‘u‘eo may also mean “hill” (*pu‘u*) “full of food” (*‘eo*) referring to the bounty of agricultural resources produced on its fertile slopes (Pukui and Elbert 1986:42, 358). An alternative interpretation of the name Pu‘u‘eo as “Victory Hill,” however this would rely on the spelling of the second half of the name being “*eo*” instead of “*‘eo*” (ibid.:42).

The sometimes-raging Wailuku River, whose name can translate to “destructive water” tracks along the Pi‘ihonua/Pu‘u‘eo *ahupua‘a* boundary (Figure 4). The Wailuku River is the largest and longest river in the Hilo District with a length of 315.6 kilometers (196.1 miles) (Parham *et al*. 2008:1034). The Wailuku River is classified as a perennial stream and is the main feature of the Wailuku River watershed. The Wailuku River watershed is 653.2

square kilometers (252.2 square miles), with a maximum elevation of 4,200 meters (13,779 feet), effectively connecting it to Mauna Kea (ibid.:1033). The sheer scale of the Wailuku River and the abundance of fresh water it brings down from the upper elevations impacts the communities within North and South Hilo Districts. It is also perhaps, one of the most storied rivers in east Hawaiʻi and a vital source of *wai* or fresh water, which is not only necessary for survival but also carries cultural significance for the Hawaiian people.

The word *wai* is a component of several other words associated with water such as *kahawai* (river, stream, creek), *punawai* (spring), *ʻauwai* (irrigation ditch), *lokowai* (fresh water pond, lake). The term *waiwai* (water-water) is used to express the idea of prosperity and wealth of an individual or a place and refers to the amount of and access to fresh water (Handy et al. 1991:57). The term *kānāwai* (law, rule, ordinance, to learn from experience) is also associated with water. The concept of *kānāwai* is said to originate from the customary practice of sharing water between neighbors especially for irrigated fields. Given that traditional irrigated fields were built along the water system, it was a customary practice for Hawaiian farmers to take only what water they needed, and to ensure those located below them had access to an ample and clean supply of water (ibid.:58). Traditionally, the use and management of fresh water were both a right and a privilege, and anyone wishing to tap into any source of fresh water was expected to abide by these long-standing decrees (Sproat 2009:3). *Wai* was not just revered for its physical importance in nourishing crops and sustaining life but also its spiritual importance.

Wai is considered a *kinolau* (physical manifestation) of the *akua* (deity) Kāne, who along with his companion Kanaloa (whose dominion was over the ocean), came to Hawaiʻi from Kahiki (land outside of Hawaiʻi). Legend has it that Kāne and Kanaloa both enjoyed consuming *ʻawa*, a drink prepared by mixing the root of the *ʻawa* plant (*Piper methysticum*) with fresh water. In their travels, they stopped at various places around the Hawaiian Islands, including Hilo and opened new fresh water springs from which they prepared their favorite drink (Handy, Handy & Pukui 1991:65). The *ʻōlelo noʻeau* (Hawaiian proverb) "*He huewai ola ke kanaka na Kāne*" literally translates as [m]an is Kāne's living water gourd," and emphasizes the relationship that Hawaiians have to fresh water, and thereby to the the deity Kāne (Pukui 1983:68). Handy et al. emphasize the spiritual relationship that Native Hawaiians had to water:

> Fresh water as a life-giver was not to the Hawaiians merely a physical element; it had a spiritual connotation. In prayers of thanks and invocations used in offering fruits of the land, and in prayers chanted when planting, and in prayers for rain, the "Water of Life of Kane" is referred to over and over again. Kane—the word means "male" and "husband"—was the embodiment of male procreative energy in fresh water, flowing on or under the earth in springs, in streams and rivers, and falling as rain (and also as sunshine), which gives life to plants. (1991:64)

Wai was not only valued for its life-giving properties, but also its purifying properties. The continuous *mauka* to *makai* flow of *wai* provided fresh drinking water, supplied water to irrigated fields, and fishponds, recharged ground water supplies, and sustained productive estuaries and fisheries by transporting nutrients from the uplands to the sea (Sproat 2009). Because a flowing river was considered a vital artery for both the land and man, great care was paid to maintaining clean rivers. To that end, domestic duties involving the use of water were dispersed along the length of the river. For instance, "there was a place for bathing (*ʻauʻau*) low down in the stream; a place up farther along the stream for washing utensils or soaking calabashes; still farther up were dams for *ʻauwai*; and above the dams was the place where drinking water was taken" (Handy et al 1983:61). Because of the high degree of dependency on *wai* to furnish and satisfy life's needs, *wai* was a public trust resource that was considered inalienable. Handy et al. continue thusly,

> Inalienable title to water rights in relation to land use is a conception that has no place in old Hawaiian thinking…[w]ater, whether for irrigation, for drinking, or other domestic purposes, was something that "belonged" to Kane-i-ka-wai-ola (Procreator-in-the-water-of-life)… The *aliʻi nui*, in old Hawaiian thinking and practice, did not exercise personal dominion, but channeled dominion. In other words, he was a trustee. (ibid.:63)

The introduction of western law during the reign of Kamehameha III (1825-1854), and the subsequent land privatization movement known as the *Māhele ʻĀina* set in motion new *kānāwai* (laws) that gave rise to the notion of private ownership of the land and its resources. Sproat (2009) notes that although the concept of water as a public trust carried over into the Kingdom of Hawaiʻi laws, many newcomers were unaware or failed to respect the customary practices resulting in a number of water disputes. This conflict was amplified as sugar and later pineapple plantations began diverting water to furnish their fields, thus resulting in the loss of water for farmers using the traditional method of irrigated taro cultivation (ibid.). *Wai* was and remains a treasured resource. However, the history of water use in many parts of Hawaiʻi remains contentious and unresolved.

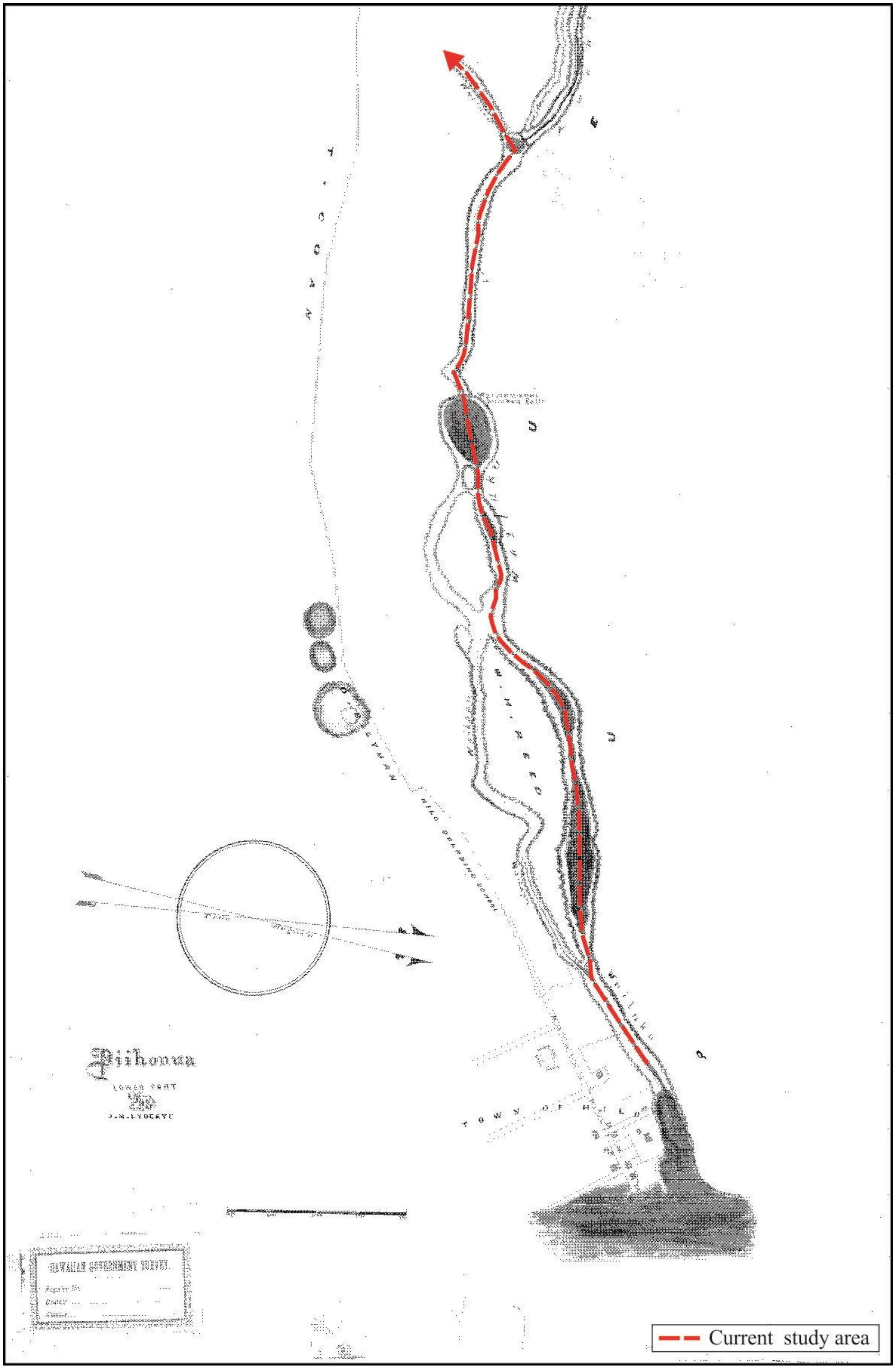

Figure 4. Portion of Registered Map 525 (n.d.) of Pi‘ihonua by J.M. Lydgate showing the study area location.

Legendary accounts

As the Hawaiian people had no written language throughout the Precontact Period, traditional *mo'olelo* (stories, tales, and myths) and *'ōlelo no'eau* (proverbs and sayings) were passed down orally from one generation to the next. Legendary sources indicate that Hilo was, among other things, renowned for its rain and fertility and that its inhabitants were experts in *hula*, fighting, and other traditional competitions including running, fishing, debating, and solving riddles. In addition, many legends associated with the Wailuku River and the greater project area vicinity feature humans, goddesses, and demi-gods interacting with *mo'o* (guardians of fresh water with reptilian features). According to Kamakau, the *mo'o* most commonly referred to in Hawaiian folklore differ from the typical house or rock lizard. Kamakau notes that the bodies of mythical *mo'o* were "extremely long and terrifying" (1964:82) and they were often seen near or in bodies of fresh water and even in certain fishponds. In legendary accounts, *mo'o* are often depicted as fearsome and meddlesome, while in other accounts they are portrayed as friendly and even helpful (Beckwith 1970). In *The Epic Tale of Hi'iakaikapoliopel*e, Hi'iaka, the heroine of the journey slays numerous malevolent *mo'o* (Ho'oulumāhiehie 2006). Nonetheless, their association with fresh water contributes to a better understanding of the cultural significance of Hawai'i's waterways.

'Ōlelo No'eau of Hilo

The oral tradition of Hawai'i is perhaps best preserved in *'ōlelo no'eau*, which have been passed down throughout the generations. Many *'ōlelo no'eau* speak of Hilo and most mention the region's abundant water and agricultural prosperity. The following proverbs illustrate Hilo in great detail, and appear below as they were interpreted and published in *'Ōlelo No'eau, Hawaiian Proverbs & Poetical Sayings* by Mary Kawena Pukui:

> *'Au umauma o Hilo i ka wai.*
> Hilo has breasted the water.
> To weather the storm. The district of Hilo had many gulches and streams and was difficult to cross. (1983:28)
>
> *Halulu me he kapua'i kanaka la ka ua o Hilo*
> The rain of Hilo makes a rumbling sound like the treading of feet. (ibid.:53)
> *Hilo 'ai lū'au.*
>
> Hilo, eater of taro greens.
> The people of Hilo were said to be fond of cooked taro greens. When storms came to Hilo, it was impossible to obtain fish from the streams or the sea. The people had to be content with taro greens. (ibid.:107)
>
> *Hilo 'āina ua lokuloku.*
> Hilo of the pouring rain. (ibid.)
>
> *Hilo i ka ua Kani-Lehua.*
> Hilo of the Kanilehua rain.
> The Kanilehua rain, or the rain that patters in the *lehua* forest, is frequently referred to in the chants and songs of Hilo. (ibid.:168)
>
> *Hilo iki, pali 'ele'ele.*
> Little Hilo of the dark cliffs.
> Hilo-pali-ku, or Hilo-of-the-standing-cliffs, is always green because of the rain and mists. (ibid.:107)
>
> *Hilo mahi ha'aheo.*
> Hilo of the proud farmers.
> The climate makes the soil of Hilo very easy to till, so the farmers used to make a game of planting. They used long digging sticks to make the holes and wore *lei* to work. Working in unison, they made a handsome picture. (ibid.)
>
> *Hilo, mai Mawae a ka pali o Maulua.*
> Hilo, from Mawae to the cliff of Maulua.
> The extent of the Hilo district is from Mawae on the Puna side to Maulua on the Hāmākua side. (ibid.:108)

Hilo, nahele paoa i ke ʻala.
Hilo, where the forest is imbued with fragrance.
Hilo's forest is fragrant with *hala* and *lehua* blossoms. (ibid.)

Hilo paʻele ku.
Hilo is dark all over. (ibid.)

Ka ua lei māʻohu o Waiānuenue.
The rain of Waiānuenue that is like a wreath of mist.
Wai-ānuenue (Rainbow-water) in Hilo, Hawaiʻi, is now known as Rainbow Falls. On sunny days a rainbow can be seen in the falls, and on rainy days the rising vapor is suggestive of a wreath of mist. (ibid.:170)

Kau i ka lani ka holowaʻa ua o Hilo.
Placed high in heaven is the rain trough of Hilo.
An expression of admiration for a person of regal bearing. (ibid.:173)

Ka ua heʻe nehu o Hilo.
The *nehu*-producing rain of Hilo.
The people knew the season when the schools of *nehu* fish followed the rain. (ibid.:167)

Ku pāpū Hilo i ka ua.
Hilo stands directly in the path of the rain. (ibid.:207)

Leʻa ka ʻai a ka ʻiola, ua nui ka ʻili.
The rats joyously eat their fill, there are many skins [remaining].
There were two Hilo brothers who lived at Kukuau and Puʻueo. The latter was very prosperous but neglectful of his needy brother. One day the Kukuau man decided to visit his wealthy brother and found many friends eating. After watching them for a while he made this remark. It was overheard by someone who reported it to their host. When he came to see who it was he found that it was his own brother. Sadly he realized then how he had neglected his own kin while outsiders enjoyed his wealth. This saying is sometimes used for one who does for outsiders but neglects his own. (ibid.:212).

Luʻuluʻu Hanakahi i ka ua nui.
Weighted down is Hanakahi by the heavy rain.
Hanakahi, Hilo, was named for a chief of ancient times. This expression was much used in dirges to express heaviness of the heart, as tears pour like rain. (ibid.:219)

"Māmā Hilo?" "ʻAe, māmā Hilo i ka wai ʻole."
"Is Hilo light?" "Yes, Hilo is light for lack of water."
A question asked of a runner, and his reply. It means that the way is clear, with no robbers or unpleasant experiences, and no rains to swell the streams and make traveling difficult. (ibid.:232)

Noho maialile ka ua o Hilo, ʻelua wale no māua.
Keep your silence, O rain of Hilo, there are only two of us.
Uttered by Kanuha in retort when rebuked by the Reverend Titus Coan for Sabbath-breaking: "Hold your silence, for there are only two of us in authority" – meaning Kanuha and Governor Kuakini. Rev. Coan was not to give orders when either was present. Now it is used to mean, "Keep quiet. You're not the boss around here." (ibid.:253)

Pau kea ho i ke kahawai lau o Hilo.
One's strength is exhausted in crossing the many streams of Hilo.
Said of or by one who is weary with effort. First uttered by Hiʻiaka in a chant when she found herself weary after a battle with the lizard god Panaʻewa. (ibid.:287)

Pā mai, pā mai ka makani o Hilo; waiho aku i ka ipu iki, hō ma ii ka ipu nui.
Blow, blow, O winds of Hilo, put away the small containers and give us the large one.
Laʻamaomao, the god of wind, was said to have a wind container called Ipu-a-Laʻamaomao. When one desires more wind to make the surf roll high, or a kite sail aloft, he makes this appeal. (ibid.:285)

Pāuli hiwa ka lani o Hilo.
Black with rainclouds is the sky of Hilo.
Sometimes said in humor when a dark-skinned person is seen. (ibid.:287)

Pō Hilo i ka ua Kanilehua.
Hilo is darkened by the Kanilehua rain.
Said of one who is weighted by sorrow and grief. (ibid.:293)

The following three *ʻōlelo noʻeau* of Hilo refer specifically to the Wailuku River, Piʻihonua and Puʻuʻeo:

Ka ua hehi ʻulu o Piʻihonua.
The rain that treads on the breadfruit leaves of Piʻihonua.
Refers to Piʻihonua. (ibid.:167)

Ka wai lumalumai kanaka o Wailuku
The water of Wailuku where men were drowned.
Refers to Wailuku, Hilo, where victims were drowned to be offered in sacrifice at a nearby *heiau*. (ibid.:179)

Piha ʻōpala ke one o Haʻakua.
The sand of Haʻakua is filled with rubbish.
Said of one who is untidy, or who talks nonsense. Haʻakua is under the Puʻueo end of the railroad bridge that spans the Wailuku River in Hilo, Hawaiʻi. (ibid.:289)

Moʻolelo of South Hilo and the Wailuku River

Traditional *moʻolelo* associated with the beautiful *wahi pana* (legendary places) of South Hilo abound. Many of these are tales of heroism involving some of Hawaiʻi's most well-known legendary characters, including Hina and her son Māui who made their home in a cave behind the curtain of water known as Waiānuenue or Rainbow Falls in the Wailuku River (Figure 5), located within the current study area behind the Hilo Medical Center.

Figure 5. Historical photo of Rainbow Falls, C.J. Hedemann Collection (Lang 2007:115).

The namesake of the subject *ahupuaʻa*, chief Piʻihonua appears in the aforementioned *moʻolelo* "*Kaʻao Hoʻoniua Puʻuwai no Ka-Miki"* ("the Heart Stirring Story of Ka-Miki"), which was published in a series of articles between 1914 and 1917. The Hawaiian text of these newspaper articles was translated by Kepā Maly in 1992 and 1993. One thread of this narrative focuses on two supernatural brothers, Ka-Miki (the adept one) and Maka-ʻiole (rat eyes) who circumnavigated Hawaiʻi Island on foot along the *alaloa* and *alahele* (trails and paths) during the 1300s. The relevant portion of the story that highlights the competitive nature of the Hilo chiefs as well as the connections between legendary characters and specific places in the District of Hilo is reproduced as it appears in a report by Maly (1996b). Many of the names of these legendary figures, such as Panaʻewa and Piʻihonua, are still preserved in the place names encountered throughout Hilo today. The excerpt begins with the main characters' arrival in Hilo:

> . . . Ka-Miki, Maka-ʻiole and their companion Keahialaka departed from the compound of Kapuʻeuhi (in ʻŌlaʻa) and descended the *ala loa* towards Hilo to continue their journey. The travelers arrived at a large compound and community, where they saw a man coming towards them with a club. This man was Kūkulu-a-hāne-pū (Kūkulu). Kūkulu was a guardian of the chiefess and lands called Panaʻewa-nui-moku-lehua (Great Panaʻewa of the *lehua* forest). Panaʻewa was a sacred chiefess of Hilo, the sister of the chiefs Waiākea and Piʻihonua.
>
> The chiefess' compound and surrounding community were forbidden to strangers, and Kūkulu regularly killed unaware travelers (thus the name "Unjust place"). Kūkulu challenged Ka-Miki *mā* but he was quickly defeated, and Ka-Miki left him there as an example to other *ʻōlohe* and to receive his due justice. Ka-Miki *mā* then continued their journey into Hilo, seeking out ʻŪpēloa, Kuʻu-aho-hilo-loa, and Haili-kula-manu.
>
> The lands of Waiākea were named for the high chief Waiākea-nui-kumuhonua, the brother of Piʻihonua-a-ka-lani (k) [*kane*:male] and Panaʻewa-nui-moku-lehua (w) [*wahine*:female]. After departing from Panaʻewa, Ka-Miki *mā* met Haili-kula-manu, who was a guardian of Waiākea. Haili led Ka-Miki and his companions to his chief's compound at Kalepolepo. Arrangements were made for Ka-Miki to compete with the *ʻōlohe* – experts of Waiākea, with the event to be held at the *kahua* (contest site) at Kalepolepo. ʻŪpēloa the champion – land administrator and war councilor of Waiākea, and an expert fighter with *ʻŌkaʻa a lāʻau* (war clubs) was called to Kalepolepo. (Maly 1996b:11-12)

Crowds soon gathered in Kalepolepo to observe the *ʻōkaʻa lāʻau* (war club fighting) competition, the loser of which "would be killed and baked in an *imu*" (ibid.:12). Ka-Miki defeated ʻŪpēloa with his bare hands. He was then challenged to fight Kalanakāmaʻa, the best student of Kaūmana "the foremost teacher of *lua, ha ʻihaʻi, kākā lāʻau* (bone breaking fighting, and spear fighting), and all manner of fighting" (ibid.:13). Ka-Miki swiftly bested him as well. The legend continues with mentions of chief Piʻihonua, the namesake of the subject *ahupuaʻa* as well as chief Hanakāhi, after which the aforementioned *ʻokana* of Hilo was named. The legend continues,

> Ka-Miki then attacked Kalanakāmaʻa and quickly over came him, Kaūmana then leapt to the *kahua* and was beaten as well. After Ka-Miki defeated Kaūmana, word spread throughout the region, and Piʻihonua, Waiākea's brother called his council together wondering how they might help regain the honor of Hilo from this stranger.
>
> Hanakāhi told Piʻihonua that it would be best not to fight, Piʻihonua then said that perhaps it had been a mistake to honor Hanakāhi with his title as champion, and marriage to ʻOhele. Hanakāhi told Piʻihonua all of the things that *Nā-Mauʻu-a-Pāʻao* had told Piʻikea about Ka-Miki, and said it would be unwise to compete, and thus leave all of the champions of Hilo in disgrace.
>
> Hanakāhi himself was a master *ʻōlohe* trained by Maulua of Hilo-Palikū, he was skilled in *kākālāʻau* (spear fencing), *pololū* (long spear fighting), *ihe laumeki* (barbed spear fighting), and all manner of knowledge. Hanakāhi told his chief, "It is my desire to go before them (Ka-Miki *mā),* not in the manner of a competitor, but in the spirit of friendship, and to learn from them the things which they have been taught by their teachers. If I succeed, I will be the foremost *ʻōlohe* of all Hilo, and I will serve as their guide as they journey from one border of Hilo to the next border of Hilo." Hanakāhi then asked his chief, "Do you agree?" Piʻihonua told Hanakāhi to go and compete first, then if he was securely bound to surrender and ask for friendship.
>
> Hanakāhi approached Kalepolepo, and the contest between Ka-Miki and himself was announced. *ʻŌkaʻa .lāʻau* (club-spear fighting) was selected as the method of fighting, and when Hanakāhi

> asked Ka-Miki, “How shall the victory be determined?” Ka-Miki said, “By the breaking of one’s spear.”
>
> Ka-Miki greatly admired the nature of Hilo-Hanakāhi, and as they competed, Ka-Miki dodged each of the thrusts. To those gathered at the *kahua,* it was as if Ka-Miki was the teacher and Hilo-Hanakāhi was the student. Hilo-Hanakāhi tried each technique he had learned from his teacher, but was unable to score against Ka-Miki. Worn out, Hilo-Hanakāhi collapsed and was taken off of the *kahua,* borne in a net. Hilo-Hanakāhi acknowledged the nature and skills of Ka-Miki and surrendered to him, thus *ke ‘ahi kananā* (the fierce tuna fish) of Hilo befriended Ka-Miki *mā* upon the *kahua*.
>
> Hilo-Hanakahi returned to the chief Pi‘ihonua and they spoke of the events which had taken place at Kalepolepo. Pi‘ihonua then sent his messenger to invite Ka-Miki *mā* to his compound in the manner of *aikāne* (companions). Ka-Miki *mā* were well hosted by Pi‘ihonua, and Ka-Miki asked Hilo-Hanakāhi to accompany them to the border of Hilo and Hāmākua at Ka‘ula. Thus Hilo-Hanakāhi traveled with Ka-Miki *mā* through out the rest of Hilo. (ibid.:14)

The following legend tells the story of the Naha Stone, which currently resides in front of the Hilo Library on Waiānuenue Avenue in Pi‘ihonua Ahupua‘a. This legendary stone is directly linked to King Kamehameha and the unification of the Hawaiian Islands under his rule. In the early 1900s, the ancient legend of the Naha stone was published by the Board of Trade of Hilo as a pamphlet under the title *The Story of the Naha Stone*; and in 1952, the Hawai‘i Natural History Association (now Hawai‘i Pacific Parks Association) reprinted it as part of their *Hawaii Nature Notes* series. The story was originally recorded in Hawaiian by Reverend Stephen Desha of Hilo, editor of the *Hoku o Hawaii* newspaper, and adapted by Lionel W. de Vis-Norton for publication. The story is reproduced here as it appears in the original undated publication:

> For many, many years, there lay, in the back garden of a house in Hilo, Hawaii, a great four-sided obelisk of lava stone. For so long, indeed, had it lain there, that this present generation has well-nigh forgotten its existence. The ever-present rank growth of the lantana had covered it, and its resting place bid fair to remain undisturbed forever. . .
>
> Just how, and why the great obelisk first became famous, is veiled in the mystery of past days, for the first authentic record of it deals with its voyage from the far away island of Kauai. Here it had rested hard by the Wailuku [Wailua] river on that island, but was placed upon a double canoe by the high chief Makaliinuikualawalea, and by him brought to the river of the same name in Hawaii the Beautiful, and there was placed in front of the temple Pinao, of which but one single stone now remains, and the site of which is the back-garden with which our story opens.
>
> It is said that the Naha Stone had the peculiar property of being able to determine the legitimacy of all who claimed to be of the royal blood of the Naha family, and many times, in front of the temple of Pinao, must the strange ceremony have been enacted. . .
>
> As soon as a boy of the royal stock was born, he was brought to the Naha Stone and was laid thereon, while the kahunas prayed to the gods and chanted their strange barbaric chants. One can imagine how anxiously the parents would watch the unconscious babe, for one faint cry from those infant lips would bring upon him shame which would endure through all his lifetime, and he would be thrust out to take his place among the common people and to make his stormy way through life as best he could.
>
> But should the infant have been endowed with the golden virture of silence, then indeed a career was open to him, for he would be declared by the high kahuna to be of true Naha descent, a royal prince by right and destined to become a brave and fearless soldier and a leader of hs fellow men.
>
> . . . the Naha Stone was vested with yet more mystery, for concerning it there existed an ancient prophecy that only the chiefs of the Naha blood could violate its sanctity by moving it, and that he who moved it would become a king of the Island of Hawaii. And yet more: for the saga had come down through the past ages that he who could overturn the stone would be a king indeed, for to him should be given the power to conquer all the islands of the group and bring them under one sovereignty. (de Vis-Norton n.d.:3-4)

The legend continues by providing a history of Kamehameha’s birth, boyhood and his rise to power thus setting the stage for the story of the Naha stone’s influence on his life and the history of the Hawaiian Islands. De Vis-Norton describes the troubled times across the islands during Kamehameha’s early years and leading up to Kalani‘ōpu‘u’s reign thusly:

> And warfare and strifes spread throughout all the land of Hawaii, and for many seasons the warfare ceased not, and ever the tidings came of fierce and terrible conflicts, of chief against chief and brother opposed to brother, so that men died in their thousands and all the land was red with blood. (ibid.:5)

Meanwhile, Kamehameha resided in Hilo, where he became "stronger in manhood and greater of stature, so that his fame began to spread abroad, even as far as Kohala, where Kalaniʻōpuʻu had taken up his abode" (ibid.). As a result, the legend continues, Kalaniʻōpuʻu invited Kamehameha to Kohala. Shortly after Kamehameha's arrival, prince Kaiokuanuiakanaele spoke of "rumors and strange whispers" about Kamehameha that had been circulating and requested that the king "gather together the kahunas and the priestesses that they may examine into his future and tell us the things that shall come unto him" (ibid.:6). Kalaniʻōpuʻu granted his request and "the priests took counsel together, and communed with their gods," and made the following statement:

> . . . "Great shall he be and mighty; a warrior above all warriors. None shall stand before him, neither may any dare to meet him in combat. Behold we do pronounce him dedicated to the stormy winds, and as a stormy wind shall he live, sweeping all before him, for none may stand in his path."
>
> And having said these things, the kahunas were silent. (ibid.:6-7).

Kalaniʻōpuʻu then asked the priestesses for their counsel and, as a group, they agreed with the *kahuna*. However, the high princess Kalaniwahine set herself off from the rest and made the following pronouncement:

> "Hearken ye unto these words and mark them well, for they are words of wisdom. The young Kamehameha will have but one adversary who will sorely try his strength, and the strength of his men learned in the throwing of spears, for surely will Keaweokahikona try them to the uttermost. And now behold, these twain are of one blood, wherefore it is fitting for Kamehameha to go and visit his relative, that they may learn and understand and dwell together as brothers. Also there is a deed for Kamehameha to do, even the overthrowing of a mountain. And now is the time propitious for these things, therefore let him hasten and tarry not, lest he be too late for the meeting." (ibid.)

Shortly thereafter, Kamehameha, Kalaniwahine and two high chiefs Naihe and Kalaninuimakolukolu made the journey by canoe to Hilo where they were welcomed by princess Ululani. While feasting with Ululani, Kamehameha said, "I have come to try and move the Naha Stone, for by that symbol I shall attain success and live, or shall meet that which will bare my bones" (ibid.:9). The next day, Kamehameha, Ululani, the Hilo chiefs, and Kalaniwahine journeyed to the Naha Stone at the *heiau* of Pinao. Ululani spoke thusly while on their journey:

> "O, Prince, thou knowest, perchance, that this stone is sacred to those of the Naha family, and they are the only persons who may ascend it and move it. Now thou, dear Prince, belongest not to the royal family of Naha, but to the royal family of Niu-pio, and it may be that this will hinder thee in the moving of the stone."
>
> But Kamehameha answered never a word, and presently they were come to the temple of Pinao, in front of which the Naha Stone lay. And Kamehameha came and stood by the stone, and when he had seen its great size, he uttered a heavy sigh, and spake these words:
>
> "Now do I perceive that this is indeed no stone, but a mountain, and perchance I may not be able to move it. Moreover, it is said that only they of the royal Naha line may essay the task. Howbeit, I will put forth my strength, and if I fail, then it can be truly said that this stone belongs to the Naha line by law, and if I succeed, then by my strength and favor of the gods my success will be attained."
>
> . . . Kalaniwahine, taking hold of his hands, spake encouraging words unto him and said unto him:
>
> "If indeed the Naha Stone shall be this day moved by thee, then shall the whole group of islands, from Hawaii to Kauai be moved, but if indeed it shall be moved and turned from its resting place, then shall all dissensions be removed, and thou and thy people and thy prophetess shall live and shall dwell henceforth in peace forever. For this is the prophecy of the Naha Stone, O Prince, so get thee to thy great task."
>
> . . . he placed his hands under the stone and began to move them so that he might better take hold. Which being done, he cried these words:
>
> > "Naha Stone art thou:
> >
> > And by Naha Prince only may thy sacredness be broken,

> Now behold, I am Kamehameha, a Niu-pio
>
> A spreading mist of the forest."

> Then gripped he the stone and leaned over it, and as he leaned, great strength came into him and he struggled yet more fiercely, so that the blood burst from his eyes and from the tips of his fingers, and the earth trembled with the might of his struggling, so that they who stood by believed that an earthquake came to his assistance.
>
> . . . And he put forth all his strength, and, behold, the stone did move under his arms, and he raised it on its side and with supernatural strength did over turn it, so that all who stood by were amazed and dumb with awe. (ibid.:9-10)

Afterwards, Keaweokahikona made the following declaration to Kamehameha:

> For that this day ye have done a great deed whereas all men may wonder, now do I declare unto thee that henceforth shalt thou be my chief man in battle, and to thee will I give all my art in war, and teach thee many things. Therefore, let us live together as relatives and let there ever be peace between us. . .
>
> This, then, is the story of the Naha Stone, which lies by the library in Hilo today for all to see. (ibid.:10-11)

Figure 6 is a photograph of the Naha Stone behind the old Hilo Library building reproduced from the same publication. According to an article titled "Ka Moolelo O Na-Ha Pohaku" from the Hawaiian newspaper *Hoku o Hawaii* in early 1915, the Board of Trade of Hilo began planning to move the Naha stone from its then resting place "on the Hilo side of Waianuenue Avenue. . . in front of the first house foundation of governor Kipi of Hilo," at a place "named after an old Heaiu called 'Pinao'" (*Hoku o Hawaii* December 9,1915:2). Figure 7 shows the stone in its present-day position in front of the current Hilo Library building, which opened in 1951, and is located on the north side of Waianuenue Avenue in Piʻihonua Ahupuaʻa. De Vis-Norton concluded his version of the tale of the Naha Stone thusly:

> . . . The fulfillment of the prophecy concerning the Naha Stone attracted all the high chiefs and the greatest warriors to Kamehameha's standard, and this, in conjunction with the immunity from harm and the apparent favor with which the young Prince was regarded by the gods, caused him to embark upon the long series of conquests which made him King of all the group of the islands, and made his name revered for justice and equity and high statesmanship among all who have learned to know and love the Hawaiian race. (ibid.:10-11)

An upright stone believed to be part of the entrance pillar of Pinao Heiau is displayed beside the Naha stone in both Figures 6 and 7, and still, rests in front of the Hilo Library (ibid.:11). The so-called Pinao stone is said to be the only stone that remains from the former Pinao Heiau, which was located at or near the site of the Hilo Public Library at the corner of Waiānuenue Avenue and Ululani Street (Stokes and Dye 1991). The word *pinao* translates literally as "dragonfly" (Pukui and Elbert 1986:331).

Piʻihonua and Puʻuʻeo are briefly mentioned by John Papa ʻĪʻī in *Fragments of Hawaiian History* as having preferred surf spots called Huia and Pāʻula, respectively (1959:134). Kamakau also mentions Huia in an anecdote about a hunchback named Kawau published in *Tales and Traditions of the People of Old*. Kawau was "a lesser chief of olden times" who lived in Hilo and often looked at "the waves of Huia—this is the surf off Piʻihonua and Punahoa," upon his return from fishing (1991:116). The place name Pāʻula is further defined by Pukui et al. as a "small beach east of the mouth of the Wai-luku River" and "Queen Liliʻu-o-ka-lani planted seaweed here" (1974:181). In his book *Hawaiian Surfing: Traditions from the Past*, John Clark provides the following mentions of Pāʻula found in Hawaiian language newspapers:

> *Ke hoi nei ko Kaipalaoa keiki ua hai ka nalu o Paula.* (*Ke Au Okoa*, June 12, 1865:4)
>
> Kaipalaoa's son is going home. The waves of Pāʻula have broken.
>
> *Mai ka nalu nehe i ka ililii o Paula.* (*Ko Hawaii Pae Aina*, April 12, 1879:4)
>
> From the waves that rustle the pebbles at Pāʻula.
>
> (Clark 2011:110-111)

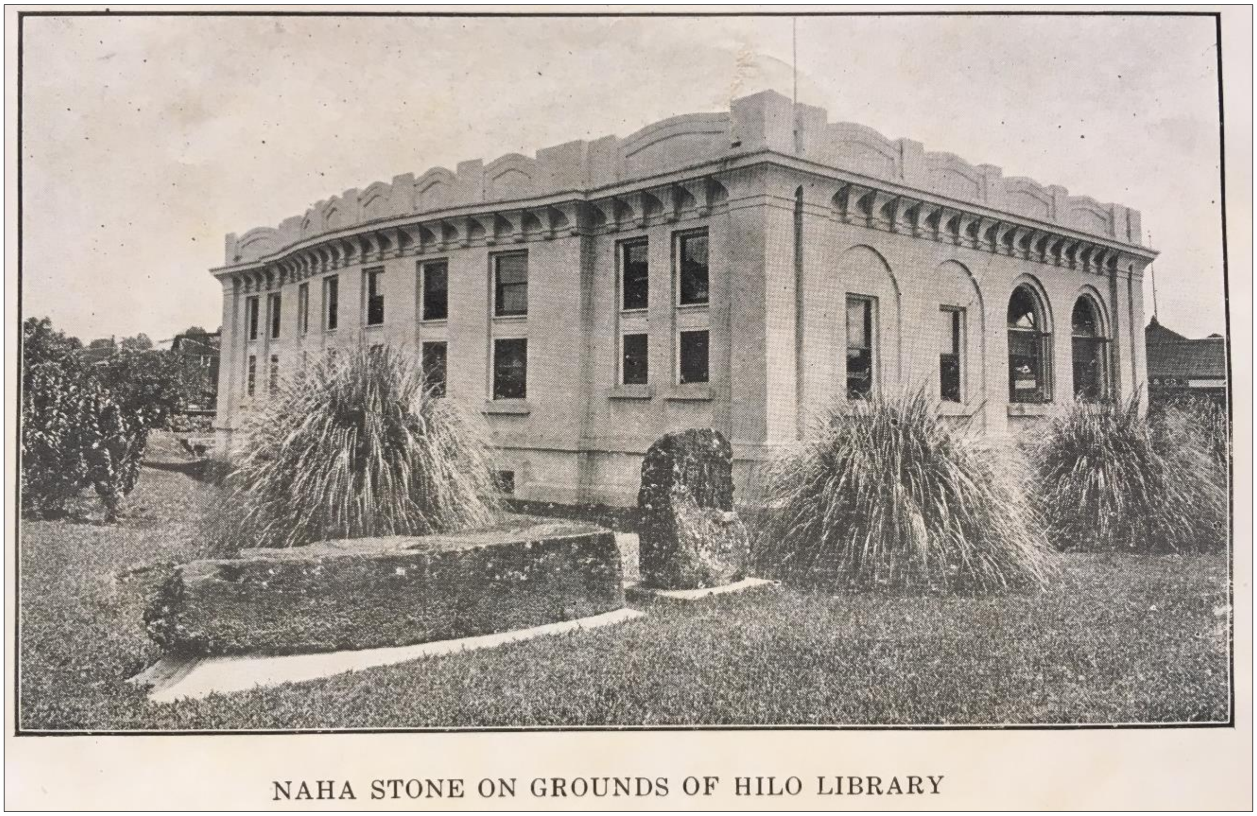

Figure 6. Historical photograph of Naha and Pinao Stones from de Vis-Norton (n.d.:2) prior to 1951.

Figure 7. Recent photograph showing location of Naha and Pinao Stones since 1951.

Kaipalaoa, as mentioned in the first quote, refers to "an ancient surfing area" as well as "land at foot of Waiānuenue Street" where "Kamehameha I often visited" (Pukui et al. 1974:70). In addition, a *heiau* of the same name was once located near here; and upon his birth, Liholiho "was taken to the heiau Kaipalaoa, and the sacred right of the cutting of his navel cord was performed by the kahuna" (Kamakau 1991:220). Kamakau also mentions Kaipalaoa as the site of a battle between Kamehameha and the Maui chief Namakeha who resided on Hawai'i and refused to join Kamehameha in his conquest of the islands: "In September of 1796, Kamehameha returned to Hawaii to make war on Na-makeha and his followers" (ibid.:174) in response to Namakeha's attempt to mount a rebellion by preparing the men of Hilo, Puna, and Ka'ū for war against him. Namakeha fled and hid until January of 1797, when "with the consent of Kamehameha, he was offered as a sacrifice to the gods in the heiau of Kaipalaoa in Pi'ihonua, Hilo" (ibid.). According to Kamakau, the battle of Kaipalaoa was the last battle fought by Kamehameha in his effort to unite all the islands under his rule.

The *mo'olelo* pertaining to South Hilo also include many legends that refer to the Wailuku River specifically. According to Charlotte Hapai, author of *Legends of the Wailuku*, Wailuku means "destroying water," and many of the legends associated with the river "confirm the belief that it was named for its violent habits" (1920:5); such as taking lives and damaging property when the waters overflowed its banks. One such tale titled "Kuna, the Dragon" (ibid.:14-16), tells of a fearsome dragon *kupua* (demigod) who sought to drown the famed moon goddess Hina, who dwelled within the cave hidden behind the crashing sheet of water at Waiānuenue or more commonly known as Rainbow Falls. This legend also mentions a "Mauka Bridge" across the river and explains the origin of two rock formations: KaWa'a o Māui and Lonokaeho in the Wailuku River. The legend is reproduced here, in its entirety:

> Far above Rainbow falls there lived a powerful kupua named Kuna. Kuna had the form of a monstrous dragon, unlike anything in these islands today.
>
> Kuna often tormented the goddess Hina in her rocky cave behind Rainbow Falls by sending over great torrents of water or by rolling logs and boulders down the stream. Quite often he would block the stream below the falls with sediment sent down by freshets during the rainy seasons.
>
> But Hina was well protected. Her cave was large and the misty cloud of spray from the falling waters helped to conceal it. So in spite of the frequent floods and many threats from Kuna, Hina paid him not the slightest attention, but with her songs and gay laughter lightly mocked him as she worked.
>
> On many days Hina was quite alone, while her eldest son, the demi-god Maui, was away on one of his numerous expeditions. Even then she did not mind this for should any danger befall her she had a peculiar cloud servant which she called "ao-opua." If Hina were in trouble this ao-opua would rise high above the falls, taking an unusual shape. When Maui saw this warning cloud he would hurry home at once to his mother's side.
>
> One night while Maui was away from home on the Island of Maui, where he had gone to bargain with the Sun, a storm arose. The angry waters roared about the mouth of Hina's cave. They hissed and tossed in ugly blackness down the narrow river gorge; but Hina heard naught of the wildness without. Being used to the noisy cataract, her slumbers were not disturbed by the heightened tumult of its roar.
>
> But Kuna, quite aware of the situation, was quick to take advantage and to act. Hina's apparent indifference annoyed him. He recalled several failures to conquer her, and rage overwhelmed him. Calling upon his powers he lifted an immense boulder and hurled it over the cliffs. It fitted perfectly where it fell between the walls of the gorge and blocked the rush of the hurrying torrent.
>
> Laughing loudly at his success, Kuna called on Hina and warned her of her plight, but still unknowing, Hina slept on until the cold waters entered the cave, rapidly creeping higher and higher until they reached her where she slept. Startled into wakefulness she sprang to her feet, and her cries of panic resounded against the distant hills. As the waters rose higher her cries became more terrified until they reached the Island of Maui and the ears of her son.
>
> Through the darkness Maui could see the strange warning cloud, unusually large and mysterious. With his mother's cries ringing in his ears he bounded down the mountain to his canoe, which he sent across the sea to the mouth of the Wailuku with two strong sweeps of his paddle. The long, narrow rock in the river below the Mauka Bridge, called Ka Waa o Maui (The Canoe of Maui), is still just where he ran it aground at the foot of the rapids.

> Seizing his magic club with which he had conquered the Sun, Maui rushed to the scene of danger. Seeing the rock blocking the river he raised his club and struck it a mighty blow. Nothing could resist the magic club! The rock split in two, allowing the strong current to rush unhindered on its way.
>
> Hearing the crash of the club and realizing his attempt on the life of Hina had again failed, Kuna turned and fled up the river.
>
> The remains of the great boulder, now known as Lonokaeho, overgrown with tropical plants and with the river rushing through the rift, lies there to this day as proof of Maui's prowess. (Hapai 1920:14-16)

Hina's son Māui is perhaps best known as the trickster *kupua* who snared the sun at Haleakalā on Maui, convincing it to circle slower so that his mother may have sufficient time to dry her *kapa*. However, he appears frequently in *mo'olelo* of the Wailuku River, where he made his home with Hina in the cave behind Waiānuenue (Rainbow Falls), located within the current study area. In the legend titled "Maui's Fishook" published in the same volume by Hapai (ibid.:34-37), after a failed attempt at joining together the Hawaiian Islands, Māui grew frustrated with his uncharmed fishhook and discarded it by throwing it into the forest near Waiānuenue (Rainbow Falls). According to the legend, it remained where it landed, untouched until foreigners came to Hawai'i and dismantled it:

> To those early settlers the magic fishhook of Maui was of less interest as such than as material for masonry, and not a piece of it remains. At the forks of the Piihonua-Kaumana Road [likely refers to the area where Waianuenue Avenue crosses the river, *mauka* of Boiling Pots] one may, however, see the peculiar shaped depression where it lay for so long, before civilization's vanguard swept the tangled jungle of Maui's time from its hiding place. (ibid.:37)

Another *mo'olelo* about Māui mentions the Wailuku River in the context of his fascination with the beloved ancient Hawaiian pastime of kite-flying. Titled "Maui's Kite-Flying" as published in *Legends of Ma-ui* by Westervelt (1910:112-118), this legend tells of the giant enchanted kite Māui made for himself, which "was much larger than any house of his time or generation" (ibid.:114). Māui fashioned it from strong fibers of the native *olonā* plant and Hina's *kapa* and, "endowed both kite and string with marvelous powers" (ibid.); however, when he launched the kite, it failed to take flight for the winds did not hold it aloft. As a result, Māui sought out Kaleiioku, the elderly priest of Waipi'o "who had charge of the winds," which he kept hidden inside a calabash "when he did not wish them to play on land and sea" (ibid.:115). According to Westervelt, Kaleiioku's calabash "was known as ipu-makani-a ka maumau, 'the calabash of the perpetual winds'" (ibid.) and Māui called for the priest to release the winds, asking the priest to:

> open his calabash and let the winds come up to Hilo and blow along the Wailuku river on the side of which Maui stood. The natives say that the place where Maui stood was marked by the pressure of his feet in the lava rocks of the river bank as he braced himself to hold the kite against the increasing force of the winds which pushed it towards the sky. (ibid.)

Perhaps the depression in the rocks left by Māui's feet along the riverbank is the same depression that Hapai (1920) attributed to Māui's fishhook at Piihonua Road and Kaumana Road (present-day Waianuenue Avenue) in the legend "Maui's Fishook," mentioned above. "Maui's Kite-Flying" legend, as told by Westervelt, continues as follows:

> Then the enthusiasm of kite flying filled his youthful soul and he cried aloud screaming his challenge along the coast of the sea toward Waipio—
>
> "O winds, winds of Waipio.
> In the calabash of Kaleiioku.
> Come from the ipu-makani.
> O wind, the wind of Hilo.
> Come quickly, come with power."
>
> Then the priest lifted the cover of the calabash of the winds and let the strong winds of Hilo escape. Along the sea coast they rushed until as they entered Hilo bay they heard the voice of Maui calling—
>
> "O winds, winds of Hilo,
> Hasten and come to me."
>
> With a tumultuous rush the strong winds turned toward the mountains. They forced their way along the gorges and palisades of the Wailuku river. They leaped into the heavens, making a fierce attack upon the monster which Maui had sent into the sky. The kite struggled as it was pushed upward by the hands of the fierce winds, but Maui rejoiced. His heart was uplifted by the joy of the conflict in

> which his strength to hold was pitted against the power of the winds to tear away. And again he shouted toward the sea—
>
> “O winds, the winds of Hilo.
> Come to the mountains, come.”
>
> The winds which had been stirring up storms on the face of the waters came inland. They dashed against Maui. They climbed the heights of the skies until they fell with full violence against their mighty foe hanging in the heavens. (ibid.:115-116)

The legend continues with Māui calling for still stronger winds testing the strength of his homemade kite, “until the kite was far above the mountains. At last, it broke and the kite was tossed over the craters of the volcanoes to the land of the district of Ka-u on the other side of the island” (ibid.:117). Māui then set off to retrieve his kite, crossing the mountains in only a few strides, and when he returned, “he was more careful in calling the winds to aid him in his sport” (ibid.). The legend ends with the following anecdote about how Māui’s kite flying was linked to fair weather and mentions the Wailuku River again, as follows:

> The people watched their wise neighbor and soon learned that the kite could be a great blessing to them. When it was soaring in the sky there was always dry and pleasant weather. It was a day for great rejoicing. They could spread out their kapa cloth to dry as long as the kite was in the sky. They could carry out their necessary work without fear of the rain. Therefore when any one [*sic*] saw the kite beginning to float along the mountain side [*sic*] he would call out joyfully, “E! Maui’s kite is in the heavens.” Maui would send his kite into the blue sky and then tie the line to the great black stones in the bed of the Wailuku river. (ibid.:117-118)

In the conclusion of this legend Westervelt also reports his version of the final resting place for Māui’s fishhook and his double canoe, which differ from Hapai’s version presented earlier in this discussion:

> Time passed and even the demi-god died. The fish hook with which he drew the Hawaiian Islands up from the depths of the sea was allowed to lie on the lava by the Wailuku river until it became a part of the stone. The double canoe was carried far inland and then permitted to petrify by the river side. The two stones which represent the double canoe now bear the name “Waa-Kauhi,” and the kite has fallen from the sky far up on the mountain side, where it still rests, a flat plot of rich land between Mauna Kea and Mauna Loa. (ibid.:118)

Wa‘a-Kauhi is also mentioned in the valuable reference book *Place Names of Hawaii* (Pukui et al. 1974). The following sentence is found listed under Wai-luku: “A rock here called Wa‘a-Kauhi (canoe [of] Kauhi [a Maui chief]) is said to be the petrified canoe of the demigod Māui” (1974:225). Thus, the listing corroborates the origin of the rock formation as presented in Westervelt’s version of Māui’s Kite legend above, for both references bear the same name. However, another listing in *Place Names* under “Ka-wa‘a-o-Māui” reads thusly: “Double rock lying in Hilo Bay said to be Māui’s magic canoe” (ibid.:97), which Pukui et al. attributed to Westervelt’s *Legends of Maui*. Indeed, Westervelt mentions Ka Wa’a o Maui in his version of the aforementioned legend in which Kuna tries to drown Hina, which he published under the title “Hina and the Wailuku River” as follows:

> . . . he [Māui] crossed the sea to the mouth of the Wailuku river. Here even to the present day lies a long double rock, surrounded by the waters of the bay, which the natives call Ka waa o Maui, “the canoe of Maui.” It represents to Hawaiian thought the magic canoe with which Maui always sailed overt the ocean more swiftly than any winds could carry him. (1910:151).

Thus, it appears that Westervelt attributes two distinct rock formations to Māui, Ka Wa‘a o Māui in Hilo Bay and Wa‘a Kauhi located further *mauka*, along the side of the Wailuku River (Figure 8).

Figure 8. 2014 photograph of Waʻa Kauhi (long groove along embankment) and Nā Mauʻu a Pāʻao (large rock outcrop) in the foreground.

This next *moʻolelo* titled "The Coming of Paoa [Pāʻao]" (Hapai 1920:20-24) also mentions Waʻa Kauhi. However, in this tale, Pāʻao a powerful god from Tahiti, chose the low rock near the mouth of the Wailuku as his new home after he fled Tahiti in search of peace following the sacrifice of his only son. Traveling across the Pacific Ocean in his canoe, Pāʻoa brought only three things with him: *aku* and *ʻōpelu* fish, and *pili* grass. Pāʻao's journey was interrupted by a bout of dreadful weather which threatened his safety. In an effort of placation, Pāʻao tossed his *aku* and *ʻōpelu* overboard. Almost immediately, the weather cleared and Pāʻoa called out to his helpful fish to come back to his canoe. He was able to safely continue his voyage across the vast sea until he encountered a beautiful place, the island of Hawaiʻi:

> At last Paoa [Pāʻao]came to an island which appeared very large and was covered with vegetation. Paddling his canoe into a great crescent-shaped bay, he observed a river emptying into it and turned the nose of his tiny craft that way. Not far up the river he came to a long, low rock which he called Waa Kauhi, and landed on the southeastern side of its point.
>
> So great was the joy of Paoa upon reaching this beautiful island that he decided to make it his home. To commemorate his safe landing he at once planted on the rock the pili grass he had brought with him. Also he liberated his aku and opelu fish in the new waters, where today their progeny teem in countless millions.
>
> Very soon he built himself a grass hut for a home, and was careful to protect the pili grass, which grew rapidly and before long spread to other parts of the big island, where it throve even better than on the scant soil of the pahoehoe rock.
>
> Hawaiians soon learned to use the pili grass in house building, as it made a tighter thatch and lasted longer than the lauhala or the grasses to which they had been accustomed. The stems of the flowers were later used in weaving hats, as they, too, were firm and strong.
>
> Farther up the river, which Paoa learned was called the Wailuku, there lived the goddess Hina. Soon after the arrival of this stranger from Tahiti, Hina heard of him and his chosen home. Evidently he had not come to wage war or do harm to the people, for he had already made friends with many of the fishermen living near him.

> So Hina decided to see him for herself and went down to his home. She was surprised that he had really established himself on that low rock.
>
> "Why," she exclaimed, "you must not stay on this rock! Can't you see the waters above here are high? When the rain comes you will be washed away and drowned. It is not safe!"
>
> Paoa stood upon the little plot of pili grass as he answered her. "No, I will not go away, for no matter how high the waters come they shall never cover this spot."
>
> From that day Paoa's word has held true. No matter how high the Wailuku rises, it never has covered the little plot of pili grass which still grows on the long, low rock at the river's mouth. (1920:22-24)

Figure 8 depicts the area known as Nā Mauʻu a Pāʻao, which translates as "the grasses of Pāʻao," and is said to be the area where the priest Pāʻao set up his residence.

Regarding Māui's final defeat of Kuna, Westervelt recounts the following details, including references to earthquakes, Peʻepeʻe (Boiling Pots) (Figure 9), and other geologic features within the Wailuku River. The following excerpts are taken from "Hina and the Wailuku River" (Westervelt 1910:146-154), and follow Māui's successful rescue of Hina by damming the river:

> . . . Maui rushed up the river to punish Kuna-mo-o for the trouble he had caused Hina. When he came to the place where the dragon was hidden under deep waters, he took his magic spear and thrust it through the dirt and lava rocks along one side of the river, making a long hole, through which the waters rushed, revealing Kuna-mo-o's hiding place. This place of the spear thrust is known among the Hawaiians as Ka puka a Maui, "the door made by Maui." It is also known as "the natural bridge of the Wailuku River."
>
> Kuna-mo-o fled to his different hiding places, but Maui broke up the river bed and drove the dragon out from every one, following him from place to place as he fled down the river. Apparently this is a legendary account of earthquakes. At last Kuna-mo-o found what seemed to be a safe hiding place in a series of deep pools, but Maui poured a lava flow into the river. He threw red-hot burning stones into the water until the pools were boiling and the steam was rising in clouds. . . The waters of the pools are no longer scalding, but they have never lost the tumbling, tossing, foaming, boiling swirl which Maui gave to them when he threw into them the red-hot stones with which he hoped to destroy Kuna, and they are known to-day as "The Boiling Pots." [see Figure 9]
>
> Some versions of the legend say that Maui poured boiling water in the river and sent it in swift pursuit of Kuna, driving him from point to point and scalding his life out of him. Others say that Maui chased the dragon, striking him again and again with his consecrated weapons, following Kuna down from falls to falls until he came to the place where Hina dwelt. Then, feeling that there was little use in flight, Kuna battled with Maui. . . He was forced over the falls into the stream below. . . the swift waters swept him against the dam with which he had hoped to destroy Hina; and when the whirling waves caught him and dashed him through the new channel made by Maui's magic club, they rejoiced. . . Maui had rushed along the bank of the river with tremendous strides overtaking the dragon as he was rolled over and over among the small waterfalls near the mouth of the river. Here Maui again attacked Kuna, at last beating the life out of his body. "Moo-Kuna" was the name given by the Hawaiians to the dragon. . . Moo Kuna is the name sometimes given to a long black stone lying like an island in the waters between the small falls of the river. Ads one who calls attention to this legendary black stone says: "As if he were not dead enough already, every big freshet in the stream beats him and pounds him and drowns him over and over as he would have drowned Hina." (ibid.:151-153)

Two other storied rock formations Papa-kāhulihuli and Kāluakanaka are also associated with the Wailuku River. Papa-kāhulihuli (swaying rock) is defined by Pukui et al. as:

> A stone in the Wai-luku River, Hilo, that tipped when stepped upon, dropping the stepper into a pit (Ka-lua-kanaka, the human pit) where he died unless he found the opening that led underground to Moku-ola (Coconut Island). (1974:179)

The same volume references Kālua-kanaka as a "balancing stone in the Wai-luku River at Hilo, Hawaiʻi; it was believed connected by a tunnel to Coconut Island, and that persons falling over the stone into the stream would drown. . . *Lit.*, oven-baking man" (1974:78). Ka Lua-kanala is also mentioned in the following *mele* of the *hula paʻi umauma* as recorded by Emerson:

A Hilo ai e, hoolulu ka lehua;	At Hilo I rendezvoused with the lehua;
A Wai-luku la, i ka Lua-kanaka[b];	By the Wailuku stream, near the robber-den. . .

[b] *Lua-kanaka*. a deep and dangerous crossing at the Wailuku river, which is said to have been the cause of death by drowning of very many. Another story is that it was once the hiding place of robbers. (1909:203)

Figure 9. Historic photo of Boiling pots, C.J. Hedemann Collection (Lang 2007:108).

In addition to the legendary rock formations presented above, two *pōhaku hānau*, or birth stones, are located near the Wailuku River. According to June Gutmanis (1986), *pōhaku hānau* are of particular importance to Hawaiians because these stones were associated with either male or female energy, thus allowing them to procreate, and birth more stones. The stories shared by Gutmanis were originally collected by Theodore Kelsey who spoke to Hawaiian informants in 1919. Gutmanis writes:

> Along the Hilo shoreline and along the Wailuku River are at least two of these stone "families." One is that of a chief of the Puueo area who mated with Namaka, a chiefly woman of Piihonua. Tradition has it that some of their children were rocks, some were eels, and others were sea creatures of various kinds.
>
> Along the Wailuku River, in the area called Waimalino by Reeds Island, are two stone "brothers" What family they belong to is no longer known. The older brother is called Konanuhea and the younger is called Mu. They are said to have had two other brothers. One was a *kupua* (being with supernatural power) who could take the form of an ʻanuhe (caterpillar) or a chief. When in the form of a chief, however, he retained a tail like a caterpillar. The other brother whose name was Mano, is at Waianuenue or "Rainbow Falls". He too was a *kupua* and could take the form of a turtle, *ʻaha* fish or eel. (ibid.:29)

In addition to the *pōhaku hānau* of Konanuhea and Mu, Gutmanis (1986) also notes the story of Kana, a supernatural being who with the aid of his grandmother took various forms including rope, banana, *pōhuehue* (*Ipomoea pes-capre*), spider, and finally he is eternalized as a stone located in the Wailuku River. In her book, *Hawaiian* Mythology, Martha Beckwith (1970) also gathered several accounts for the legend of Kana. However, none of the accounts mentioned by Beckwith relate the legend of Kana to the Wailuku River. Nonetheless, Gutmanis' version states:

> The most famous stone "family" in the area is that of Kana and [his wife] Pohaku Hanau. Little is known of the mother or her background—even her true name remains unknown. Today she is called Pohaku Hanau or "Reproducing Stone." She maybe found at Kuipaa in the Kapehu branch of the Wailuku River. It is said that Kana, the father was not always a rock; he was born as a rope that could stretch. His unusual ability to stretch distances led to many adventures and the stories of his exploits are used to explain many strange markings or rock outcrops found on all the Hawaiian islands (ibid.:29-30).
>
> One of Kana's most famous adventures occurred when his mother, Hina, was kidnapped from Hilo by a Molokai chief [Kapeʻepeʻekauila], who carried her away on the back of a turtle. With a brother [Niheu], Kana tried to rescue Hina but lost a fight with her guards. Next, he challenged the turtle to a stretching contest. When Kana lost that contest his grandmother was brough to Molokai to help him in more stretching contest. First she turned him into a rope, then a pōhuehue (morning glory vine), then a banana, and finally a spider so large that it stretched from Molokai to Hilo. While he was stretched out as a spider, Kana's brother grabbed Hina and rushed her back to Hilo.
>
> Tradition does not say why or when Kana was turned into a rock or whether his children were born as rocks. His stone body can be found in the Wailuku River in the main gulch between Pukao [Puka o] Maui and Kapaukea (1986:30).

Gutmanis also conveys another story of a family of stones located at various points along the Wailuku River. These stones are said to be the other children of Kana and his wife Pohaku Hanau. She writes:

> Along the shore on the Puueo side of the Wailuku River mouth, below the old railroad bridge, is a daughter, Puao, and a son, Haakua. A nearby sister was lost when the bridge was built. Named Ohuwai, she was believed to care for the aborted material from miscarriages until that material matured and swam away as sharks. Pieces of umbilical cord were also left in her care.
>
> On the upper side of the main bridge over the Wailuku River is a stone brother named Ahuawa. It was believed that he made the waves of the harbor swell. When standing by that rock looking upstream on the left bank of the river, the stone Kawaakauhia [Ka waa Kauhi a] Maui, "The-ahi-fishing-canoe-of Maui," can be seen.
>
> The last two stone sons born to Kana and Pohaku Hanau lie just above Death Falls [Make Fall- located upstream of the Wainaku Stree bridge]. They are Huakuaikai and Huakuaiuka. They divide the river water that flows to the two falls. There are some who say that there is still another son further up the river beyond Puu ʻOʻo Ranch. His name is Papakolea. (ibid.:31-32)

The Wailuku River also appears in another legend associated with Hiʻiakikapolepole, Pele's favorite sister who journeyed throughout the islands in search of her sister's lover Lohiʻau. According to the version of the legend published in *Hawaiʻi Island Legends* under the title "How Hawaiʻi Was Made Safe" by Pukui and Curtis (1996:29-41), as Hiʻiaka's party approached Hilo, they stopped to ask if they were going the right way:

> "Yes, follow that trail," the old people answered. "Soon you will come to the Wailuku River. Two logs make a bridge over the river. But do not cross until you have made offering to the gods who guard the bridge." (ibid.:39)

The old couple informed Hiʻiaka that the two logs belonged to two gods and that when they wanted to cross, they left vegetables or fish on the logs to appease the gods and ensure their safe passage. However, Hiʻiaka traveled without food; thus, the old couple warned "Then do not try to cross, for the gods will turn these logs beneath your feet and you will fall into the raging river. You will be dashed to death upon the rocks" (ibid.). Once they arrived at the crossing, Hiʻiaka refused to give the so-called gods any food and in front of a gathering crowd challenged them thusly:

> "I'll show you they are no gods!" shouted Hiʻiaka as she whirled her pāʻū. The people saw two frightened figures rushing away to hide in a cave far up the river. Hiʻiaka followed them and the

two dashed out to find another hiding place. The pāʻū of the goddess flashed and the figures were turned to stone.

Hiʻiaka returned to the people. "the crossing is safe," she said. (ibid.:40)

Hoʻoulumāhiehie (2006), offers another version of the story in which Hiʻiaka encounters two gamblers, named Piʻihonua and Puʻuʻeo in Hilo. Similarly, two *moʻo* named Kuāua and Piliamoʻo guard Wailuku Stream and demand offerings in exchange for safe passage over a bridge made of *ʻahakea* (*Bobea* sp.) logs. Hiʻiaka refuses the demands of the *moʻo*, and offers a supplication chant instead. Upon hearing Hiʻiaka's chant, Piliamoʻo dashes up the river embankments and shoots her tongue up causing the bridge to overturn. Hiʻiaka and her companions then draw upon their supernatural powers to outsmart the two *moʻo*; thus allowing them to cross the Wailuku River. The legend concludes with Hiʻaka turning the two *moʻo* to stone, thus making the Wailuku a little safer for the people to cross (2006:91-93).

The well-watered environs of Hilo are also featured in the legends concerning the romance between Halemano of Oʻahu and the beautiful and forbidden princess Kamalalawalu (Kama) of Puna. Kama lived under a strict *kapu* (taboo) that kept her from leaving her home or having visitors, and her parents had promised her as the wife of either the Hilo or the Puna King upon reaching maturity. Visions of Kama appeared to Halemano in his sleep and he fell in love with the image of her without knowing her name. Halemano's sister, Laenihi, a shape-shifting sorceress, located Kama and took him to meet Kama in person in Puna. The two lovers recognized one another from their dreams and were soon married and living simply and happily. Then, driven by jealousy, the kings of Puna and Hilo decided to make war on Halemano's people and the couple was forced to flee to Maui, where Kama realized that she missed her former life as a princess and did not wish to remain a farmer's wife there. Kama left Halemano for the king of Puna, but realizing her mistake, she soon left the king and chose to wander the islands alone. To win his wife back, Halemano trained as a master chanter, assuming that she might return to him if he became something more than a farmer. Once he had learned the art of chant, he entered a competition where Kama was among the audience gathered to hear the performance. Halemano took the opportunity to compose a chant about the life they had shared together in Hilo. Halemano's chant is taken from the version of this romance published under the title "The Story of Ha-le-ma-no" in *Legends of Hawaii* by Padraic Colum (1937:123-132), and mentions Hilo, the Wailuku River, and Piʻihonua (emphasis added):

"We once lived in Hilo, in our own home,
For we had suffered in the home that was not ours,
For I had but one friend, myself.
The streams of Hilo are innumerable,
The high cliff was the home where we lived.
Alas, my love of the lehua blossom of Moku-pa-ne!
The lehua blossoms that were braided with the hala blossoms,
For our love for one another was all that we had.
The rain fell only at Le-lewi,
As it came creeping over the hala trees at Po-mai-kai,
At the place where I was punished through love.
Alas, O my love!
My love from the leaping cliffs of Pi-i-kea;
<u>From the waters of Wai-lu-ku where the people are carried under,</u>
<u>Which we had to go through to get to the many cliffs of Hilo</u>,
Those solemn cliffs that are bare of people,
Peopled by you and me alone, my love,
You, my own love!" (ibid.:131)

To which Kama responded in her own chant thusly:

"Alas, thou art my bosom companion, my love!
My companion of the cold watery home of Hilo.

> I am from Hilo,
>
> From <u>the rain that pelts the leaves of the breadfruit of Pi-i-honua</u>. . .
>
> Alas, O companion, my love!
>
> My love of the cold, watery home of Hilo,
>
> The friendless home where you and I lived." (ibid.:131-132)

Thus, Halemano and Kama were reunited and remained together.

Historical Accounts of Hilo

Early written accounts, such as those presented in the following pages, describe an unwooded plain above Hilo extending to about 1,500 feet, or the forest line. This open parkland with occasional, widely spaced homes, neat gardens and small clusters of trees characterized early Hilo. From at least Kamehameha I's time (late 1700s-early 1800s), a foot trail known as the *alaloa* (main road) extended from above the cliffs of Hāmākua to, and along the shore of, Hilo Bay and linked the communities along the way. The same plantings as at the coast continued upland, with the addition of greater amounts of dryland *kalo* and bananas. *Kipikipi* (irrigated *kalo* fields) and fishponds sat along the Waiōlama and Wailoa streams near coastal homes, and between Waiākea Pond and the Pana'ewa forest stood stands of *kukui*, *hala*, and mountain apple (Cordy 2000).

With respect to early Historic land use, the current study area falls within the lower reaches of the Upland Agricultural Zone (Zone II), the second of five zones of Hawaiian land use and settlement for the Hilo region (Coastal Settlement, Upland Agricultural, Lower Forest, Rainforest, and Sub-alpine) as proposed by McEldowney (1979) based on a review of historical accounts. This Upland Agricultural Zone extended between three and six miles behind Hilo town, from roughly half a mile inland to 1,500 feet in elevation. According to McEldowney, land use patterns were generally uniform in Hilo and consisted of the following:

> . . . more concentrated settlements on gulch or valley floors near the coast and of widely spaced plantations and huts scattered across "unwooded," gentle slope up to 2,000 ft elevation (Ellis 1963:349; Macrae 1922:48-49; Menzies 1920:51). It has been suggested that steep cliffs, the small number of protected bays, and the frequently rough ocean limited fishing opportunities, thus explaining the relatively low population of the area (Ellis 1963:351). (1979:14)

The early 1800s heralded a new era in the Hilo Bay area that was marked by numerous rapid changes. During the first two decades of the nineteenth century, sandalwood was harvested and shipped from Hilo Bay and whaling ships were a common sight as they stopped at Hilo for supplies. In 1823, British missionary William Ellis and other members of the American Board of Commissioners for Foreign Missions (ABCFM) toured the island of Hawai'i seeking out communities in which to establish church centers for the growing Calvinist mission (Ellis 1917). Ellis estimated that at the time of his visit, about 2,000 people lived in 400 houses or huts along the coastline at Hilo Bay (ibid.). Ellis described the residential and land use practices he observed while in the Hilo ("Hiro") District, which is applicable to the study area vicinity, thusly:

> *Hiro*, which we had now left, though not so extensive and populous as Kona, is the most fertile and interesting division on the island.
>
> The coast from Waiakea to this place is bold and steep, and intersected by numerous valleys or ravines; many of these are apparently formed by the streams from the mountains, which flow through them into the sea. The rocks along the coast are volcanic, generally a brown vesicular lava. In the sides and bottoms of some of the ravines, they were occasionally of very hard compact lava, or a kind of basalt.
>
> This part of the island, from the district of Waiakea to the northern point, appears to have remained many years undisturbed by volcanic eruptions. The habitations of the natives generally appear in clusters at the opening of the valleys, or scattered over the face of the high land. The soil is fertile, and herbage abundant.
>
> The lofty Mouna-Kea, rising about the centre of this division, forms a conspicuous object in every view that can be taken of it. The base of the mountain on this side is covered with woods, which occasionally extend within five or six miles of the shore. . . rain is frequent in this and the adjoining division of Hamakua, which forms the centre of the windward coast, and is doubtless the source of their abundant fertility. The climate is warm. Our thermometer was usually 71° at sun-rise; 74° at noon; and 72° or 73° at sun-set. Notwithstanding these natural advantages, the inhabitants, excepting

> at Waiakea, did not appear better supplied with the necessaries of life than those of Kona, or the more barren parts of Hawaiʻi. They had better houses, plenty of vegetables, some dogs, and a few hogs, but hardly any fish, a principle article of food with the natives in general. (ibid.:263-264)

Another missionary named Hiram Bingham I spent over twenty years in the Hawaiian Islands and wrote a memoir in 1847, which recounted his experiences as well as those reported to him by his colleagues. Bingham tells of the establishment of a new mission station in Hilo during early 1824. Mr. and Mrs. Ruggles and Mr. and Mrs. Goodrich left Kauaʻi for Hawaiʻi to establish “the new station at Waiakea, central for the large districts of Hilo and Puna, which extend along the seaboard about eighty miles” (1848:206). During their initial journey to Hilo, the party lodged in a *hālau waʻa* (canoe house) they described as follows:

> . . . they anchored in Hilo bay about sun-set, and landed before dark with a few necessary articles. They at once prepared their lodging in a large thatched building, seventy feet by thirty, designed as a shelter for canoes, timber, and other articles, and, by order of the chiefs at Oahu, appropriated to their use. It was without floor, partitions, or windows; and though the canoes were removed, a large pile of long timber still occupied the central part of the building, near the rude posts that supported the ridge-pole. . .
>
> The next day, the duties of preaching and public worship engaged their attention. To favor this Kaahumanu had offered the use of another building of similar structure. It was well filled by the people and missionary company, to whom Mr. Ellis preached. (Bingham 1848:207)

In June of 1825, an American Protestant missionary by the name of Charles Samuel Stewart visited Hilo. Stewart depicted Hilo as a well-populated residence for natives and missionaries alike:

> . . .The reef runs in a curved direction from the point at the channel, about half a mile to the east, where it joins a romantic little islet covered with cocoanut trees; from that fact, called “Cocoanut island.” A small channel runs between this and the main land, which is low, and sweeps round to the western cliffs in a beautifully curved sandy beach of about two miles, making the form of the bay that of a flattened horseshoe. The beach is covered with varied vegetation, and ornamented by clumps and single trees of lofty cocoanut, among which the habitations of the natives are seen, not in a village, but scattered everywhere among the plantations, like farm houses in a thickly inhabited country. The mission houses were pointed out to us, pleasantly situated near the water, about the middle of the curvature forming the head of the bay. At a very short distance from the beach, bread-fruit trees were seen in heavy groves, in every direction, intersected with the pandanus and kukui, or candle-tree, the hibiscus and the acacia, &c. The tops of these rising gradually one above another, as the country gently ascends towards the mountains in the interior, presented for twenty or thirty miles in the southeast a delightful forest scene, totally different in extent from anything I had before witnessed on the islands. (1828:287)

On July 21, 1835, another Protestant missionary named Titus Coan and his wife made landfall in Hilo, where they were to be stationed. Coan recorded observations he made of the Hilo landscape and the homes of other missionaries such as Goodrich and Lyman, thusly:

> . . .on the 21st we saw the emerald beauty of Hilo, and disembarked with joy and thanksgiving. Hundreds of laughing natives thronged the beach, seized our hands, gave us the hearty “*Aloha*” and followed us up to the house of our good friends, Mr. and Mrs. Lyman, who were with us to comfort and inform us all the way.
>
> The bay of Hilo is a beautiful, spacious, and safe harbor. The outline of its beach is a crescent like the moon in her first quarter. The beach is composed of fine, volcanic sand, mixed with a little coral and earth. On its eastern and western sides, and in its center, it is divided by three streams of pure water; it has a deep channel about half a mile wide, near the western shore, sufficiently deep to admit the largest ship that floats. Seaward it is protected by a lava reef one mile from the shore. This reef was formed by a lateral stream of lava, sent out at right angles from a broad river of molten rocks that formed our eastern coast. This reef is a grand barrier against the swell of the ocean. Lord Byron, who visited Hilo, when he brought home the corpses of King Liholiho and his queen [in 1825], gave the name of “Byron’s Bay” to this harbor, but that name is nearly obsolete.
>
> The beach was once beautifully adorned with the cocoa palm, whose lofty plumes waved and rustled and glittered in the fresh sea-breeze. Beyond our quiet bay the broad, blue ocean foams or sleeps,

> with a surface sometimes shining like molten silver, tumbling in white foam, or gently throbbing as with the pulsations of life.
>
> Inland, from the shore to the bases of the mountains, the whole landscape is “arrayed in living green,” presenting a picture of inimitable beauty, so varied in tint, so grooved with water channels, and so sparkling with limpid streams and white foaming cascades, as to charm the eye, and cause the beholder to exclaim, “This *is* a scene of surpassing loveliness.”
>
> Behind all this in the background, tower the lofty, snow-mantled mountains, Kea and Loa, out of one of which rush volcanic fires. At the first sight we were charmed with the beauty and the grandeur of the scene, and we exclaimed, “Surely the lines are fallen to us in pleasant places, and we have a goodly heritage.”
>
> . . . Hilo had then but one framed house. It was a low, two-story building in the style of a New England farm-house, built and occupied by the Rev. Joseph Goodrich, a good and faithful missionary of the A.B.C.F.M.
>
> Mr. Lyman’s home, into which we were received, was a small, stone house, with walls laid up with mud, and a thatched roof. Each family had but one room about fifteen feet square. (1882:24-26)

In 1840, Lieutenant Charles Wilkes, head of the U.S. Exploring Expedition, traveled to Hilo. His narrative provides a similar account to those written by others in earlier times, painting the Hilo settlement as a lush, verdant, and well-watered home shared by missionaries and natives:

> The scene which the island presents as viewed from the anchorage in Hilo Bay, is both novel and splendid: the shores are studded with extensive groves of cocoa-nut and bread-fruit trees, interspersed with plantations of sugar-cane; through these, numerous streams are seen hurrying to the ocean; to this succeeds a belt of some miles in width, free from woods, but clothed in verdure; beyond is a wider belt of forest, whose trees, as they rise higher and higher from the sea, change their characters from the vegetation of the tropics to that of polar regions; and above all tower the snow-capped summits of the mountains. . .
>
> Hilo is a straggling village, and is rendered almost invisible by the luxuriant growth of the sugar-cane, which the natives plant around their houses. A good road has been made through it for the extent of a mile, at one end of which the mission establishment is situated. This consists of several houses, most of which are of modern style, covered with zinc and shingles. One of them however, the residence of the Rev. Mr. Coan, was very differently built, and derived importance in our eyes, from its recalling the associations of home. It was an old-fashioned, prim, red Yankee house, with white sills and casements, and double rows of small windows. No one could mistake the birthplace of the architect, and although thirty degrees nearer the equator than the climate whence its model was drawn, I could not but think it as well adapted to its new as to its original station.
>
> The whole settlement forms a pretty cluster; the paths and roadsides are planted with pine-apples; the soil is deep and fertile, and through an excess of moisture, yields a rank vegetation.
>
> The church is of mammoth dimensions, and will, it is said, accommodate as many as seven thousand persons. It is now rapidly falling into decay, and another is in progress of erection. Many of the native houses are surrounded with bread-fruit and cocoa-nut trees, and have a fine view of the bay. (Wilkes 1845:114-115)

In 1848, the whaler *Josephine* made port in Hilo with Samuel Hill on board. After a journey to Kīlauea, Hill visited Hilo and provided the following details in the account of his journey:

> . . . and it was not until near sunset that we discovered any signs of our approach to the little port of Hilo, when we came suddenly upon a piece of meadow land, on which were feeding several head of cattle, with letters marked upon their skins, which as plainly revealed the fact of their captivity as it assured us of the near termination of our journey.
>
> In another half-hour we opened a view of Byron’s bay; after which, we crossed some further meadow land, which brought us to the village of Hilo, seated upon the bay near the shore. The place appeared to consist merely of a few scattered huts, among which it was easy to distinguish the residence of an European; and we rode immediately up to that of Mr. Pitman, to whom I had brought the letter of introduction, and from whom we now met a hearty reception, without a word of reproach for our depredation at the crater of the volcano. . .

> Byron's bay, or Waiakue Kaikuono, as it is called by the natives, comprises a spacious harbor, formed by a reef of coral rocks, of about half-a-mile in breadth, through which there is a channel three-quarters of a mile wide, with a depth of water throughout of about eleven fathoms. Hilo is a missionary station, both Protestant and Romish, and has one of the best Protestant schools in the islands. It is well situated, as well in relation to the bay upon which it is placed as to the surrounding country; and promises to become one of the most flourishing settlements in the islands. It consists, at present, of thirty or forty scattered huts, a Protestant church, a small Romish chapel, the dwellings of the missionaries, a school-house, and several houses belonging to Mr. Pitman, by whom all the proper commerce of the place is carried on. (1856:290-292)

During the mid-1800s, epidemics spread through the islands and ravaged the native population. In 1847, a measles epidemic, the same disease which caused the demise of Kamehameha II and Kamāmalu, struck in Hilo. Introduced by the American warship the *Independence*, from Mazatlan, Mexico, measles spread swiftly throughout the islands (Schmitt and Nordyke 2001). A short article printed in *The Polynesian* in 1848, describes the effect of measles, as well as other introduced diseases such as whooping cough mumps, and the flu on the native population in Hilo:

> SICKNESS.—Much sickness prevails here at the present time. The measles and whooping cough have at length made their appearance here. The whooping cough made its appearance a few weeks since, and during the last week several cases of the measles have occurred in town. By an arrival from Hilo, we learn that the measles prevail extensively among the native population at Hilo. Both the measles and whooping cough are comparatively light, and no fears need be entertained if proper care be taken. Among the native population some cases have proved fatal, owing to exposure and improper treatment. The mumps prevailed here some years since, and we understand several cases have lately occurred Pleurisy and bilious fever prevail to some extent among the native population. Several cases of influenza similar to that which occurred here in 1845 have lately occurred. (*The Polynesian* October 14, 1848:86 c.3)

Early Historical Accounts of Piʻihonua, Puʻuʻeo and the Wailuku River (1825-1846)

Portions of the historical record of Hilo also mention the Wailuku River specifically, as in the following account composed by Lord George Anson Byron (1826), commander of the *H.M.S. Blonde*, which departed London on September 28, 1824, with the bodies of King Kamehameha II and his wife Kamāmalu aboard. The royal couple had perished just six days apart due to measles. Their caskets were removed from the ship on May 11th of 1825 on the island of Oʻahu and on June 7th, departed Oʻahu for Hawaiʻi Island. Lord Byron, accompanied by Kaʻahumanu, her sister, three other lower-status chiefs, and forty other Hawaiians, toured the coast of Hawaiʻi Island until they reached Hilo on June 12, 1825. Byron's journal, emphasizes the importance of the Wailuku River as a source of fresh water for the ships of visiting sailors. In addition, Byron provides a detailed portrait of the environs of the Wailuku River and the falls therein; an illustration by Rob Dampier included in Byron's journal is reproduced as Figure 10 below:

> There is a creek at the [Hilo Bay] extremity, up which boats go as far as a fall of fine fresh water of excellent quality, which keeps long at sea, and is particularly convenient for watering the ships. . .
>
> The neighborhood of the watering-creek is particularly picturesque. The entrance is about fifty yards wide, between high precipitous rocks, crowned with palm and artocarpus trees, and almost covered with beautiful creeping plants, whose broad green leaves and many-coloured flowers only partially show the dark lava beneath. About fifty fathoms inland there is a ledge of rock, over which a beautiful clear river of fresh water comes, pouring its streams into the creek*; and, a few yards higher up, there is another cascade of still greater beauty. Immense masses of lava lie in picturesque confusion on the banks, between which gay shrubs and flowers have rooted, and partially conceal them. At these falls we were often amused by looking on, while the natives enjoyed themselves in the water. Some of their exercises, indeed, were almost fearful: they would strip even their maro, and then plunge into the river above the first fall, and allow themselves to be carried down into the deep pool below, in which they would disappear, and then rise again at some distance and draw breath to be ready for the second fall, down which they would go, and then return to the upper rocks to renew their sport; nay some of them would ascend the cliffs above, a height of thirty or forty feet, and leap from these into the water, seemingly enjoying our terror at their daring diversion; but they are like the amphibious animals, accustomed to the water from infancy, and whether rolling about in the surf on their float-boards, or dashing down the cascades along with the waters, seem equally at home. (1826:165-166)

Figure 10. Historical illustration of “Waterfall, Byron Bay” (Byron 1826:165).

Although life-sustaining, the waters also proved treacherous and sometimes deadly as can be seen in the note that accompanies the previous excerpt by Byron “*This river is the Wairuku; that is, the forceful, or destructive, or rushing water” (ibid.166). The following excerpts from the journals of Wilkes and Stewart also touch upon the dangers of the Wailuku River:

> Excellent water is to be had in abundance, and with great ease, within the mouth of the Wailuku river; but it requires some care in passing in and out the river when the surf is high. (Wilkes 1845:230)
>
> After satisfying our curiosity here, we rowed down the creek and across the bay, to another stream on the western side of the harbor, called Wairuku—*river of destruction*—where the ships get their water. (Stewart 1828:289)

Another account describes the way travelers would cross the river in the days before bridges spanned the Wailuku; the history of Wailuku River bridges is the subject of a separate section presented later in this discussion. The account, composed by Ellis ca. 1827 reproduced below, mentions Puʻuʻeo Ahupuaʻa and bears the self-explanatory title, “Toll Charged for Crossing Wailuku River”:

> Returning from Pueo, I visited Wairuku, a beautiful stream of water flowing rapidly over a rocky bed, with frequent falls, and many places eligible for the erection of water-mills of almost any description. Makoa and the natives pointed out a square rock in the middle of the stream, on which, during the reign of Tamehameha, and former kings, a toll used to be paid by every traveler who passed over the river.
>
> Whenever any one approached the stream, he stood on the brink, and called to the collector of the toll, who resided on the opposite side. He came down with a broad piece of board, which he placed on the rock above mentioned. Those who wished to cross met him there, and deposited on the board whatever articles had been brought; and if satisfactory, the person was allowed to pass the river. It did not appear that any uniform toll was required; the amount, or value, being generally left to the collector.

> The natives said it was principally regulated by the rank or number of those who passed over. In order the better to accommodate passengers, all kinds of permanently valuable articles were received. Some paid in native tapa and mats, or baskets, others paid a hog, a dog, some fowls, a roll of tobacco, or a quantity of dried salt fish. (Ellis 1917:241-242)

Other accounts describe a marketplace along the banks of the river, which acted as an epicenter of trade for the region from the middle to late nineteenth century. Figure 11 is as a daguerreotype (predecessor of the photograph of the Wailuku River captured during the mid-nineteenth century, which depicts the riverbanks during the years when the markets were still active.

Figure 11. 1853 daguerreotype by Hugo Stangenwald of the mouth of the Wailuku River (Mission Houses Museum).

Ellis described the markets that had been held along the Wailuku ("Wairuku") as follows:

> The river of Wairuku was also distinguished by the markets or fairs held at stated periods on its banks. At those times the people of Puna, and the desolate shores of Kau, even from the south point of the island, brought mats, and mamake tapa. . . These, together with vast quantities of dried salt fish, were ranged along on the south side of the ravine.
>
> The people of Hiro and Hamakua, as far north as the north point, brought hogs, tobacco, tapa of various kinds, large mats made of the pandanus leaves, and bundles of ai pa, [*pa'i'ai*] which were collected on the north bank. . . From bank to bank the traders shouted to each other, and arranged the preliminaries of their bargains. From thence the articles were taken down to the before-mentioned rock in the middle of the stream, which in this place is almost covered by large stones. Here they were examined by the parties immediately concerned, in the presence of the collectors, who stood on each side of the rock, and were the general arbiters in the event of any disputes arising.

> To them also was committed the preservation of good order during the fair, and they, of course, received a suitable remuneration from the different parties.
>
> On the above occasions, the banks of the Wairuku must often have presented an interesting scene, in the bustle of which these clerks of the market must have had no inconsiderable share.
>
> According to the account of the natives, this institution was in force till the accession of Rihoriho, the late king, since which time it has been abolished. (1917:242)

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James Jackson Jarves, the founder and editor of the first Hawaiian weekly newspaper, *The Polynesian*, provided the following description of the activities associated with the Wailuku River market:

> At stated periods, markets or fairs were held in various places. The most celebrated occurred on the banks of the Wailuku river, in the district of Hilo, Hawai'i. Here, inhabitants from all portions of the island assembled, to make exchanges of property. Certain districts were noted for the goodness of their tapas; others, for their mats, live stock, or excellence of their *poi*, or dried fish. The peddlers cried their wares, which were exhibited in piles on either side of the stream, according to certain rules; and when a bargain was in negotiation, the articles were deposited on a particular rock, where they could be mutually examined in the presence of inspectors, who were appointed as arbiters in cases of dispute, and also acted as a police for the preservation of order. They received a remuneration for their services. A toll was required from all who crossed the river. (1843:77-78)

Byron also decribed a chiefly residence located on the riverbank in his 1827 account of the Wailuku River environs:

> As lord Byron had determined to refit here, Kahumanu [Ka'ahumanu] appropriated to his use a large and very convenient house, which had just been constructed for the chief of the district. It was delightfully situated on the banks of the Wairuku: the floor was laid with small black pebbles, and carefully covered with mats, and the roof lined with the leaves of the pandanus; there was a door at each end, and several windows were cut in the thatch, so that when we had furnished it with a few chairs and tables, and screened off our bed-places with tappa, it really formed a very comfortable habitation. . .(Byron 1826:166-167)

Between 1846 and 1865, a village began to replace the traditional huts and gardens located between the Wailuku and Wailoa Rivers. According to McEldowney, "the main pier near the mouth of the Wailuku River served as the focal point of this 'New Bedford' type whaling town of trading stores, stables, churches, small boarding houses, and residences" (1979:37). In regard to agriculture, Handy et al. relate that although it was possible to plant *kalo* in soil-rich areas "on the slopes between Waiakea and the Wailuku River" (1991:538-539), the rocky river banks so prevalent throughout South Hilo made it difficult to cultivate *kalo* in traditional *lo'i*-style terraces. As a result, a creative method of planting *kalo* was developed, known as *kanu kipi.* According to Handy et al. (emphasis added),

> In lava-strewn South Hilo there were no streams whose valleys or banks were capable of being developed in terraces, but <u>cuttings were stuck into the ground on the shores and islets for many miles along the course of the Wailuku River far up into the forest zone</u>. In the marshes surrounding Waiakea Bay, east of Hilo, taro was planted in a unique way known as *kanu kipi*. Long mounds were built on the marshy bottom with their surface two or three feet above water level. Upon the top and along the sides of these mounds taro was planted. Flood waters which occasionally submerged the entire mound are said to have done no harm, as the flow was imperceptible. This swampy land is now abandoned to rank grass. *Kipi* (mounds) were also formerly made along Alenaio Stream above Hilo. We are told that farther seaward in Waiakea taro is still grown by the ingenious method of heaping up stones around a taro *huli* which is submerged in water, and held upright by chunks of lava; the stones presumably accumulate refuse enough to nourish the taro, along with the food taken in by the roots from lava and water. (ibid.)

This method of planting *kalo* proved to be quite successful, and flourished in the marshy environment provided by the Hilo streambeds. Handy et al. further describe *kanu kipi* thusly:

> The *kipi* method of planting taro where it was not possible to make *lo'i* was described to Mrs. Pukui by James Hala'ole as yielding the tallest plants that he had seen anywhere. This method was not used in Puna because there were no streams, but it was used in Hilo near the streams. The native population was so tremendous in the olden days that all available land was used and special methods were studied for the different localities. Hilo had marshes along some of the stream beds and it was in those marshes that *kipi* planting was done. Bulrushes were trampled down into the mud until a heap rose about to the surface, then earth was thrown on until it rose well out of the water, the earth being obtained by digging a trench on the *mauka* or land side. "A succession of these *kipi* patches looked like long islands divided by ditches. The taro was planted on these 'islands,' such varieties as did not rot when wet and that liked moisture. The taro plant grew from six to nine or more feet tall and the *kalo* (corm) itself was very big." (ibid.:102-103)

The *Māhele ʻĀina* of 1848

By the mid-nineteenth century, the ever-growing population of Westerners in Hawaiʻi forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership. In 1848 the *Māhele ʻĀina* became the vehicle for determining ownership of native lands. This change in land tenure was promoted primarily by the missionaries and Western businessmen in the island kingdom. Generally, these individuals were hesitant to enter business deals on leasehold land. The *Māhele* (division) defined the land interests of Kamehameha III (the *Mōʻī* or King), the high-ranking chiefs (*aliʻi*), and the *konohiki*. During the *Māhele*, all lands in the Kingdom of Hawaiʻi were placed in one of three categories: (1) Crown Lands (for the occupant of the throne); (2) Government Lands; and (3) *Konohiki* Lands (Chinen 1958:vii and Chinen 1961:13). The chiefs and *konohiki* were required to present their claims to the Board of Commissioner to Quiet Land Titles (also known as the Land Commission) to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands 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.

All lands awarded during the *Māhele* were subject to the rights of the native tenants therein; those individuals who lived on the land and worked it for their subsistence and the welfare of the chiefs (Sinoto and Kelly 1975). Native tenants could claim, and acquire title to, *kuleana* parcels that they actively lived on or farmed at the time of the *Māhele*. The Kuleana Act of December 21, 1849 provided the legal framework by which native tenants could apply for and receive fee-simple interest in their *kuleana* lands from the Land Commission. The Board of Commissioners oversaw the program and administered the lands as Land Commission Awards (LCAw.). Not all lands that were claimed were awarded. The volumes of native registry and testimony collected for the *kuleana* claims provide a snap-shot of life in Hawaiʻi during the middle part of the nineteenth century.

Prior to the *Māhele*, Piʻihonua and Puʻuʻeo *ahupuaʻa* were held by Kamehameha I until the time of his death in 1819. Upon Kamehameha I's death, Piʻihonua was passed down to his son, Liholiho. Kelly et al. (1981) speculate that Piʻihonua may have been given to Chief Kalaeokekio by Kauikeaouli or Boki in 1828. Puʻuʻeo was transferred to one of his wives by the name of Kaheiheimālie, who held it until her death in 1842, at which point the land passed to her daughter Kekāuluohi who died in 1845.

During the *Māhele*, Piʻihonua was retained as Crown Land (ibid.). According to records in the Waihona ʻĀina database, twenty-one *kuleana* claims were made within Piʻihonua, of which fifteen were awarded; while fourteen of nineteen *kuleana* claims were awarded in Puʻuʻeo (Table 1), the locations of which are illustrated in Figure 12 below. Most of the *kuleana* awarded consisted of single parcels, except for LCAw. 4809 and LCAw. 4659 in Puʻuʻeo, which contained two and three discrete *ʻāpana*, respectively. Eight of the fourteen *kuleana* in Puʻuʻeo (including LCAw. 4659:3) were located along the coast, one of which (LCAw. 5145) was located at the mouth of the Wailuku River, downriver from the current study area; while four *kuleana* (including LCAw. 4659:1 and 2) were situated further inland.

Table 1. LCAw. Awarded in Piʻihonua and Puʻuʻeo Ahupuaʻa.

LCAw.	***Royal Patent***	***Claimant***	***Acres***	***Ahupuaʻa***
67	14	Pitman, Benjamin	1.92	Piʻihonua
11046B	598	Akina	.96	Piʻihonua
571	5576	Hoyer, Cornelius	.75	Piʻihonua
1178	16	Moore, George M.	.96	Piʻihonua
2276	7640	Kuhio	4.38	Piʻihonua
2604	1143	Paulo	4.49	Piʻihonua
2630	1145	Pohano, Kimoteo	.97	Piʻihonua
3758B	3620	Ulu, wahine	1.63	Piʻihonua
3994	6109	Haunu	2	Piʻihonua
4539	3897	Ewaliko	4	Piʻihonua
4597	4678	Hanaumaikai	.37	Piʻihonua
4598H	5029	Halaki	0.22	Piʻihonua
4894	1144	Kalaeloa	2.16	Piʻihonua
4918	5546	Kapapa	4.1	Piʻihonua
1783	4339	Aina heirs (Mikaele)	4.3	Piʻihonua
1B	4693	Wahine	1.09	Puʻuʻeo
1C	4691	Mary	5.68	Puʻuʻeo
8629/2228	7780	Kaapa	0.57	Puʻuʻeo
4598H	2479	Halaki	1.59	Puʻuʻeo
4659	4666	Papa	5.78	Puʻuʻeo
4696	4657	Laauohala	5.88	Puʻuʻeo
4786	4686	Nalona, wahine	2.86	Puʻuʻeo
4809	4687	Lo, Moses	8.86	Puʻuʻeo
4989B	4671	Kaili	0.57	Puʻuʻeo
5021	4656	Kupihe	1.48	Puʻuʻeo
5145	4883	Kauhiahiwa	0.59	Puʻuʻeo
5159	4677	Kapuupuu	0.8	Puʻuʻeo
7753	----	Kahikona	58.65	Puueopaku
8069	4841	Haalou	2.31	Puʻuʻeo

In contrast, the majority of the *kuleana* awarded in Piʻihonua were concentrated along present-day Waiānuenue Avenue and Kalakaua Streets. Two of these *kuleana* (LCAw. 2604 and LCAw. 2630) were located in close proximity to the current study area. In fact, LCAw. 2604 counted the Wailuku River as its northern boundary, according to *Māhele* records. While two *kuleana* in Puʻuʻeo (LCAw. 1C and LCAw. 4809:1) counted the Wailuku as their southern boundary.

Further analysis of *Māhele* records for LCAw. 8069, 2604, 5154 and 4809 indicates that these parcels contained one or more houses. While LCAw. 5154, 2630 and 4809 describe *kīhāpai* or gardens (Pukui and Elbert 1986:147), with no mention of specific cultivated crops. Of interest is LCAw. 5154 and 4809, as these parcels are described as having an *ʻauwai* or ditch/canal (Pukui and Elbert 1986:33) thus connecting them directly to the Wailuku River.

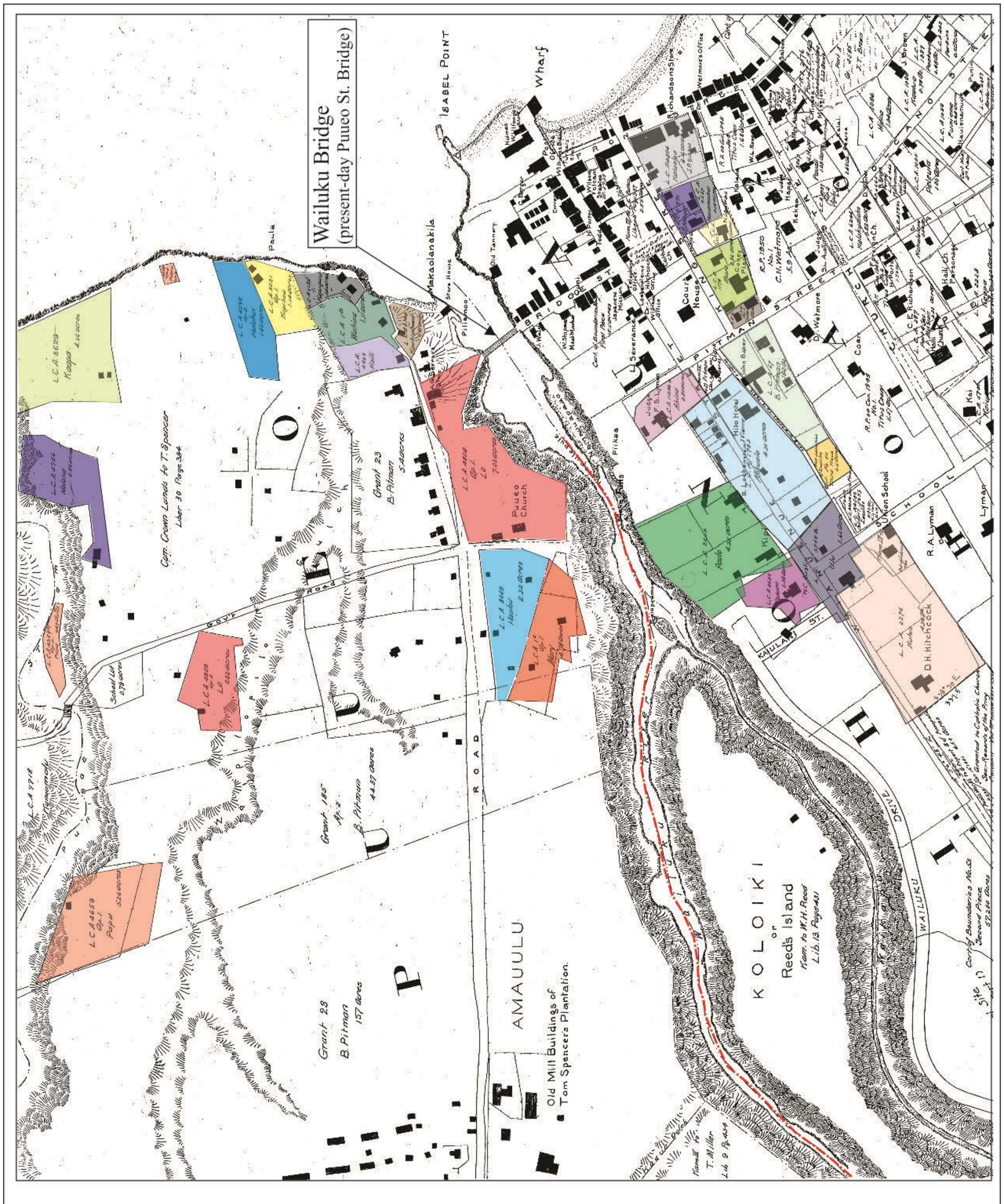

Figure 12. Portion of Registered Map no. 812/917 showing locations of *kuleana* and land grants awarded in the study area vicinity.

The following details regarding *'auwai* are taken from an article titled "Ancient Hawaiian Water Rights and Some of the Customs Pertaining to Them" published in *Thrum's Almanac and Annual for 1894* by Emma Metcalf Nakuina, Commissioner of Private Ways and Water Rights for the District of Kona, O'ahu:

> All *auwais* (water courses), had a proper name, and was generally called after either the land, or the chief of the land that had furnished the most men, or had mainly been instrumental in the inception, planning and carrying out of the required work. All *auwais* tapping the main stream were done under the authority of a *Konohiki* of an *Ahupuaa*, *Ili* or *Ku*.
>
> *Auwais*, were generally dug from makai—seaward or below upwards. The *konohiki* who had the supervision of the work having previously marked out where it would probably enter the stream, the diggers worked up to that point. The different *ahupuaa's*, *ili's* or *ku's* taking part in the work furnished men according to the number of cultivators on each land. (1893:79)
>
> Bordering on the upper portions of most *auwais* are small *lois* [lo'i] limited in size and number, generally on a hillside, or on the borders of a gulch. These *lois* are generally awarded *kulu* or drops; that is, they are entitled to continual driblets of water, and no one having a water share may turn the water entirely away from them unless, in times of scarcity, it should be seen that these *lois* or *loi* were full to overflowing. (ibid.:81)

Mrs. Nakuina also elaborates on some of the general principles and rules for establishing and regulating *'auwai*. She states,

> . . . No auwai was permitted to take more water than continued to flow in the stream below the dam. It was generally less, for there were those living makai or below the same stream, and drawing water from it, whose rights had to be regarded. . .
>
> Any dam made regardless of this well recognized rule, were levelled to the bed-rock by the water right holders below, and at any rebuilding, delegates from each dam below were required to be present to see that a due proportion of water was left in the stream. . .
>
> The general distribution of the quantity of water each independent land was entitled to was in proportion to the quota of hands furnished by each land, but subject to regulations as to distance from source of supply. This quantity was regulated by the time each had in the water rotation or division, when such land would take all or almost all of the water of the auwai for the period of time allotted to it. This time varied in the cases of *mooaina*, *ku*, *ili*, or *ahupuaa* from a few hours, half a day, a day, night, or both, to two or three days. The divisions of the day were regulated by the sun, the night by the stars. (ibid.:79-80)

Subsequent to the *Māhele*, the King also authorized the issuance of Royal Patent Grants to applicants for tracts of land, larger than those generally available through the Land Commission. The process for applications was set forth by the "Enabling Act" of August 6, 1850, which set aside portions of government lands for grants. The goal of this program, which lasted into the early twentieth century, was to get native tenants, who may not have been awarded a *kuleana* parcel, on the land. Despite the stated goals of the granting program to provide land to native tenants, many of the grants given in the study area vicinity area went to foreign individuals. One such individual was Benjamin Pitman Jr. originally from Massachusetts, who first came to the Hawaiian Islands with his father, a trader, around 1833. He is best known for opening the Volcano House but he was also the widower of chiefess Kino'ole o Liliha, from whom he inherited large land holdings around Hilo. In addition, he purchased over 300 acres of land (Land Grant 23 for 162.4 acres; Land Grant 185 for 210.62 acres) in Pu'u'eo Ahupua'a (Figure 13), much of which would eventually become the locus for a coffee plantation and commercial sugar cultivation venture known as Amau'ulu Plantation, discussed in further detail below.

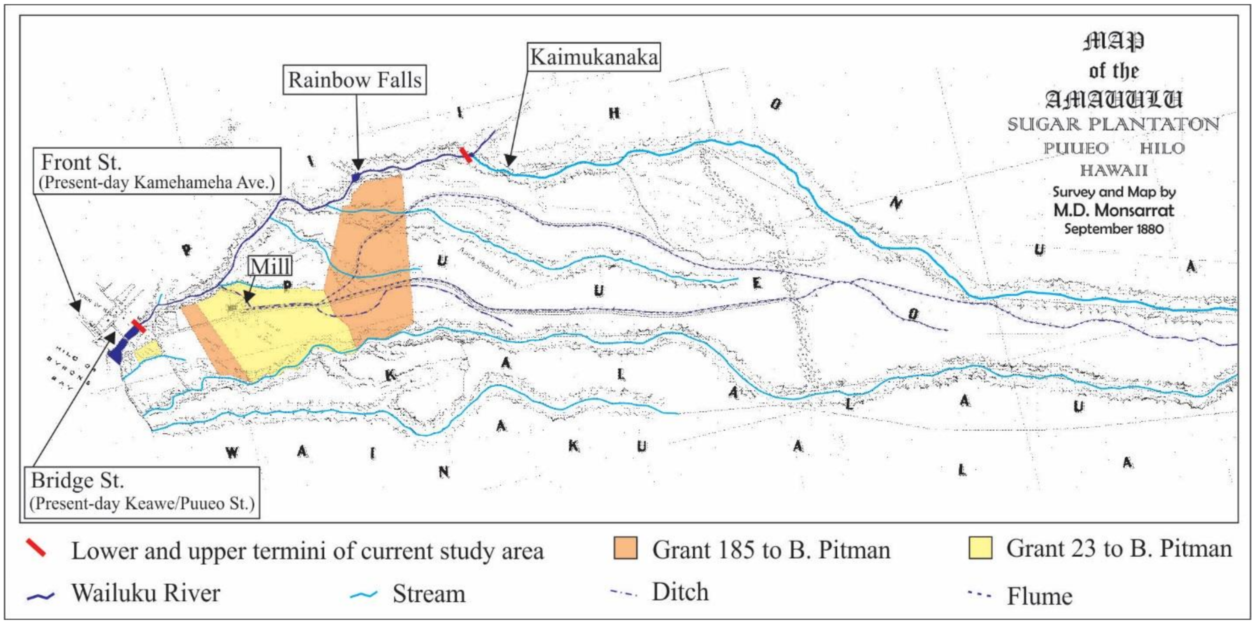

Figure 13. Annotated map of Amauulu plantation showing land grants and points of interest referred to in the text.

Boundary Commission Testimony for Pi‘ihonua and Pu‘u‘eo Ahupua‘a (1873-1875)

The Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai‘i in 1862 to legally set the boundaries of all the *ahupua‘a* that had been awarded as part of the *Māhele*. By 1874, the Commissioners of Boundaries were authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. This information was collected primarily between A.D. 1873 and 1885 and was usually given in Hawaiian and simultaneously transcribed in English.

On October 8, 1873, hearings were held regarding the boundaries of Pi‘ihonua *ahupua‘a*. Manuia, a former resident of Pi‘ihonua, was born and lived there until shortly before his testimony. He served as the primary witness for the Boundary Commission (Maly 1996a). His testimony, regarding the boundaries of the *ahupua‘a*, is as follows (emphasis added):

> Manuia K., sworn, I was born at Piihonua during the time of Kamehameha I and have always lived there until a short time since. [I] know a part of the boundaries, was shown them by Kaumu (my father), Puukia, Mano, and Awakua *kahu hanai* [my guardian from childhood, or foster parent]. These men are all dead. They were bird catchers and I used to go into the woods with them. I have been a bird catcher from my youth to the present time. I know the junction of Pōnahawai and Piihonua…in the woods at a place called Puuike, at the *mauka* corner of Punahoa 1st and Punahoa 2nd. Thence the boundary runs to Nahuina, junction of the old roads. Know the place called Nahaleoeleele, it is a hill *mauka* of Nahuina on the boundary between Kaaumana and Piihonua. Ponahawai leaves Piihonua at Nahuina and Kaaumana joins it. From Nahaleoelelele the boundary runs *mauka* to Kawauuai on the lava flow of 1855 (I know where it is now). Thence to Kapiliiki and thence to Kapilinui. These places are islands [*kipuka*] in the flow, covered so thickly with trees and *uluhi* [*Dicranopteris*] that it is impossible to go through them (hence their name). Thence to Kalapalapaiki and from thence to Kalapalapanui. My parents told me the land of Kaaumana runs very narrow (about two chains more) to Mawae.
>
> Kilohana is on Piihonua and the boundary is on the Puna side of it. Naunapaakea is on Piihonua, it is partly covered by the lava flow. Mawae is where Waiakea and Piihonua cut off Kaaumana, and the *mawae* [a deep crack or fissure] was covered up by the lava of 1855. I saw a pile of rocks there before the flow of 1852, said to have been put up by a foreigner who was engaged in surveying lands. This pile of stones was on the boundary between Piihonua and Waiakea (now covered by lava). The boundary used to run up old road in a straight line from Kalapalapanui to Mawae. Thence the boundary between Waiakea and Piihonua runs to Kaelekalua, small *ohia* trees where we used to catch birds. Thence to Luaoanapapa a cave where people used to sleep on the Hilo side of the lava

flow; here, Humuula cuts these other lands off. This is as my *makua* told me. I have always been told that Humuula took the *mamani* [*Sophora chrysophylla* trees] and *pili* [*Heteropogan* grass] outside of the forest and *makai* to the other lands.

This is as far as I learned the boundaries from my parents. I learned the mountain boundaries from Kamalo and Naa, when I was working for Mr. Castle (James Castle's father). Thence along Humuula to Aaina. Thence to Laumaia. Thence to Waipahoehoe, below Aahuwela. Thence to Kapuakala, the *mauka* end of Honolii. The *mauka* boundary of Piihonua runs along the edge of the forest, the *pili* and *mamani* outside are on Humuula. Thence follow down Kapuakala gulch. I have never been along these woods. The boundary between Puueo and Piihonua follows up the Wailuku gulch from the seas shore to a branch gulch called Awehe. Thence it runs up this gulch to the junction of Kawala with Awehe gulch, *mauka* of Waihiloa. Thence along that gulch to Namahana. Thence across land to Nahuina, the *mauka* corner of Alae, and where the Puueo and Alae roads join (close to Honolii gulch). Thence to Honolii gulch, the boundary running towards Hamakua (from Namahana to Honolii) and the land of Paukaa is on the Hamakua side of the gulch. I have been as far as this after birds, but no further. Have always heard that the boundary between Piihonua and Paukaa follows up Honolii gulch to Kapuakala. I think Kalapalapanui belongs to Piihonua, I have never heard of a place called Lai. <u>I have always heard that all the water in the Wailuku belongs to Piihonua</u> and that <u>the water in Awehe [present-day Waiau] belongs to both lands of Piihonua and Puueo,</u> and the water in the Kawala gulch belongs to both lands also.

Have heard that the water of Kapuakala belonged to Piihonua and Paukaa. Piihonua had fishing rights at the seashore from Puuau to Piilani [vicinity of the light house on the shore].

I know a place called Halehaleakalani, it is near Kapilinui, near the boundary, Kaaumana and Piihonua run through it. Kapiliwaleokahalu is on the boundary between Kaaumana and Piihonua, *mauka* of Kilohana. Kilohana is not on the boundary. Waiakea and Piihonua are not cut off by the land of Humuula at Mawae. I am certain that I was told by my parents that these lands extended to Kaelekalua and from thence to Luaoanapapapa, at which place they were cut off by Humuula. Know a place called Kalaeokahiliku, *makai* of Kaulukahaku on the lava flow of 1855 (a rocky point). It is on Waiakea and is *mauka* of a rocky point called Nakalaikiolaola and is *mauka* of Mawae (can see Mauna Kea from Mawae). Hailewa is the name of a pond of water in the woods on Piihonua.

Kamalo K. knows the boundaries outside of the woods where he used to kill bullocks, and I know the boundaries where we used to catch birds. Kaaumana runs from Nahuina to Mawae but the land is very narrow. Kukuau ends at Nahuina. (Maly 1996a:A-23-A-24)

Kamalo, a bird catcher and native of Piʻihonua, provides testimony regarding the boundaries of Piʻihonua (emphasis added):

Kamalo K., sworn, Ponahawai joins Piihonua at a place called Nahuina. Punahoa ends at Puuiki, and from there to Nahuina, Ponahawai bounds Piihonua (Punahoa 2nd is owned and Patented by mess. T. Coan, D.B. Lyman and C.H. Hitchcock).

Kaaumana joins Piihonua at Kawauwai where bird catchers used to live, said place was destroyed by the lava flow of 1855. Thence the boundary between these two lands runs *mauka* to Kalapalapanui; thence to Kalapalapaiki, on the lava flow; thence to Naumuapaakea, a small island in the lava flow covered by trees thence to Kilohana an *ahua* in the center of the lava flow from which you can see to the shore; thence to Piliwaleokahalu, an *ahua* in the flow which is in sight of Kilohana; thence to Kapilinui, an island in the flow covered with trees, this is the *mauka* end of Kaaumana and where Piihonua and Waiakea join. (You come to Kapiliiki before you come to Kapilinui). Thence the boundary between Piihonua and Waiakea runs *mauka* to Halehaleakalani, an *ahua* on the lava flow where bird catchers used to meet the ones who carried up the food; thence to Mawae, a small island in the lava flow covered with trees, this is where Humuula cuts off Piihonua and Waiakea. There is an old pile of stones there and when Wiltse surveyed for a road, Keakaokawai and myself built another pile close to it. The first pile was built previous to 1859. Thence the boundary runs along the land of Humuula turning towards the right to Kaelekalua, an old *kauhale*, where trees are growing. The boundary runs *makai* of the old *kauhale*, and the tall trees belong to Piihonua. Thence to Kalaikahiliku a grove of *koa* and *ohia* trees, the boundary runs along the edge of the woods. The tall trees being on Piihonua and the short ones on Humuula. Thence to Nakalokiolaola the boundary running on the *mauka* edge of the woods on the *makai* side of this place. Thence to Kaelewa a large pond of water and *kauhale* on Humuula. Thence along the edge of the woods to Puuoo a hill larger than Halai. The boundary runs about as far from said hill as from the Court House in Hilo to the sea shore; on the edge of the bush. Thence along the edge of the bush to Waikeeiki, and thence to Waikeenui, to small *kahawai* branches of the Wailuku; thence to Aama a cave where people used to sleep. This is in the Wailuku stream and belongs to Humuula. The boundary is in the edge of the woods *makai* of this place. Thence to Laumaiaiki, the boundary running to a *kahawai makai* of it; thence to Laumaianui a *kahawai*; all these *kahawai* are branches of the Wailuku. Thence along the edge of the woods to Waipahoehoe, a cave in the *kahawai*; thence to Lai a point of the woods, covered with *koa* and *ohia*, *makai* of Ahuwela, a hill at the foot of the mountain, which you can see from Waiakea. At this point the large trees have been marked and a stone buried by Hitchcock bearing September 1873. Kalapapainiu is directly below Lai; thence to Kapuakala, *kahawai* at the junction of Piihonua and Paukaa on the boundary of Humuula; this place is at the *mauka* end of Honolii gulch, and is the true boundary between these two lands, as told me by my *kupuna* Eleele, Manoawahua, Paliupu, Pumine and Makaole. I went with them catching birds from the time I was small till I grew up. Their *kupuna* told them in olden times, these men are all dead.

It is a short distance from Kapuakala to Lai. From Kapuakala the boundary of Piihonua runs up to Kalapapainiu, following the gulch; the water in the gulch belongs to Paukaa. Thence to Ka Puulehu, a hill on the edge of the gulch; thence to Puuhaohailele, *kauhale kaawili manu*; thence to Kamokuloulu, a *kauhale*, among the palm trees; thence to Kawala, the *mauka* corner of Alae; thence along the gulch across the head of Alae to the corner of Puueo. I know this gulch is on the boundary between Piihonua, Alae and Puueo. I do not know how wide Alae is at the *mauka* end nor do I know the points on the boundary till you come to Waihiloa, a waterfall on Awehe, but I know the gulch is the boundary between Puueo and Piihonua. Thence the boundary between these lands runs along the center of the gulch to the junction of the Waiele, with the Wailuku; thence along the Wailuku gulch to the shore. The sea water belonged to Wailuku but the tide water at the mouth of the gulch belonged to Piihonua; also the shallow water at the foot of the land, deep sea belongs to Waiakea.

Kahue in a conversation with me told me that the boundary of Piihonua and Humuula was at Nahuina, on the Wailuku river. This conversation took place just before our giving testimony on the boundaries of Makahanaloa.

He made offer to me (which I understood as endeavors to bribe me) to give evidence the same as his, whereby he and I could make money.

I used to go bird catching on Piihonua with Malo and others. Humuula people catching birds outside of the woods, and Piihonua people catching them, to the *mauka* edge of the woods. That was the boundary and my *kupuna* told me fights used to occur when the Humuula men went below the edge of the woods, or if the Piihonua people went above them. From the time I was young to the present day, I have caught birds without hinderance from the Humuula people, within the boundaries I have defined. (Maly and Maly 2005:321-322)

Kamoku testimony:

Kamoku, K., sworn, I was born and have always lived on Puueo. I am a bird catcher, and have been bullock catching and know some of the boundaries of Piihonua. I do not know the boundaries on the Waiakea side, only on the Hamakua side. The boundary at shore between Puueo and Piihonua is in the Wailuku river; thence the boundary runs *mauka* to the junction of Awehe gulch with Wailuku gulch; thence up said gulch to *mauka* of Waihiloa, and to the junction of Kawala and Awehe gulches; this is as far as I know the boundaries on this side. I have always heard that Piihonua extends through the woods, to the pili grass. And that the *mamani* and *pili* are on Humuula. This is all I know about the boundaries. (ibid.:323)

Pilimoku testimony:

Pilimoku, K., sworn, I was born at Piihonua before the *moku aa* came into Hilo and have always lived on said land and Punahoa, know the boundaries of Piihonua as far *mauka* as where Puueo cuts Alae off. Punahoa ends *mauka* of Puuiki. Know Waiakea and Piihonua join at Mawae, I do not know any points on the boundary below Mawae, on that side. Have always heard that the tall woods are on Piihonua, and the *mamani* and *pili* are on Humuula.

> <u>The boundary between Puueo and Piihonua is the Wailuku river;</u> thence up the gulch to the junction of Awehe gulch with the Wailuku; thence up said gulch to *mauka* of Waihiloa, to the junction of *Kahawai o kahakai o Kawala*; thence along this gulch to the Alae road; where Puueo cuts Alae off. I have heard that Paukaa and Piihonua join in the woods (ibid.:324)

Hoikaikaeleele, a native of the neighboring *ahupuaʻa* of Punahoa, testifies as to the boundaries of Piʻihonua:

> Hoikaikaeleele, K., sworn, I was born on Punahoa at the time of Ainoa, at the time Kaahumanu came to Hilo [ca. 1824], *olelo o ke* Akua; I know the boundaries of Piihonua on the South East side and on the mountain. When I was young I went with Kamalo, bird catching and killing bullock. Punahoa 2nd bounds Piihonua from the shore to a place in the woods called Puuiki; thence Ponohawai [Ponahawai] bounds it to Kilohana. This information I got from Kamalo. I went on the mountain with Eleele, and he said Piihonua runs to Kaelekalua, from Mawae along Waiakea; thence to Anapapapa, at the edge of the *pili* where Humuula cuts Piihonua off and Waiakea off. Thence the line runs to Kaelewa, thence to Puuoo, said place being on Piihonua and the *mamani mauka* on Humuula; thence to Aama on Wailuku gulch; thence to Laumai gulch (the place of that name is on Humuula). Thence along the *mauka* edge of the woods, to Waipahoehoe, thence to Lai, thence to Kapuakala. Paukaa is on the Hamakua of this place on the *mauka* end of Honolii gulch. Eleele said that Paukaa was the other side of the gulch, that Lai is on Piihonua and Aahuwela, is *mauka* of it. Kapuakala is *mauka* end of Honolii gulch. (ibid.)

Kanaloa, a native of Alae, testifies regarding the boundary of Piʻihonua and Alae:

> Kanaloa, K., sworn, I was born at Alae after the time of Peleleu [ca. 1795], and have always lived there. My parents lived there. Know the boundaries between Alae and Piihonua. Alae joins Piihonua at Waihiloa on the Awehe gulch. Thence up that gulch across the head of Alae to the corner of Kaiwiki and from thence straight to Honolii gulch, Piihonua cutting off Kaiwiki and Alae.
>
> A place on Honolii gulch called Waikee is the mauka corner of Kaiwiki. (ibid.:324-325)

The native testimonies provided during the Boundary Commission hearings provide insights into the land use and residency of Piʻihonua during the 1840s. From this, we learn that bullock hunting and bird catching were practiced at the upper elevations along the edges of the Wailuku River. Although the majority of the testimonies indicate the Wailuku River to be the main boundary separating Piʻihonua and Puʻueo *ahupuaʻa*, it is unclear from the testimonies whether the water of the Wailuku River belonged exclusively to Piʻihonua or Puʻueo *ahupuaʻa*, or whether the water was a shared resource. Although Manuia comments that the water in the Wailuku River was reserved for Piʻihonua Ahupuaʻa, Kamalo comments that the water was shared between the neighboring *ahupuaʻa*. While the descriptions of *ʻauwai* (canal/ditch) included in LCAw. 5154 (Kauhiahiwa) and LCAw. 4809 (M. Lo), located in Puʻuʻeo Ahupuaʻa, suggest that some residents in Puʻuʻeo were utilizing water from the Wailuku River for food production.

Piʻihonua, Puʻuʻeo and the Greater Hilo Area after the *Māhele*

The decades that followed the *Māhele* of 1848 are characterized by a growing detraction to traditional subsistence activities, undoubtedly the result of the relatively swift expansion of the non-native population in Hilo that occurred throughout the 19th century. Between 1863 and 1890, landing wharves were built at the foot of what is now Waiānuenue Avenue at the mouth of the Wailuku River in Piʻihonua Ahupuaʻas (Figure 14). These landings became a focal point for trade, commerce, and transportation. D.H. Hitchcock built the first landing and wrote that the "little wharf was a vast improvement on the old style of running the boats up onto the sand beach and transferring passengers and goods from them to dry land on the backs of the stalwart boat boys, stripped to their *malo"* (Lang 2007:86). During this time Hilo Bay was ranked as the third most frequented port for whaling vessels in need of repair and re-provisioning. Both whalers and missionaries, who overlapped in time, influenced the culture of the Hilo area.

Historic accounts from the latter part of the nineteenth century portray Hilo as a city full of life, where traditional lifeways persisted in the face of increasing modernization and urbanization. Isabella Bird visited Hilo in 1873 and published her experiences in *The Hawaiian Archipelago: Six Months Among the Palm Groves, Coral Reefs, & Volcanoes of the Sandwich Islands* (Bird 1876). Her firsthand accounts of Hilo are dreamy and romanticized; reminiscent of Byron, Stewart, and Coan's accounts composed nearly half a century before. In the following excerpt, she provides a colorful depiction of native life with meticulous attention to detail, perhaps the most vivid of all foreign accounts of the environs of Hilo and native lifeways there (underlined emphasis added):

There is a large native population in the village, along the beach, and on the heights above the Wailuku River. Frame houses with lattices, and grass houses with deep verandahs, peep out everywhere from among the mangoes and bananas. The governess of Hawaiʻi, the Princess Keelikolani, has a house on the beach shaded by a large umbrella-tree and a magnificent clump of bamboos, 70 feet in height. The native life with which one comes constantly in contact, is very interesting. . .

The melon and *kalo* patches represent a certain amount of spasmodic industry, but in most other things the natives take no thought for the morrow. Why should they indeed? For while they lie basking in the sun, without care of theirs, the cocoanut, the breadfruit, the yam, the guava, the banana, and the delicious *papaya*, which is a compound of a ripe apricot with a Cantaloupe melon, grow and ripen perpetually. Men and women are always amusing themselves, the men with surf-bathing, the women with making *leis*—both sexes with riding, gossiping, and singing. Every man and woman, almost every child, has a horse. There is a perfect plague of badly bred, badly developed, weedy looking animals. The beach and the pleasant lawn above it are always covered with men and women riding at a gallop, with bare feet, and stirrups tucked between the toes. To walk even 200 yards seems considered a degradation. The people meet outside each others' houses all day long, and sit in picturesque groups on their mats, singing, laughing, talking, and quizzing the *haoles*, as if the primal curse had never fallen. Pleasant sights of out-door cooking gregariously carried on greet one everywhere. This style of cooking prevails all over Polynesia. A hole in the ground is lined with stones, wood is burned within it, and when the rude oven has been sufficiently heated, the pig, chicken, breadfruit, or *kalo*, wrapped in *ti* leaves is put in, a little water is thrown on, and the whole is covered up. It is a slow but sure process.

Bright dresses, bright eyes, bright sunshine, music, dancing, a life without care, and a climate without asperities, make up the sunny side of native life as pictured at Hilo. But there are dark moral shadows, the population is shrinking away, and rumours of leprosy are afloat, so that some of these fair homes may be desolate ere long. However many causes for regret exist, one must not forget that only forty years ago the people inhabiting this strip of land between the volcanic wilderness and the sea were a vicious, sensual, shameless herd, that no man among them, except their chiefs, had any rights, that they were harried and oppressed almost to death, and had no consciousness of any moral obligations. Now, order and external decorum at least, prevail. There is not a locked door in Hilo, and nobody makes anybody else afraid. (Bird 1876:65-67)

Figure 14. Photo of Hilo Landing in the early 1890s. (http://www.huapala.net/items?page=8).

In this next excerpt, Bird provides additional details about the environs of Hilo, and mentions the Wailuku River and the landing there (underlined emphasis added):

> This is the paradise of Hawaii. What Honolulu attempts to be, Hilo is without effort. Its crescent-shaped bay, said to be the most beautiful in the Pacific, is a semi-circle of about two miles, with its farther extremity formed by Cocoanut Island, a black lava islet on which this palm attains great perfection, and beyond it again a fringe of cocoanuts marks the deep indentations of the shore. From this island to the north point of the bay, there is a band of golden sand on which the roar of the surf sounded thunderous and drowsy as it mingled with the music of living waters, the Waiakea and the Wailuku, which after lashing the sides of the mountains which give them birth, glide deep and fern-fringed into the ocean. Native houses, half hidden by greenery, line the bay, and stud the heights above the Wailuku, and near the landing some white frame houses [Figure 15] and three church spires above the wood denote the foreign element. Hilo is unique. Its climate is humid, and the long repose which it has enjoyed from rude volcanic upheavals has mingled a great depth of vegetable mould with the decomposed lava. Rich soil, rain, heat, sunshine, stimulate nature to supreme efforts, and there is a luxuriant prodigality of vegetation which leaves nothing uncovered but the golden margin of the sea, and even that above high-water-mark is green with the Convolvulus maritimus. So dense is the wood that Hilo is rather suggested than seen. It is only on shore that one becomes aware of its bewildering variety of native and exotic trees and shrubs. From the sea it looks one dense mass of greenery, in which the bright foliage of the candle-nut relieves the glossy dark green of the bread-fruit—a maze of preposterous bananas, out of which rise slender annulated trunks of palms giving their infinite grace to the grove. And palms along the bay, almost among the surf, toss their waving plumes in the sweet soft breeze, not “palms in exile,” but children of a blessed isle where “never wind blows loudly.” (ibid.:35)

Figure 15. Undated photograph by Brother Bertram showing houses at the mouth of the Wailuku River (Brother Bertram Photo Collection, Ulukau).

In this last excerpt, Bird specifically discusses the dexterity and ease of the natives in the waters of the Wailuku River:

> These people are truly amphibious. Both sexes seem to swim by nature, and the children riot in the waves from their infancy. They dive apparently by a mere effort of the will. In the deep basin of the Wailuku River, a little below the Falls, the maidens swim, float, and dive with garlands of flowers round their heads and throats. The more furious and agitated the water is, the greater the excitement, and the love of these watery exploits is not confined to the young. I saw great fat men with their hair streaked with grey, balancing themselves on their narrow surf-boards, and riding the surges shore-wards with as much enjoyment as if they were in their first youth. I enjoyed the afternoon thoroughly. (ibid.:70)

In 1874, another visitor named Louise Coffin Jones wrote of her impression of Hilo in an article titled “My Journey with a King” published in the 1881 edition of *Lippincott’s Magazine of Popular Literature and Science*. She had spent a month on Hawai‘i prior to departing on a tour around the island aboard the steamer *Kilauea* alongside King Kalakaua and his retinue on their way to Maui. Jones shared the following reminiscences of her time in Hilo:

> Vivid pictures of Hilo pass before me as I write,—the little town embowered in strange tropical foliage of pride-of-India-, mango-, bamboo-, and palm-trees, with a wealth of shrubbery and flowers; the frowning rain-clouds; the rare glimpses of sunshine and blue sky; the gleam of the untrodden snow on distant Mauna Kea when the clouds lifted from the horizon; the reflected glow of Mauna Loa’s fires at night; crescent-shaped Hilo Bay, with its pale-green water meeting the indigo-blue of the ocean; the masts of a whaler and of a lumber-ship at anchor, seen above the houses along the wharf; Cocoanut Island, out in the bay, and the tall cocoa-nut-trees which grew along the beach. . .
>
> But other sights and sounds of Hilo life come vividly back: the natives from the country galloping into town and down the sloping streets, men and women alike wearing wreaths of ferns or a fragrant wild vine called *maile* around their hat-brims or across one shoulder and under one arm, the women mounted astride, with fluttering strips of bright-red calico streaming backward from either stirrup; the Chinese, or Chinese-Hawaiians, who came to the back doors of the houses, bringing vegetables and fruit in two baskets hung at the ends of a pole over their shoulders; the fruits themselves,—bananas, or limes, or guavas, or sometimes the insipid alligator-pears and water-lemons, and the vegetables, taro and yams. Sometimes they brought fish which they had caught off Cocoanut Island; and no parrots that ever flew through the green glooms of a tropical forest could surpass in brilliancy and combination of colors these fish out of Hilo Bay. They were red and purple and golden and blue and orange and scarlet, barred and striped and spotted till they looked like bits of living rainbow. . .
>
> . . . The gleam of rainbow-tinted mist about a distant headland, the play of a silvery water-fall as it streamed hundreds of feet into the sea, the free, joyous motions of the palm-tree fronds in the wind, the shine of sunset waters, the hues of bright wild-flowers, the fragrance of a vine, the majestic aspecr of the high green mountains crowned with black rain-clouds, the awe-inspiring grandeur of the scenery of cliff and pali and lava-flow, all stirred the natural poetry in their breasts and were woven into songs or meles and chaned while they worked or played. As we strolled one day along the beach, we heard a native man crooning one of these ancient melodies as he chipped away on a canoe he was hollowing out of a single log. The native washwomen, who seated themselves by the side of the stream that ran along the principal street and washed their clothes on flat stones, hummed a mournful Hawaiian ditty as they pounded. . . (1881:362-363)

A review of historical sources revealed very little regarding traditional fishing practices or Historic fishing in the Wailuku River. However, today one will often see folks perched on the riverbank, mainly near the river mouth doing pole fishing. Thus, it is likely that people similarly fished along the river in earlier times. The only direct reference to the Wailuku River in an account on fishing was found in a December 1887 article titled “The Fish Question” in the *Planters’ Monthly* (1887:542-543). This article addresses the subject of raising fresh water fish in ponds; a concept introduced in an earlier issue of the same periodical. The author mentions Hilo residents specifically as having “gone ahead of the rest of the Islanders in this direction” (1887:542). To that end, the article described the attempt of fresh water fish raising in the Wailuku River as follows:

> At Hilo the question of the adaptability of our Hawaiian streams for supporting trout has to be solved. Some two or three years ago Mr. Arnold imported five hundred young trout, only thirty-five

> of which reached Hilo alive; these were put into the Wailuku River below the Rainbow Falls. In that pool they have lived and thriven, and some months ago a couple were caught with a fly, rising readily to the cast of a skillful fisherman. The samples taken were between five and a half and six inches in length. Since that catch the fish have remained undisturbed. But the fact that trout *can* be raised has been realized by the people of the Hilo district, and they have clubbed together to stock the streams on a regular plan. An order has been sent forward for 25,000 eggs, which will be hatched out in Hilo and then distributed between the Wailuku and Wainaku streams. If this venture succeeds, Hilo will add to its other attractions that of the sport of trout fishing, so dear to the elderly heart, and no doubt Piscator will in a few years be found whipping the Wailuku stream, and returning to Honolulu with most wonderful accounts of what weights he has brought to bank. But joking aside, the example of these gentlemen in Hilo should be followed by others on the Hawaiian Islands. . . At the next meeting of the legislature it would not be amiss to put a small sum into the appropriation bill, for the purpose of buying and importing fish eggs. A careful person would have to be appointed to look after them, and a law would have to be passed preserving the streams in which they mught be placed. If some of our landowners will only take the matter up in earnest, we feel sure that after a few years they will come to the conclusion that their money has been laid out well. (542-543)

A late nineteenth-century photograph (Figure 16) and a 1891 map of Hilo, reproduced as Figure 17 below, show Hilo town and vicinity as they appeared to visitors and residents near the end of the nineteenth century. In 1898, Mabel Clare Craft Deering visited Hawai‘i, the same year that Hawai‘i was annexed to the United States. In a manner similar to Isabella Bird, Deering provides a picturesque account of Hilo, expressing the prevalence of New England-style architecture and mentions the current study area vicinity (underlined emphasis added):

> Hilo is a straggling village, and the approach to it is through delightful country lanes, like the beautiful oleander-bordered ones of Tahili, in Oahu. The houses are wide-eaved and hospitable-looking, the gardens big and crowded with bloom, the grass green and lush. It looks old, and it looks like New England. A big blue stone church, which belongs to the foreigner, is the only modern thing. A still bigger white church on the hill, with a square tower and a sweet-toned bell, is the native church—the famous Haile Church. There is a good hotel, with clustering cottages and a sloping sward, and down the incline to the exquisite bay run the little streets that are devoted to business.
>
> And by the time you have seen this, the whole town is blotted out behind a thick gray curtain of rain, and Hilo is paying the penalty of her fertility. It pours and pours, but no one pays the slightest attention. Housewives hang out the washing, girls come down the hill on bicycles, the mud spurting in streams from their tires, and their white duck skirts in some mysterious way kept unsullied. No wheel except a Hilo wheel could keep itself upright in such mud.
>
> The bay is the most beautiful harbor in all Hawai‘i. As elsewhere, there is no wharf, and landings to and from the little steamers must be made in small boats. Around the bay is a bold headland crowned with green, and the water of the bay is exceedingly clear and limpid emerald.
>
> Hilo has a number of show places. Cocoanut Island is one of the landmarks of the harbor. . . The drive to and from Cocoanut Isle is delightful, across the wide Wailuku River [actually the Wailoa River], through lanes bordered with delicious wild strawberry guavas, which the natives do not even take the trouble to gather.
>
> On the other side of the town are Rainbow Falls, within easy riding or walking distance. As a walk it is very charming. The road is lumpy and invariably muddy, and almost impassable for wheeled vehicles, but fine for a short skirt and stout shoes. There are rippling little streams to cross on foot-bridges where it is pleasant to sit and dangle your feet and eat pineapples from the neighboring field. Behind the hospital, down a steep little ravine, is a spring that gushes pure and cold from the mountain. This is one of the finest, because it is the coldest, in all Hawai‘i. It was for centuries, a *tabu* spring, sacred to the use of the high chief of this district. No common man was allowed to slake his thirst there. If one ever did, it was in the dead of night and at the peril of his life, for the *tabu* sticks of white *kapa* guarded the place day and night. (Deering 1899: 176-178)

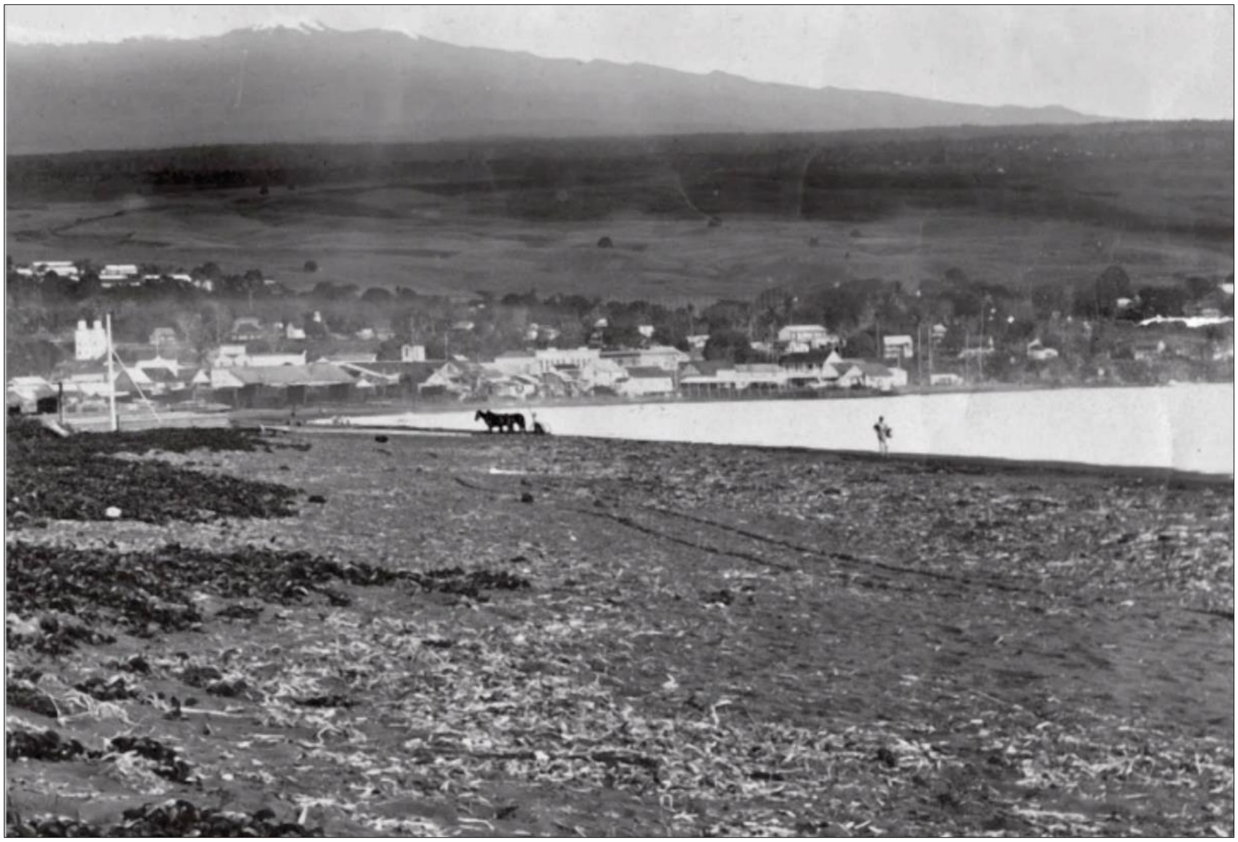

Figure 16. Late 19th century urbanization of Hilo, looking towards the Wailuku River (from Valentine 2014:21).

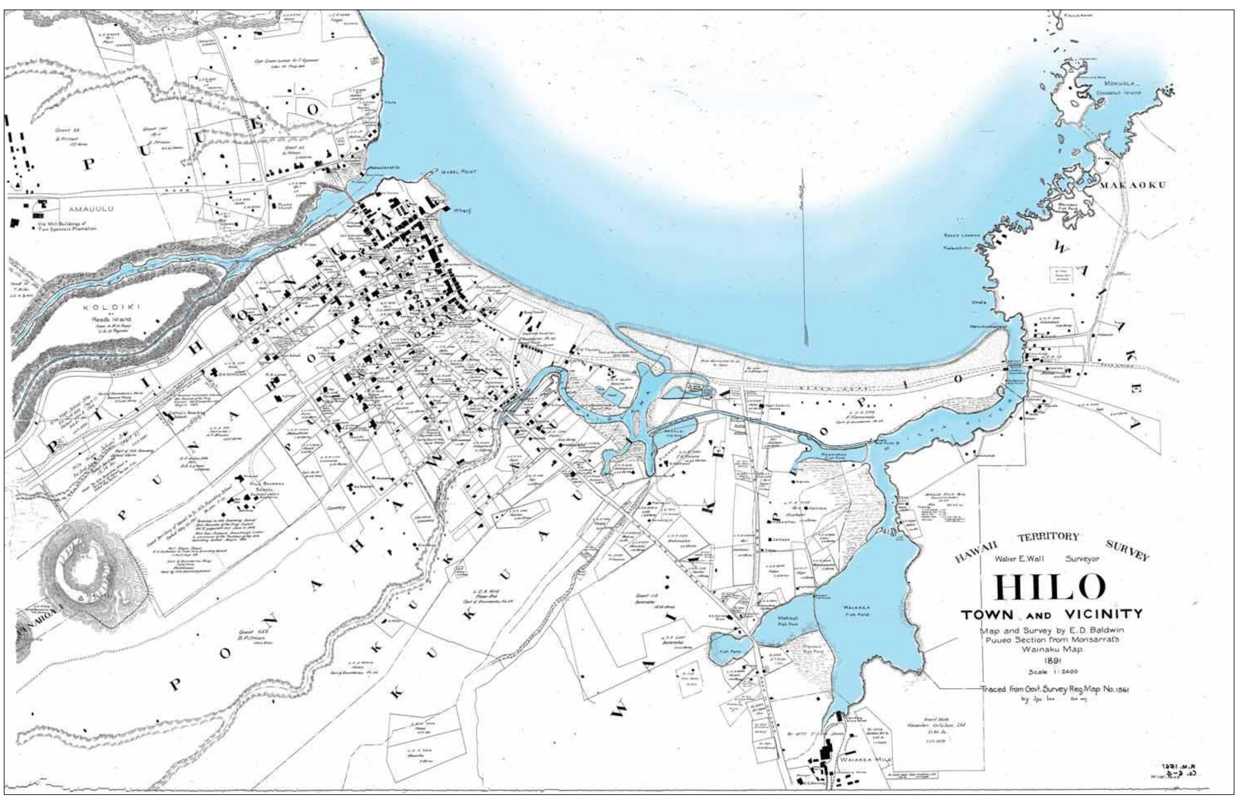

Figure 17. 1891 map of Hilo Town (Registered Map 1561) and vicinity by E.D. Baldwin.

According to *Godfrey's Handbook of Hawaii, Guide to Hilo and the Volcano*, by 1899, the population of Hilo had swelled, "approaching close to 5000" (Godfrey 1899:37). He writes that "beyond the Wailuku bridge lies the district of Puueo and where are many elegant residence" (ibid.:43). Based on a review of historical photographs, many grass hale were still present in Hilo town well into the late 1800s. Regarding the prominence of Hilo as a population and commercial center, Godfrey wrote:

> Hilo, the Queen City and capital of the island of Hawaii is the second in size of the coming cities of the group and is the commercial and the industrial center, as well as the chief shipping port, of this the largest island. . .
>
> This "Queen City" of Hawaii is rapidly growing in importance in the number and size of its industrial and business enterprises and with the impulse soon to be given by the returns from the coffee area, now practically developed, the inauguration of the Olaa sugar plantation and the introduction of a belt line of railroad, which will tap the producing towns of the surrounding country, many predict that Hilo will yet rival Honolulu in size, population and commercial importance. (ibid.:37)

Godfrey also made the following observations of the "country above Hilo," including the Wailuku River, as seen from the Hilo Hotel:

> Here may be viewed broad lands sweeping cloudwards, which, with their sugar cane, coffee, taro, melons, pineapples and banana groves, suggest the boundless liberality of Nature. Woods and waters, hills and valleys, are all there, and from the region of an endless summer the eye takes in the domain of a suggestive endless winter, where almost perpetual snow crowns the summits of Mauna Kea and Mauna Loa.
>
> Towards the Hilo side runs a bow-shaped band of golden sand on which the surf breaks with a sound like the boom of distant cannonading interspersed with the sharp swish, at either end, of the gathered forces of the Wailuku and Waiakea rivers. . . (ibid.:35)

Late-nineteenth century Waianuenue Avenue, so named because it led to the Wai Anuenue or Rainbow Falls, was a dirt, cart-road lined with residences and drainage ditches on both sides of the road that drained water to the ocean. While the *makai* end of Waianuenue Avenue was predominantly a commercial area, as it remains to this day. Godfrey provided the following description of what Bridge Street, now Keawe/Puueo Street, looked like as approached from Waianuenue Avenue: "Bridge street is next en route the location being easily known by the twin spire Roman Catholic church located thereon to the right. Turning to the left the visitor passes the Masonic Hall and the newspaper row of Hilo. . ." (1899:41). He continues, "Traveling along Bridge street the Wailuku river bridge is reached and from which view may be had of the broad river and the wide expanse of Hilo bay. Looking inland one may see the double falls which leap from the lava rocks into mid-stream. . ." (ibid.:41-42). Godfrey's narration of the walking tour describing the study area vicinity continues thusly:

> To Waianuenue street again, from whence a turn to the right will bring one to the steel bridge which connects the stream-encircled Riverside Park with the mainland. The park was formerly Reed's Island, so-called; but, Messrs Bruce, Waring and Co., (Mr. C S. Desky and Mr. J. G. Pratt) purchased and plotted it into homesteads, and to-day, the most popular people of Hilo are erecting beautiful residences thereon. A traverse around the park gives opportunity to view the many miniature falls, "The Bridal Vail," "Maid of the Mist," "Lover's Leap," and the "Silver Cascade." Noteworthy is the fact that Riverside Park residents are supplied with drinking water from the celebrated Waikapu "taboo water," a spring which, in Hawaiian olden days, was held sacred to the use of the high chiefs alone. From here the king Kalaniopuu and later the noted Kamehameha were always supplied, by means of runners, although oftentimes over fifty miles removed, relays of fleet-footed adherents performing the sacred duty. . . (ibid.:49)

Godfrey mentions passing the Hilo Hospital as one continues *mauka* on Waianuenue Street, and provides the following description of the approach to the next destination on the tour, Rainbow Falls as follows:

> Rainbow Falls is the Mecca of all pilgrims to Hilo and its changes are many, all most interesting. The road turns to the left just before reaching the flume of the Hilo Portuguese Mill Co., and a twenty-minute walk brings the traveler on the outskirts of the point of destination. A solitary mango tree, on an elevation to the right, marks the location; passage to which is across a plank through a sugar-cane-bordered passage and trail, until the roar of the Falls is plainly heard and to which all routes lead. (ibid.:51)

Wailuku River Bridges

As illustrated in the historical accounts below, before the time of modern bridges, the Wailuku River presented a formidable barrier for the people of the Hilo Bay area and their neighbors to the north. In 1897, D.H. Hitchcock described the dangers of crossing the Wailuku River when traveling north from Hilo along the "Laupahoehoe Trail," which followed the line of Jail Street (present-day Kinoʻole Street) and led down into the riverbed:

> Here the stream rushes, when in ordinary water, through two narrow channels and then leaps over a fall of ten to fifteen feet. Across these were laid foot wide planks on which pedestrians could cross on foot. Horses had to swim across some distance above and their trappings were carried across the planks, or as was sometimes the case, taken down to near the mouth of the river and there swum across to the Puueo shore. The crossing on foot wide planks, with the rushing waters beneath tearing through these narrow channels, was very precarious, and especially so when the planks were muddy and slippery. Some lives had been lost by the slipping of travelers from the planks. Once in the stream, which ran with the velocity of a millrace, life was gone. (Hitchcock 1897 in Lang 2007:85)

Another account, published by Henry M. Lyman in his autobiography *Hawaiian Yesterdays*, further describes crossing the mercurial Wailuku River on a plank:

> . . . we sometimes walked out to see the freshets in the Wailuku, a mountain stream which flowed in a deep rocky gorge on the north side of the town, about a quarter of a mile from the mission-houses. In fine weather, this was hardly more than a rivulet, spanned by an ordinary plank; but after a long storm it became a raging torrent, many fathoms in width and depth, roaring and dashing over the rocks and ledges and plunging furiously downward, defiling the salt seawater of the bay with mud and drift from the flanks of the mountains between which it had flowed. (1906:63)

When Titus Coan came to Hawaiʻi Island in 1835, he noted an absence of bridges in Hilo. Similarly, Sereno Edwards Bishop indicated the absence of bridges in Hawaiʻi until after 1840 (Bishop 1916). Godfrey makes the following statement in his account of the Wailuku River market "No bridge then existed but the inspectors, in charge of the bartering, levied toll on all who crossed" (1899:43). Contrary to these reports, during a visit to Hilo in 1825, Stewart noted the existence of a "rude bridge" across the Wailuku River, which may be the first of its kind recorded in the Hawaiian Islands. His description of the Wailuku River and bridge is reproduced below:

> The entrance of this river is highly romantic and beautiful, the banks being precipitous and rocky, and covered with a variety of vegetation. About a hundred yards above the beach, it opens into a still deep basin, encircled by high cliffs. Into this basin the whole stream is projected by two cascades, the upper about twenty feet, and the lower about eight feet, both rushing over their respective ledges of rock in unbroken sheets. <u>A rude bridge crosses the stream just above the falls</u>; and it is a favorite amusement of the natives to plunge from it, or from the adjoining rocks, into the rapids, and pass head foremost over both falls into the lower basin. Some of them were engaged in this sport when we arrived, for the gratification of Lieutenants Keith, Talbot, and Gambier, whom we found there. The accession of our party collected a greater crowd, and the cliffs and rocks were quickly covered with men, women, and children, many of whom not only passed over the falls in the manner described, but jumped also from a height of thirty, forty, and fifty feet, into the basin, which, though small, is of very great depth. (Stewart 1828:289-290)

In addition to the turbulent nature of the Wailuku River, natural disasters in the form of tsunami also foiled efforts to span the river and would ultimately lead to the demise of the Hilo Railroad Company. On November 7, 1838, a tsunami made landfall in Hilo Bay bringing widespread destruction in its wake. Twenty years later, per a newspaper article titled "Suspension Bridge in Hilo", $4,000 had been appropriated in the spring of 1858 for its construction and that it was "the first, suspension bridge in the Hawaiian Islands" opened to the public on September 3, 1859 (*Polynesian* September 17, 1859:2). In a letter written by Rufus A. Lyman and published in the *Papers of the Hawaiian Historical Society* in 1904, he describes an incident in late 1859, in which he along with "a good many others" fell into the Wailuku River when they were crossing on horseback from Puʻuʻeo back to Hilo after attending a luau (1904:6). A newspaper article titled "Breakdown of Wailuku Bridge" published on October 29, 1859, corroborates the account (*Polynesian* October 29,1859:2). Figures 18 and 19 depict the former chain suspension bridge across the Wailuku River at present-day Puueo Street, which endured until 1903.

Clearly, the Wailuku River placed limitations on the villagers of Hilo as told in the excerpt about the suspension bridge, "They [Hilo residents] are greatly enjoying the Wailuku Bridge which is open for pleasure riding and business to a large and beautiful reach of country, till lately to most of them like the other side of Jordan, fair to see but hard to come to" (*Pacific Commercial Advertiser* [*PCA*] October 27, 1859:2). According to another historian, "even as late as 1865 the river was spanned only by a chain cable bridge" (Kai 1974:41). And on August 13, 1868, another tsunami struck Hilo and destroyed homes and bridges in Hilo once again.

After her 1874 visit, Jones made the following reference to a chain bridge that likely referred to the rebuilt suspension bridge over the Wailuku:

> And the native from the country, whom we met on the outskirts of the town, driving his taro-laden mules single file across the swaying chain bridge, was beguiling his labor by singing, half unconsciously, another of the old *mélés* which have their root in the hearts of the people. (1881:363)

In 1875, an account of a horseback ride also mentions a wooden bridge over the Wailuku River thusly:

> . . . It is a magnificent ride here. The track crosses the deep, still, Wailuku River on a wooden bridge, and then after winding up a steep hill, among native houses fantastically situated, hangs on the verge of the lofty precipices which descend perpendicularly to the sea, dips into tremendous gulches, loses itself in the bright fern-fringed torrents which have cleft their way down from the mountains, and at last emerges on the delicious height on which this house is built. (Bird 1876:71)

According to an article by Robert C. Schmitt titled "Early Hawaiian Bridges" published in *The Hawaiian Journal of History*, "during the 1880s, or thereabouts, at least two covered bridges spanned streams near Hilo" (1986:153). Schmitt illustrates his statement with a photograph captioned "Covered bridge near Hilo, around 1880" (ibid.), which is reproduced as Figure 20 below.

Between 1909 and 1911, the Hilo Railroad Company (HRC) completed a railroad bridge (Figure 21) across the mouth of the Wailuku River (HRC 1911). On March 31, 1923, the railroad bridge collapsed (Figure 22) "just after one passenger train had crossed and as another was approaching" (Schmitt 1986). The collapse was attributed to the weakening of the structure because of earthquakes and a tsunami that caused 20-foot waves in the area (Loomis 1976:5).

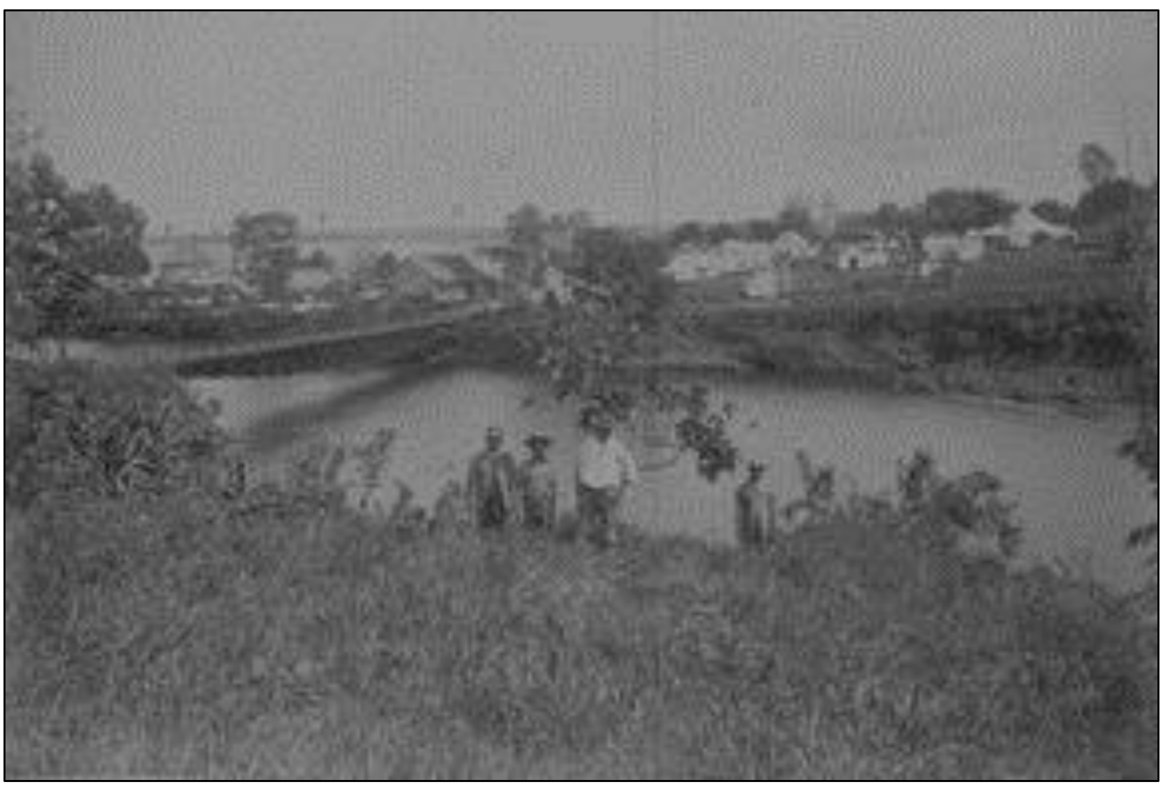

Figure 18. Chain bridge over the Wailuku River, unknown date (Mission Houses Museum).

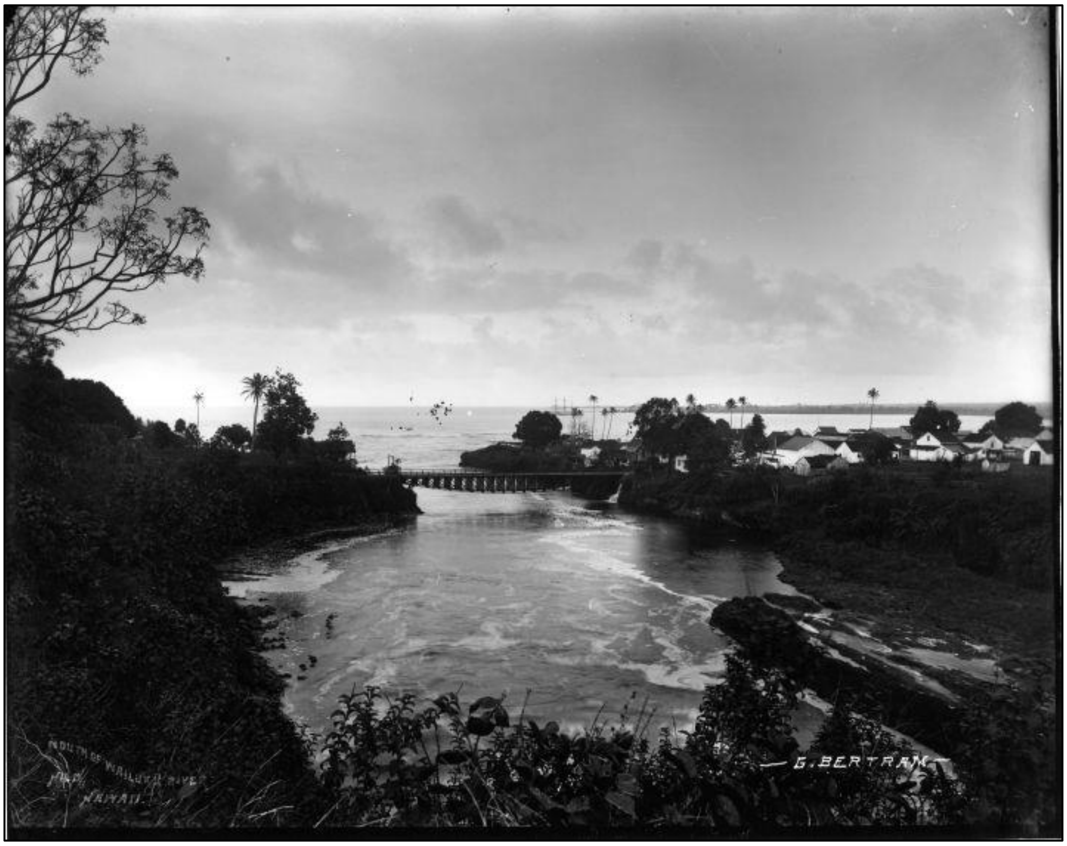

Figure 19. The mouth of the Wailuku River showing suspension bridge, photograph taken between 1883 and 1905 (Brother Bertram Photograph Collection, Ulukau).

Figure 20. Covered bridge over the Wailuku river ca. 1880 (Schmitt 1986:152).

Figure 21. Original HCR and Pu‘u‘eo Street bridges (from Valentine 2014:108).

Figure 22. The original HCR bridge after collapse (Dudley and Lee 1998:102).

The extant Wainaku Street Bridge (Old Mamalahoa Highway) was built in 1919 (Fung Associates 2013:6-26). The extant Wailuku Bridge located at Keawe /Pu‘u‘eo Street was built in 1938 (the date incised upon the concrete). Both bridges survived the devastating April 1, 1946, *tsunami*; in contrast, the violent waves rose over five meters at the mouth of the Wailuku and washed out a portion of the railroad bridge closer to the ocean (Figures 23 and 24). As a result, the HRC went out of business and a new motor vehicle transportation route was built over some of the existing rail bed. The steel bridge is known by many as the “Singing Bridge” was constructed in 1950 at the location where the railroad bridge once spanned the Wailuku (present-day Hawaii Belt Road). Around this time, the sugar industry was switching from train to truck for transportation, but was beginning to wane and will be discussed in further detail below.

Figure 23. Wailuku River looking *makai* showing rebuilt HCR bridge and Pu‘u‘eo Street bridges April 1, 1946. Note: missing span of HCR bridge in the water.

Figure 24. Later wave approaching partially washed out Wailuku River railroad bridge, April 1, 1946 (http://www.ngdc.noaa.gov/hazardimages/picture/show/1116).

The Sugar Industry in Pi‘ihonua And Pu‘u‘eo Ahupua‘a

After the *Māhele* during the middle 1800s, commercial sugarcane cultivation and sugar production became the central economic focus for the Hilo area, as in other harbor towns throughout the islands. By 1874, Hilo ranked as the second largest population center in the islands and within a few years the fertile uplands, plentiful water supply, and port combined to make Hilo a major center for sugarcane production and export. With the annexation of Hawai‘i to the United States in 1898 and the granting of territory status in 1900, Hilo was designated the center of county government in 1905 and remained the second most populated city in the newly formed Territory of Hawai‘i. Sugar cultivation continued to be the island's most lucrative industry and brought dramatic changes to the Hilo area until the 1970s. Some of Hilo's large fishponds (Hanalei, Kalepolepo, Mohouli, Waiāhole, and Hoakumau) were filled and thus destroyed; and many old residences, burial sites, trails, *heiau*, and more were destroyed by the development of sugar plantation fields.

The growing sugar industry prompted the importation of contract labor from China in 1852, from Portugal in 1878, and from Japan in 1884 (among other places), which led to the formation of Hilo's multi-ethnic character (Dorrance and Morgan 2000; Maclellan 1997). However, in an article titled "Chinese Settlers in the Village of Hilo before 1852," Kai (1974:42) explains that a group of Chinese "sugar masters" settled permanently in Hilo well before commercial sugar cultivation became established between 1825 and 1840. These men arrived with knowledge of sugar processing, took Hawaiian wives, and eventually became landowners who spent their entire lives in Hawai‘i. As early as 1843, a Chinese sugar master by the name of Chee In, known as A‘ina in Hawaiian, claimed to own "a Sugar Establishment situated on Piihonua" (ibid.:45) that included a mill on his four-acre property (LCAw. 1783) located along the southern bank of the Wailuku River. Another Chinese settler named Tang Hun Sin known as Akina (or Ahkina) in Hawaiian, had acquired an acre of land (LCAw. 11046B) within Pi‘ihonua by 1840 as well, located *makai* of A‘ina's house lot (ibid.:50).

Kai, a descendant of Akina, reports that according to family tradition, Akina was one of the founders of Amau‘ulu Plantation in Pu‘u‘eo and the 1851 report of the Royal Hawaiian Agricultural Society states that Ahkina had a plantation at Pu‘u‘eo "consisting of 90 acres" (ibid.:52). Benjamin Pitman Jr. is also associated with Amau‘ulu Plantation, as previously mentioned, he acquired over 300 acres near the Wailuku River around 1846. In addition to being a shopkeeper, Pitman was a shrewd businessman who wisely chose to rent land to the experienced Chinese farmers for sugar cultivation beginning in the mid-1800s. According to a historical account by Lyman, Pitman's land was host to "the first sugar-mill established on the Island of Hawaii" (1906:71). Lyman described his first encounter with the Chinese sugar masters and observations made during a subsequent visit to the mill during the mid-1800s thusly:

> . . . the new road extended beyond a dense grove of breadfruit trees to a considerable enclosure where a number of thatched houses had been recently erected. Two or three almond-eyed gentlemen, with long braids of hair coiled about their heads, were persuading a yoke of half-tamed oxen to walk in a circle, dragging after them a beam that rotated three vertical wooden rollers, between which a native boy was insinuating slender stalks of sugar-cane drawn from a pile by his side. . . One of the Chinamen laid down his goad, unrolled his queue, and led us into the boiling-house, where three large trypots, evidently after long service in the extraction of oil from the blubber of the sperm-whale, were set in solid masonry over a fire that was fed with the dry stalks of cane from which the sap had been previously pressed. . . then he showed us the syrup, ladled hot from the kettles, and set aside to crystallize in queer conical jars of porous Chinese earthenware. . . When we visited the place, next year, the old bullock-mill had given way to a larger system of horizontal rollers, connected with a fine overshot wheel turned by a dashing stream of water diverted from its original course to the sea [the Wailuku], and now compelled for the first time in its existence to work for a living. (1906:71)

Whaler Samuel Hill reported further that Pitman "had himself planted" an estate "in the rear of the bay," which was the home of several "Chinese settlers" during a visit to Hilo ca. 1848 (Hill 1856:303). Hill provides further details about the estate:

> We found the estate situated upon elevated ground, between one and two miles from the port, commanding a fine view of the bay and the ocean, and in the midst of a country still rising as it recedes from the shore, and comprehending one of the most fertile districts in the island. It produced chiefly sugar as an article of export, at present; but it was in a fair way of adding the profits of a large coffee plantation.

> We first inspected the sugar department with its various buildings, sheds, and mills. The machinery and apparatus employed, from the gathering in of the crop to the appearance of the sugar, were all at the same time in operation; and the scene was as full of life as if the estate had been in one of our Atlantic islands. In the field, men of the native race were cutting the cane, and boys and girls were running to and fro to supply the mill, which was fed by one single hand, while others were hurrying away with the substance that remains after the cane is exhausted to mix with the leaves, which serve for fodder for cattle.
>
> In the boiling house. . . our attention was arrested by the presence of two of the Chinese who were superintending the works, which led to Mr. Pitman informing us of the plan he had adopted in the management of his estate, and the especial use he was making of the yellow men. (1856:304-305)

Hill goes on to explain that Pitman, like many other wealthy landowners, employed Chinese men as managers of his estate and achieved great success in doing so. Thus, he gave them "direct interest" in the estate's prosperity:

> For this purpose, after averaging the crops of the last two or three seasons, and making calculations upon the chances of the new plantations, he let his estate to the same men he had advanced from labourers to be overseers, at a fixed annual rent, from which arrangement he was reaping great benefit. (ibid.:305-306)

In 1860, Pitman returned to the mainland and sold some of his property to a fellow whaler and merchant from Rhode Island named Thomas Spencer. According to a biographical account titled "Thomas Spencer: Master Mariner-Merchant-Sugar Planter" published by Thrum in his *Almanac and Annual for 1924*,

> Among the lands Spencer acquired from Pitman was a tract under lease to Chinese and planted to cane, known as the Amauulu plantation. This eventually came under Spencer's control and gradually won him away from merchandising. . . As a planter he is said to have labored long to little or no profit. On devoting himself to the sugar business, the old style system of Chinese mill and boiling-house work was done away with—grinding then being done by an overshot water wheel—and a new and modern plant of Watson's Scotch sugar machinery installed. Very naturally the name changed to Spencer's Plantation. (1923:123-124)

According to Dorrance and Morgan (2000), Spencer bought 4,000 acres and a mill in 1867 from Aiko. In 1884, the acreage of Amaauulu Plantation was combined with Wainaku Plantation lands and the Hilo Sugar Company was formed. The Hilo Sugar Company operated unlike most other sugar plantations for it was comprised of many small cane parcels and never had a plantation store; instead, workers shopped in Hilo (ibid.). The manager of the Hilo Sugar Company, John Scott became very influential in the development of Hilo. Among his accomplishments was the organization of the Hilo Electric Company in 1890, which will be discussed in a separate section in the pages that follow.

In the late 1880s, the Hawaii Mill Company began operations on the Alenaio Stream in Piʻihonua (Kelly et al. 1981). By 1905, according to Thrum (1923), the Hawaii Mill Company had 10 miles of cane flumes and produced twenty-five tons of sugar per day. According to a 1907 article written in support of protecting the koa forest titled "Piihonua Land Not Available," the cane lands of the Hawaii Mill Company's sugar plantation extended from 2,000 feet to 5,000 feet in elevation within Piʻihonua (*PCA* August 10, 1907). At that time, Piʻihonua was classified as government land "under a crown lease [no.531] to the Hon. John T. Baker of Hilo" set to expire on March 21, 1921 (ibid.). The upper portion of the tract, above 5,000 feet in elevation was sublet to W.H. Shipman as Puu Oo Ranch, while the remainder of the inland tract was part of the Hilo Forest Reserve, established in 1905. Also at this time, the waters of the Wailuku were used "for irrigation and for turning the power wheels of the Hilo Electric Light Company. For these purposes, it is diverted at points near or below 2000 feet level" (ibid.). The author of the article suggested that the Wailuku River was "one of, if not, the most important streams protected by a forest reserve in the Territory," particularly due to its then current use and "possible further development for water power, irrigation and even for domestic supply—especially in connection with the growth of Hilo town" (ibid.).

In 1923, Hawaii Mill Company was taken over by the Hilo Sugar Company (Dorrance and Morgan 2000). Figure 25 shows the study area vicinity ca. 1922 within the holdings of the Hilo Sugar Company with Amauulu Village nearby. Shortly thereafter, manual cutting was replaced with mechanical harvesting while truck hauling became the preferred mode of transport over fluming. The population of Hilo surged with returning veterans after the end of World War II and in response cane lots in Hilo, such as those depicted in Figure 26 along the south bank of the Wailuku River ca. 1949, were sold off for residential use. Other cane fields were converted to pasturage associated with cattle ranching. In 1965, the remaining fields of Hilo Sugar Company were merged along with those of the Onomea plantation into Mauna Kea Sugar Company. In 1972, Mauna Kea Sugar Company formed a nonprofit called the Hilo Coast Processing Company to harvest and grind sugar on shares. In 1973, Mauna Kea Sugar Company absorbed Pepeekeo Sugar Company's land holdings, which included the former Honomu and Hakalau plantations. The Hilo Sugar Company mill ground its last crop in 1976 (ibid.). By 1994, the Hilo Coast Processing Company and Mauna Kea Sugar milled their last harvest which marked the end of commercial sugarcane production in the Hilo area. The rise and fall of the sugar industry were closely linked with that of the railroad, which is the subject of the next section.

Figure 25. HTS Plat 799 map showing study area and places mentioned in the text.

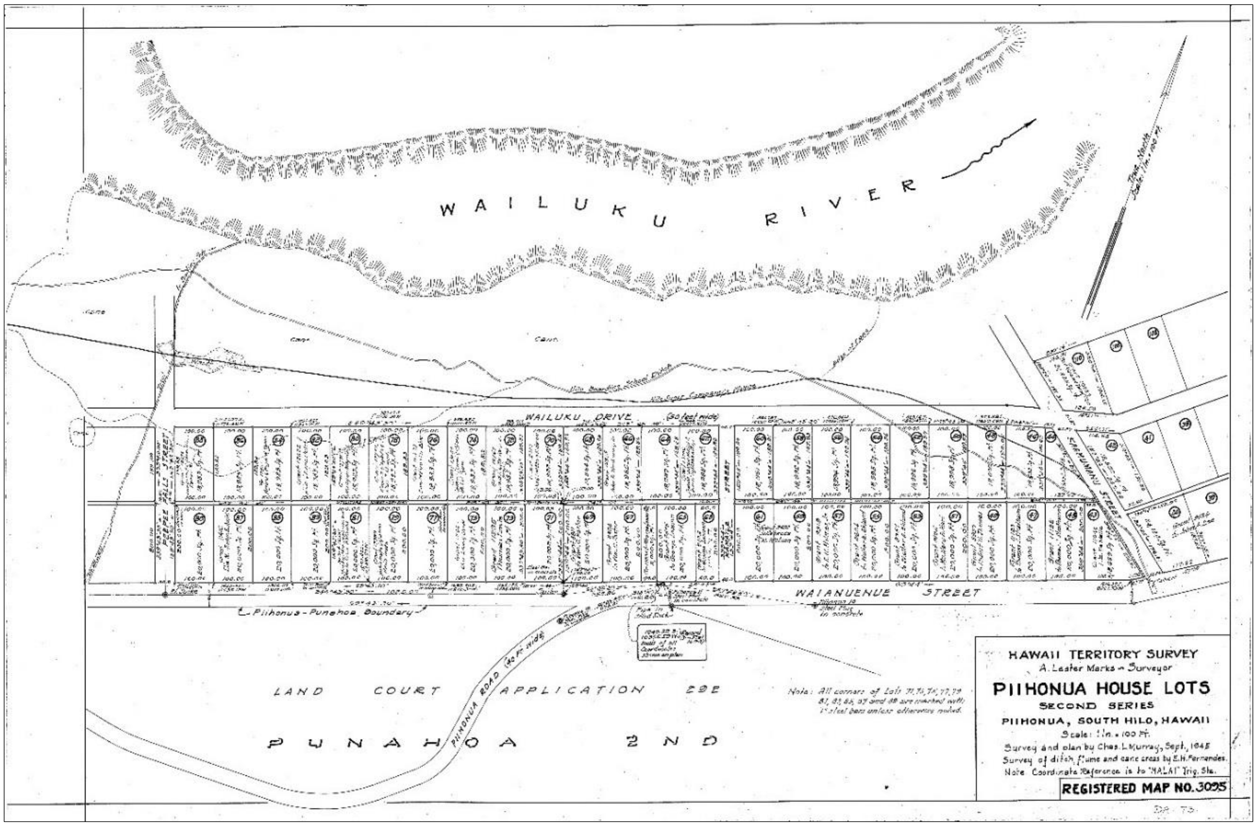

Figure 26. Registered Map No. 3095 showing cane lots located along the Wailuku River in Pi‘ihonua ca. 1949.

Railroad

Beginning in 1899, railroad lines carried sugar to the harbor for marine transport, thus Hilo became an important shipping and railroad hub. Lorrin A. Thurston, who according to Thrum had "been connected with the enterprise from its initiation" (Thurston 1913:142), wrote an article upon the completion of the railroad from Hilo to Paauilo, Hāmākua in May of 1913 titled "Railroading in Hilo" and published in *Thrum's Hawaiian Annual and Almanac for 1914*. Thurston reported that the Hilo Railroad Company (HRC) initiated the railroad endeavor in 1899 from Waiakea south to Ola‘a and onwards to Kapoho. The initial distance of twenty-five miles of track was completed by April 1901. Later that same year, the track was extended along the waterfront of Hilo to the Wailuku River, at the foot of Waianuenue Street" (ibid.:143). In 1903, HRC constructed a wharf at Waiakea and completed a branch line connecting it to the waterfront line.

The sugar industry provided most of the cargo transported by HRC but suffered a decline between the years of 1904-1907, which caused a halt of development in Hilo (ibid.). In response, HRC worked with Olaa Sugar Company to send a representative to Washington D.C. in 1907 to secure funding for the construction of a breakwater that would allow Hilo Bay to accommodate larger ocean-going vessels. The funding of the breakwater by HRC resulted in the extension of the railroad through the populated section north of Hilo all the way to Hakalau, Hāmākua, as follows:

> When the breakwater project was pending before Congress, opposition was made to the appropriation on account of the limited commerce then being transacted through Hilo harbor.
>
> Assurances were thereupon made by the Hilo Railroad Company, that if the breakwater were constructed, a railroad would be built into the country north of Hilo and suitable wharf facilities provided under the lee of the breakwater. Such assurances had a material effect in securing the appropriation. (ibid.:145)

Construction on the breakwater began in 1908 and was still ongoing at the time of Thurstons' writing (ca. 1914); the breakwater was finally completed in 1929.

Between June 1909 and December 24, 1911, HRC built 12.7 miles of rail extending from Hilo to Hakalau; followed by an additional 21 miles of rail that connected Hakalau with Paauilo to the north, which covered a total distance from Hilo of roughly 34 miles and was known as the “Hamakua Division” (ibid.:146). Thurston described the objective of the Hamakua Division thusly:

> The principal object of the extension is to give adequate transportation facilities between Hilo and the fertile and well-settled territory extending for 50 miles north of the town of Hilo, and averaging three to four miles in width. This district produces nearly one-fourth of the entire output of sugar of the Territory and is, including the town, the home of over 30,000 people. The only means of access to this section has heretofore been by wagon road, almost impassable in rainy weather, and by derrick and cable landings over bluffs rising from 50 to 300 feet sheer from blue ocean. There are no harbors. (ibid.:147)

Thurston described the scenery afforded to passengers who travelled on the Hamakua Division as follows:

> Incidentally, the road has opened up one of the most remarkable, unique and spectacular scenic routes to be found in any part of the world. It may appear impossible for a railroad to run through a thickly-settled, highly-cultivated country and yet be noted for spectacular scenery. The paradox is explained by the fact that the district lies along the base and on the steep slope of Mauna Kea, the highest mountain in the Pacific. . .
>
> The combination of steep grade and heavy rainfall has resulted in excessive erosion, the mountain side being seamed at frequent intervals with deep gulches, in which the streams form innumerable cataracts and waterfalls. . .
>
> Some conception of the rugged character of the country can be gained from the fact that in less than 34 miles, there are 211 water openings under the railroad track, ranging from a concrete culvert to steel bridges up to 1006 feet in length and 230 feet high. . . (ibid.147-149)

According to the *Twelth Report of the Hilo Railroad Company* (HRC 1911), between 1909 and 1911, HRC constructed the first bridge of the Hamakua Division, then called the Hakalau Extension, to span the Wailuku River. The following excerpt from the Report of the President and Board of Directors of the HRC described the progress on the Wailuku River railroad bridge for the year ending June 30, 1911, thusly:

> *Hakalau and Paauilo Extension*. Work was commenced on the Extension towards Hakalau in July, 1909, with a small gang of men numbering less than seventy-five in all. The Northernmost end of the road at that time reached the foot of Waianuenue Street, in close proximity to the Wailuku River. To cross this stream in the most suitable place from a railroad engineering point of view, required a bridge 750 feet in length. To withstand the heavy bucking swells from the almost open sweep of the ocean, as well as great freshets from the river, often (in the past) laden with large trees and drift wood from the mountains, it was deemed necessary to construct a series of reinforced concrete piers three feet in diameter, which should reach down through the debris of sand and boulders and be secured to solid rock below, which was done at a depth of 23 to 27 feet. These piers (46 in number, placed 16 feet apart each way) span a distance of 450 feet across the center of the river, while the three hundred feet of shore ends are built up to grade with rock, completing the first bridge on the Extension in a most substantial and enduring manner. (ibid.:4)

The cost of the Hamakua extension ultimately ruined HRC and they were forced to sell out and reorganize under the name Hawaii Consolidated Railway (HCR) in 1916. As previously mentioned, the 1923 tsunami destroyed much of the railroad tracks and infrastructure, which were subsequently repaired and rebuilt. However, the 1946 tsunami dealt the final death blow to the struggling HCR. Despite the failure of the railroad, Hilo saw success in the 1940s related to the pursuit of hydroelectric power, the history of which is particularly relevant to the current study area and discussed in further detail below.

Electricity in Hilo

In 1890, a water-driven dynamo was installed at the Hilo Boarding School, which provided power to the campus and “the first electric lights in Hilo” (Lothian 1985:28). Soon, the school was producing more electricity and providing it free to people who agreed to test it in their homes (HELCO 1994). In response to growing demand, the school applied for a franchise to turn a profit and were rejected; thus, school trustees formed the Hilo Electric Light Company (Hilo Electric) in 1894 (ibid.). In 1898, developer Charles S. Desky and W.G. Irwin proposed the consolidation of Hilo Electric and a projected new company that would expand the extant electric power system (*The Hawaiian Star* December 5, 1898:3). According to an article titled “Electric Power for Hilo” Desky had “made all arrangements for its inauguration” (*Evening Bulletin* January 24, 1899:1 c.3). He was quoted as saying, "I have made satisfactory arrangements regarding the water power of the Wailuku river at Hilo. You know that Hilo Sugar Co. owns one-half and I the other half of that water power. We have arranged the matter so that the water may be utilized for generating electric power.

"A competent hydraulic engineer will shortly come down to look over the premises and make plans for putting in the power plant.

"It is intended to generate in the neighborhood of 10,000 horse power. A company will be organized very shortly for the purpose of going ahead with the work. (ibid.)

The Hilo Boarding School and Hilo Electric kept close ties until 1905 because "the water rights owned by the school allowed them to come to an agreement in the trade of water for electricity" (Lothian 1985:32). Many proponents including developers and Governor Frear believed the Wailuku River could provide prosperity if properly harnessed. The following excerpt from a 1898 advertisement offering "Business Property in Honolulu, Oahu and Hilo, Hawaii" put out by "Financial Agents, Dealers in large Tracts of Land" Bruce Waring & Co. alludes to the imminent prosperity facing Hilo thanks to untapped water power:

Hilo, Hawaii

Is destined to become a large and prosperous city, having an island behind it as large as the State of Connecticut.

The present population being about 5,000.

Money invested in Hilo to-day will bring large returns.

Hilo is the only place in the Hawaiian Islands with immense unimproved water power. There are sixteen water falls within the limits of Hilo, only one of which is being utilized by the Hilo Electric Light Co.

We own and control eight of these falls, which combined will give 30,000 horse power.

We call the attention of manufacturers and electrical men to this immense power going to waste that could be utilized for either power or other manufacturing purposes. (*PCA* October 29, 1898:9)

The advertisement concludes by mentioning three subdivisions in Hilo owned by Bruce Waring & Co.: Puueo "on the bluff at the Sea Shore. One-fourth of a mile from the Court House," Villa Franca, and Princess Ruth Place (ibid.).

Land and water rights for the school became the subject of contentious litigation that went unresolved for many years because the water rights to the Wailuku River given by Kamehameha III were "not received with Quit Claim Deeds" (Lothian 1985:33). In 1912, the "rivalry over Wailuku river power rights" between Hilo Electric and the Conness franchise was coming to a head (*Hawaiian Gazette* February 9, 1912:6). At that time, Hilo Electric leased the rights to the water of the Wailuku from its owner, the Hilo Boarding School. In 1915, the Hilo courts settled the water rights claim and in 1917, the Supreme Court upheld the decision and allowed the school to use 5,590,000 gallons of water every twenty-four hours (Lothian 1985:33-34).

In 1910, Hilo Electric constructed the Pu‘u‘eo Plant along the lower Wailuku River; ten years later they constructed the Waiau Plant upstream (HEC 2017). These two hydroelectric plants are arranged in tandem. The Pu‘u‘eo Plant was upgraded in 1941, and the Waiau Plant was upgraded in 1947. In 1970, Hilo Electric was purchased by Hawaiian Electric Company and in 1975, its name was changed to Hawaii Electric Light Company (HELCO). In 1998, HELCO refurbished "penstocks (pipes that divert water to the plants) of both facilities" (ibid.). Today, each plant generates electricity with horizontal-axis, Pelton hydraulic turbines from run-of-river water flow (a diversion and intake structure) as its energy source; the current system size of 1.15 MW for the Waiau Plant and 2.25 MW for the Puueo Plant (ibid.).

PRIOR STUDIES

Since the early 1900s, several studies have examined where Precontact and Early Historic Hawaiians established settlements in the area near Hilo Bay. The earliest archaeological study in the Hilo area appears to be that of Thomas G. Thrum, who created a list of the *heiau* of ancient Hawai‘i. Thrum published his list of *heiau* in a series of entries titled "Tales from the Temples" in the *Hawaiian Almanac and Annual*, beginning with the 1907 edition. Of his investigations, Thrum noted the following:

This much is being realized, and expressions of regret have been freely made, that we are at least fifty years too late in entering upon these investigations for a complete knowledge of the matter, for there are no natives now living that have more than hear-say information on the subject, not a little

> of which proves conflicting if not contradictory . . . While these difficulties may delay the result of our study of the subject, there is nevertheless much material of deep interest attending the search and listing of the temples of these islands that warrants a record thereof for reference and preservation. (1906:49-50)

Thrum and his associates, W.T. Brigham and J.F. Stokes of the Bishop Museum, compiled information on over 130 *heiau* on Hawai‘i (Thrum 1907a). However, one must take into consideration that Thrum included data on *heiau* that had already been destroyed prior to his data collection efforts in the early 1900s. Regarding the *heiau* of the Hilo district, Thrum stated: “little evidence of their existence now remains, so complete has been their destruction, but though their stones are scattered, much of their history is yet preserved” (1907b:55). The results of his investigations relative to the current study area *ahupua‘a* are reproduced in Table 2 below.

Table 2. *Heiau* and *heiau* sites recorded by Thrum (1907a/b) in the current study area vicinity.

Name	*Location*	*Thrum's Remarks*
Kanowa, or Kanoa	Puueo	Site of L. Severance’s house; of medium size, about 80x60 ft., consecrated by Kalaniopuu to his war god Kaili; Luupule its priest. Its walls were thrown down prior to 1853, and entirely destroyed for roads in 1898.
Kaipalaoa		Near armory site and the foot of Waianuenue street, Hilo: of pookanaka class; the heiau at which Umi’s life was threatened and the place where Kamehameha I is said to have proclaimed his “Mamalahoa” law. Destroyed in the time of Kuakini’s governorship of Hawaii.
Kiniakua		Near Waikapu Spring; a small heiau of hooulu ai class, now entirely destroyed.
Papio	Piihonua	Back in the forest; a heiau for canoe builders and bird catchers.

Regarding the *heiau* known as Kanoa located near the current study area, Thrum noted that it was the “most prominent” (Thrum 1907b:55) *heiau* in the district although the year it was built was unknown. Thrum also cites Fornander’s *Account of the Polynesian Race*, as his source for the information regarding the consecration of the *heiau* by Kalaniopuu to his war-god Kaili, “when he set out to subdue the rebel chief Imakakaloa, in Puna” (ibid:56). Thus, Thrum interpreted the *heiau* as a “war heiau of the pookanaka class” with “Kane and Kanaloa its deities, in latter years” (ibid.). Regarding the heiau known as Kaipalaoa, Thrum provides the following further details: “the place where Keoua sacrificed Keawemauhili, Moi of the Hilo district, whom he had defeated about 1790” (ibid.). As previously mentioned, Kaipalaoa was also the site where Kamehameha sacrificed the rebel chief Namakeha (Fornander 1918-1919; Kamakau 1991).

Also of interest to the current discussion, is Thrum’s account of the origin of the aforementioned Pinao stone, which presently rests in front of the Hilo Public Library. According to Thrum,

> In the premises formerly owned by Kipi, on Waianuenue street, is a large boulder known as Pinao, which is said by old natives to have been the stone on which Keawemauhili was sacrificed. It was formerly a part of the heiau of Kaipalaoa, and was being taken for the building of the first Haili chirch, but for some reason it was left in its present locality. (ibid.)

In 1906, J.F.G. Stokes conducted an archaeological survey (Stokes and Dye 1991) with the sole purpose of recording *heiau* for the Bishop Museum. Stokes traversed the same route around Hawai‘i Island that the Missionary Ellis took in 1823. While conducting fieldwork in the district of Hilo, Stokes “relied on Caucasian sugar growers for information on the whereabouts of heiau platforms,” which resulted primarily in “recollections of where a heiau stood before it had been destroyed to plant cane” (ibid.:12). Stokes’ brief discussion of the Hilo District reads thusly, “In Hilo, as in Honolulu, the heiau have entirely disappeared and their history is lost or has become confused” (ibid.:154). He continues by citing Thrum’s aforementioned list of *heiau* for the region (Thrum 1907a) and by adding a dozen *heiau* sites with their approximate locations (ibid. 154-157). Each of the twelve additions Stokes made is listed as destroyed. Although part of Thrum’s list, Stokes included descriptions of Kaipalaoa and Kiniakua *heiau* in his so-called addition: “Probably located just west of Isabelle Point. The native name of this point is Kaipalaoa” (ibid.:154). Stokes also described three *heiau* that formerly stood within the study area vicinity: Pinao Heiau, located at “the west corner of Pleasant (now Ululani) and Waiānuenue Street” ; Kinailoa Heiau in Pu‘u‘eo Ahupua‘a, “located on Pueo Avenue”; Kānoa Heiau, “a heiau for human sacrifices” also located in Pu‘u‘eo Ahupua‘a, “at the eastern end of Kanoa Street, near the sea cliff” to the northeast of the current study area (ibid.).

Between 1930 and 1932, Alfred Hudson conducted archaeological fieldwork as part of an attempt to inventory the sites of eastern Hawaiʻi Island for the Bishop Museum. Of heiau sites in the study area vicinity, Hudson noted that there were "probably 6 in the immediate vicinity of Hilo with others close by" (1932:37). Hudson mentions Kanoa Heiau as one of four temples for which there is "traditional record" of there having been been "altered and reconstructed at least once" (ibid.:45). In his fieldwork summary for Hilo and vicinity, Hudson states "no archaeological remains are to be found within the town of Hilo itself except a few stones which are said to have been taken from heiaus…" (ibid.:226). Hudson then reproduces much of the descriptions of the various heiau sites as presented above. In addition, he provides the following detail about Papio Heiau, "Mr. John Akau thinks that this site was near Laiaole falls in the Wailuku River, but a careful search failed to reveal any indications of it" (ibid.:241). Hudson also provides the following insight:

> . . . the houses of the chiefs stood along the beach below the site of Kaipalaoa heiau. Mr. Henry Lyman tells me that Puueo was a restricted district in which the common people were not allowed to live. A slight air of aloofness still seems to cling to the Puueo neighborhood. (ibid.:240)

During the four decades between Hudson's site inventory survey and the implementation of environmental review as an integral part of construction and development on Hawaiʻi Island in the 1970s, no relevant cultural resource reports were produced. But by the 1980s, stricter environmental regulations led to an increase in the number of archaeological and cultural studies undertaken throughout Hilo. Since then, numerous archaeological studies have been conducted both to the north and south of the current study area within Piʻihonua and Puʻuʻeo *ahupuaʻa* (Table 3). The results of the most relevant and proximate of these studies are discussed below and their locations are depicted in Figure 27.

Table 3. Previous archaeological studies conducted within the vicinity of the study area.

Year	*Author*	*Ahupuaʻa*	*Type of Study*
1976	Walters, Kimura and Associates	Piʻihonua	Inventory Survey
1978	Sinoto	Piʻihonua	Inventory Survey
1980	Rosendahl	Puʻuʻeo	Reconnaissance Survey
1988	Rosendahl	Piʻihonua	Reconnaissance Survey
1991	Goodfellow	Puʻuʻeo	Reconnaissance Survey
1992	Kennedy	Puʻuʻeo	Inventory Survey
1992	Spear	Piʻihonua	Inventory Survey
1996	Walker and Rosendahl	Wainaku, Ponahawai, Piʻihonua, Waiākea	Inventory Survey
1997	Walker et al.	Piʻihonua	Inventory Survey
1999	Wolforth	Piʻihonua	Data Recovery
2004	Clark and Rechtman	Piʻihonua	Assessment and Limited Cultural Assessment
2004a	Rechtman	Piʻihonua	Inventory and Limited Cultural Assessment
2004b	Rechtman	Piʻihonua	Assessment
2009	Wilkinson and Hammatt	Piʻihonua	Field Inspection, literature review
2013	O'Hare et al.	Puʻuʻeo	Field Inspection, literature review, subsurface testing
2015	Barna and Rechtman	Piʻihonua	Inventory Survey

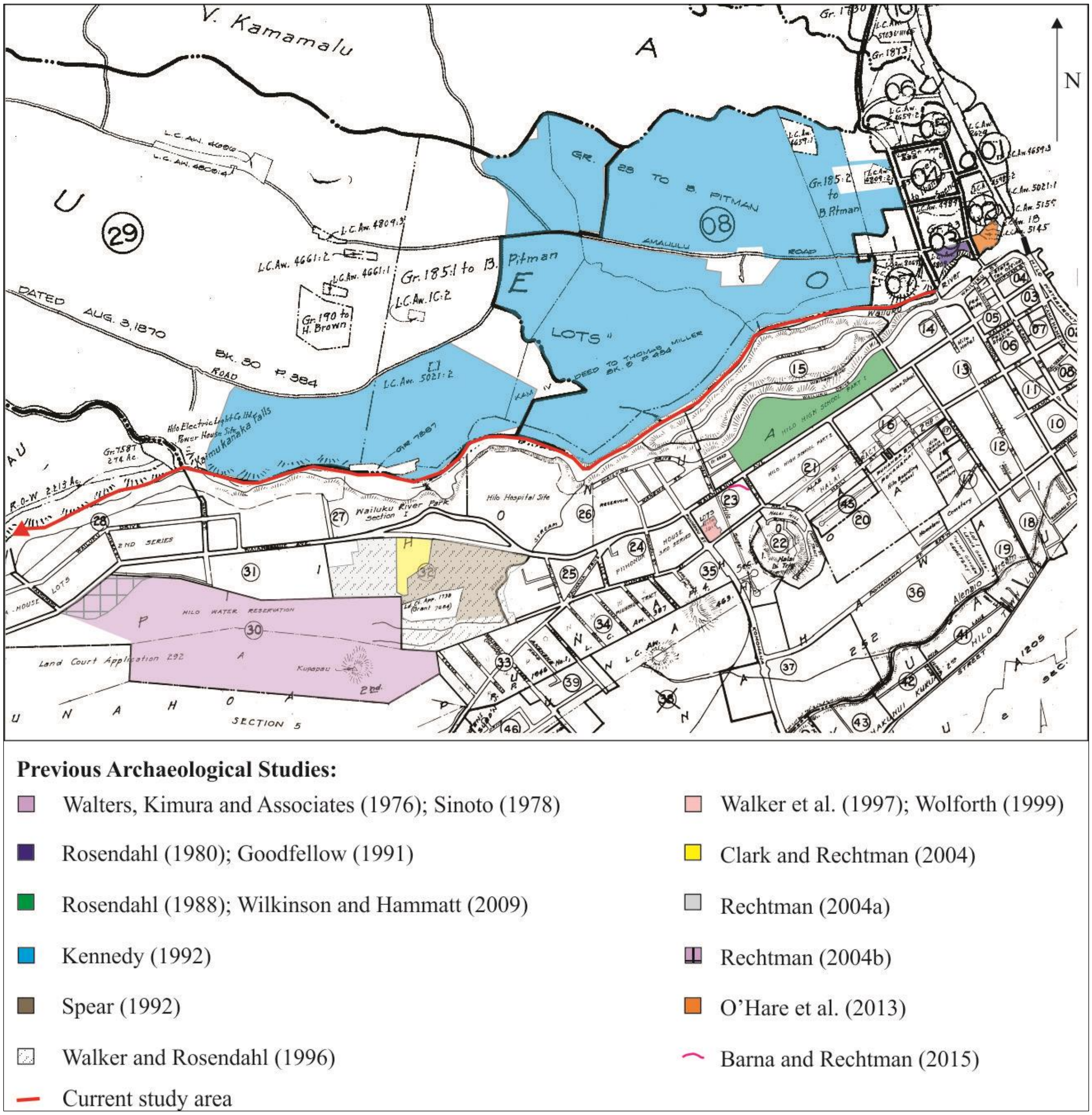

Figure 27. Previous archaeological studies conducted in the vicinity of the current study area.

In 1976 Walters, Kimura and Associates (W.K.A.) investigated a 117-acre area as part of an environmental assessment for the proposed Kaumana Springs Wilderness Park (TMKs:[3] 2-3-030:001, 002, 004, and 005), located to the south of the current study area (see Figure 27). In their report, W.K.A. failed to recognize the historic significance of agricultural features that they encountered reasoning that the area had been extensively altered by historic cultivation. However, two years later, the Bishop Museum conducted a reconnaissance survey (Sinoto 1978) of the same parcel(s) and found that the majority of the study area had not been impacted by historic cultivation as W.K.A. had claimed. To the contrary, as a result of the 1978 fieldwork, six clusters of Precontact agricultural and habitation features were identified; such features included stone terraces, alignments, walls, mounds, cairns, platforms, enclosures, *'auwai,* and stone reinforced stream banks. Sinoto noted that some of the walls appeared to be associated with more recent ranching activities. He suggested that the area represented a single continuous site, State Inventory of Historic Places (SIHP) Site 18696 and that the paucity of sites in the surrounding areas was due to mechanized agricultural activities.

In 1980, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological reconnaissance survey (Rosendahl 1980) of the then-proposed Kuuipo I Resort Condominium Site (TMKs: (3) 2-6-002:001-004) located just *makai* of the current study area on the north side of the Wailuku River (see Figure 27). As part of the investigation, they examined the exposed surface of a cut bank along the Wailuku River, which they interpreted as a possibly undisturbed deposit; this deposit was comprised of "fire-cracked rock, pieces of several species of marine molluscs, candle-nut (kukui) shell, and a few fragments of artifacts" as well as "a small hearth or fireplace and a pavement of small. Waterworn cobbles and pebbles" (Goodfellow 1991:4). As a result of their fieldwork, the only structural remains encountered "were those resulting from the recent historic period occupation of the project area" (ibid.). The results of this study formed the basis for a later report, discussed the following paragraph.

A decade later, PHRI conducted an AIS, of the 1.73-acre Noelani Gardens Project Site (Goodfellow 1991) located just *makai* of the current study area on the north side of the Wailuku River on TMKs: (3) 2-6-002:001 and 002 (see Figure 27). A portion of this project area was the subject of the PHRI reconnaissance survey (Rosendahl 1980). In addition to pedestrian survey, PHRI conducted limited subsurface testing that consisted of eleven backhoe trenches and four shovel test units excavated along the north bank of the Wailuku River. Charcoal samples recovered from five of the backhoe trenches and all shovel test units were subsequently radiocarbon dated to A.D. 1400-1670. As a result of the fieldwork, an artifact assemblage consisting of Historic items (glassware, ceramics, metal, etc.) related to domestic activities was recovered from the previously disturbed ground surface. Additionally, Goodfellow recorded several Precontact hearths, Historic refuse, and recent structural remains; all of which, were designated as SIHP Site 15415. No further work was the recommended treatment for this site.

In 1988, Paul H. Rosendahl Ph.D., Inc. (PHRI) conducted a reconnaissance survey (Rosendahl 1988) of five parcels encompassing a total of 26.30 acres in Pi‘ihonua, Punahoa 1, Kukuau 1 and 2, Ponohawai, and Waiākea *ahupua‘a* as potential sites for the Hilo Judiciary Complex. Of the five parcels, only one located just south of the Wailuku River is in close proximity to the current study area (see Figure 27). However, no archaeological sites or cultural resources were recorded.

In 1992, Archaeological Consultants of Hawai‘i conducted an AIS (Kennedy 1992) of 482.04 acres of inland Pu‘u‘eo (TMKs: [3] 2-6-008:026-029, 031-033, 035-039 and [3] 2-6-029:009-012, 014, and 014) along the north bank of the Wailuku River, immediately adjacent to much of the current study area (see Figure 27). Kennedy noted that the project area had been heavily disturbed during the last half of the nineteenth century for sugarcane cultivation. However, he did identify and record a single archaeological site (SIHP Site18074) a low rock mound interpreted as a probable Historic Period burial, located in the western portion of his project area- *mauka* and north of Rainbow Falls.

Also in 1992, Scientific Consultant Services (SCS) conducted an AIS (Spear 1992) of a 12-acre parcel (TMK: [3] 2-3-032:001B) located along the southern edge of Waiānuenue Avenue, to the south of the current study area (see Figure 27). As a result of the survey, Spear identified two Historic stacked stone walls and concluded that one of the walls was likely associated with cattle ranching, and that the other may have been used as a retaining wall for water control and erosion prevention associated with sugarcane cultivation or cattle ranching. The sites were determined no longer significant "sufficient information" had been collected from both sites; thus, no further work was the recommended treatment.

Four years later, PHRI conducted an archaeological assessment (Walker and Rosendahl 1996) of seven proposed locations for the Hilo Judiciary Complex (Sites A-G) located throughout Hilo. One of these study area locations (Site F/TMK:[3] 2-3-032:001) encompassed the Spear (1992) study area (see Figure 27). Based on the assumption that the 42.3 acres had likely been impacted by Historic sugarcane cultivation, PHRI surveyed only 11% (approximately 4.6 acres) of the property (a large portion of the current project area was included in the 4.6 acres). Walker and Rosendahl recorded no sites within the 4.6 acres they surveyed. Ten years later, Rechtman Consulting, LLC (RC) conducted an archaeological survey as part of the preparation of a request for determination of "no historic properties affected" (Rechtman 2004a) associated with the proposed expansion of the Hilo Hospital facility on a roughly four-acre portion of the same parcel (see Figure 27). As a result of the fieldwork, no historic properties were identified and Rechtman noted that the property had previously undergone substantial alteration in the past including, but not limited to, mechanized clearing and earth moving.

In 1996, PHRI conducted a limited AIS (Walker et al. 1997) of a portion of the Hilo County Correctional Center (HCCC) parcel (TMK:[3] 2-3-023:005), located to the south of the current study area (see Figure 27). As a result of their study, they identified two historic ditches, SIHP Sites 20848 and 20849. Later that same year, PHRI conducted data recovery (Wolforth 1999) of those sites (see Figure 27). As a result of their investigation, PHRI determined that while Site 20849 is a small branch of a larger ditch system, Site 20848 is an older, more natural looking 400-meter waterway that connects with the Piʻihonua Ditch (SIHP Site 21228) on the Hilo Church of God parcel.

In 2004, RC conducted an archaeological inventory survey and limited cultural assessment (Rechtman 2004b) of a parcel located along the southern edge of Waiānuenue Avenue (TMK:[3] 2-3-30:5 por.;see Figure 27) that was a portion of the area that had been previously surveyed by Sinoto (1978). As a result, Rechtman recorded two Historic stone wall remnants (SIHP Sites 24267 and 24268). The sites appeared to have been previously disturbed and were interpreted as agricultural and residential features dating to a time prior to the development of commercial sugarcane cultivation.

Also in 2004, RC conducted an archaeological and limited cultural assessment (Clark and Rechtman 2004) of 5.4-acres for the expansion of the Arc of Hilo facility (TMKs: [3] 2-3-032:006-008), located to the south of the current study area within Piʻihonua Ahupuaʻa. (see Figure 27). As a result of their fieldwork, RC found no historic properties in the project area, which had been previously bulldozed.

In 2009, RC prepared a cultural impact assessment (Rechtman and Lang 2009) for the Hilo Bayfront Trails project spanning the *ahupuaʻa* of Piʻihonua, Punahoa, Ponahawai, Kūkūau, and Waiākea. Their study included a detailed culture-historical background for all five of the primary *ahupuaʻa*, as well as a history of land use from Precontact through modern times for the region. Oral interviews were conducted with Leslie Lang (co-author of the study), Manu Meyer, Luahiwa Lee Loy Namahoe, and Sean Kekamakūpaʻa Lee Loy Browne. As a result of the study, Rechtman and Lang concluded that there were no specific resources or traditional practices identified that would be impacted by the development and use of the trail network; although they did caution that there was potential for previously undiscovered subsurface resources to be encountered during development activities.

In 2009, Cultural Surveys Hawaiʻi, Inc. (CSH) conducted an archaeological field inspection and literature review (Wilkinson and Hammatt 2009) for the proposed construction of a new gymnasium within the 24-acre Hilo High School parcel (TMK: [3] 2-3-015:001), located north of Waianuenue Avenue to the south of the current study area (see Figure 27). The *makai* portion of their study area had previously been examined by PHRI (Rosendahl 1988), which had resulted in negative findings. As a result of the 2009 fieldwork, five previously identified historic properties comprising Hilo High School (SIHP Site 7522) were recorded in addition to a previously unidentified ditch and *pāhoehoe* alignment, which they described as potential historic properties and assigned only temporary site numbers. Historic and architectural significance assessment was the recommended treatment for the five previously identified properties; and further documentation and research in the form of an AIS was recommended for the newly identified ditch and alignment features, if the proposed development would impact them.

In 2013, CSH conducted an archaeological field inspection, literature review, and subsurface testing (O'Hare et al. 2013) for the Stream Bank Bluff Protection and Stabilization project for the Riverside Apartments (TMK: [3] 2-6-003:009 por.), located to the north of the *makai* end of the current study area (see Figure 27). As a result of the fieldwork, no historic properties were identified.

In 2015, ASM Affiliates conducted an AIS (Barna and Rechtman 2015) of a 5,037 square-foot State-owned drainage easement bisecting TMK: (3) 2-3-023:006 in Piʻihonua Ahupuaʻa, to the south of the current study area (see Figure 27). This drainage easement was previously identified by PHRI in 1996 (Wolforth 1999) as a portion of the Piʻihonua Ditch (SIHP Site 21228). However, no Precontact or Historic Period elements of Site 21228 were observed during fieldwork, and it was concluded that the site had been modified to the point where it failed to retain integrity of design, setting, materials, workmanship, or feeling pertaining to its former use as an earthen irrigation ditch.

3. CONSULTATION

When assessing potential cultural impacts to resources, practices, and beliefs; input gathered from community members with genealogical ties and/or long-standing residency relationships to the study area is vital. It is precisely these individuals who ascribe meaning and value to traditional resources and practices. Community members may also possess traditional knowledge and beliefs 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 traditional cultural properties that may be identified. It is the researcher's responsibility, therefore, to use the gathered information to identify and describe potential cultural impacts and propose appropriate mitigation as necessary.

As part of the current investigation, Lokelani Brandt met with several community members with ties to the Wailuku River or those having in-depth knowledge of the Wailuku River and its connection to the broader island ecosystem. Individuals and organization contacted included: Leilehua Yuen, Manulani Meyer (who referred us to Luana Busby-Neff and Leilani Ka'apuni), Cheyenne Perry (Mauna Kea Watershed Alliance), Ronald Kodani (Pi'ihonua Hawaiian Homestead Community Association). Additionally, a complete copy of the current study was provided to the Office of Hawaiian Affairs.

LEILEHUA YUEN

Leilehua Yuen is a long-time Hilo resident and Native Hawaiian artisan with an extensive background in *hula*, music, and storytelling. Leilehua currently lives with her spouse on the northern face of Pu'u Hāla'i which is located approximately a quarter mile south of the Wailuku River. Many of the *mo'olelo* that Leilehua shared had been passed down in her family or taught to her by noted Hawaiian cultural specialist like the late aunty Nona Beamer. When asked about her understanding of the Wailuku River, Leilehua emphasized the Hawaiian cultural significance of the Wailuku River and articulates the *mo'olelo* associated with the many *wahi pana* (legendary places) located along the length of the river. Such areas include Waiānuenue (Rainbow Falls), Pe'epe'e (Boiling Pots) and its connection to water guardian, *mo'o* Kuna, the goddess Hina and her son Māui. In regards to *mo'o* Kuna, Leilehua considers the endemic and indigenous freshwater animals to be his *kinolau* or physical manifestations. She also articulates the *mo'olelo* of Kamehameha I as he traveled up the Wailuku River to Koloiki (Reed's Island) to meet with a *wahine* (woman), thus leaving his guards to tend to his canoe at the mouth of Wailuku. In the absence of Kamehameha I, his guards tie up his canoe by crafting cordage made from the *kī* (*Cordyline fruticose*) plant using a braiding technique known as *hilo*, meaning to twist, or braid (these *mo'olelo* have been documented and are presented in a preceding section of this report).

When asked about the potential cultural impacts, Leilehua expressed several concerns. First, she commented on the importance of returning the waters back to the river once it has passed through the hydropower plant. She also notes the importance of returning the water back to the river at the proper temperature. She contends that HEL should ensure the water is returned at the proper temperature or it will have an adverse impact on *mo'o* Kuna's *kinolau* (i.e. the various freshwater animals residing in the Wailuku River). Leilehua also highly encourages HEL to be more expressive of their *kuleana* (responsibility, privilege) to take care of the river and the greater riparian system to ensure continuous water flow. Leilehua comments that although rivers have been traditionally used by Native Hawaiians, it was done so mindfully and with a profound understanding of the interconnectedness of the water to the greater ecosystem. Considering this, Leilehua highly encourages HEL to be proactive in supporting water resource management efforts through forming partnerships to improve and maintain the health and condition of the Wailuku River. Given that HEL has and will likely continue to benefit from utilizing the river water, Leilehua also highly encourages HEL to develop educational outreach material that will improve the public's understanding of Hawai'i's unique rivers and streams. She notes that educational outreach can lead to an improved public understanding of rivers and streams and the connection to energy consumption in Hawai'i. Finally, Leilehua recommends that HEL develop a riparian systems protocol that will help guide their efforts and attempts at responsibly utilizing the water from the Wailuku River.

LUANA BUSBY-NEFF & LEILANI KA‘APUNI

Luana Busby-Neff and Leilani Ka‘apuni are two Native Hawaiian women from Hilo, with a long-history of activism and advocacy in protecting Hawai‘i, the *‘āina* (land) and its people. On July 7, 2017, Lokelani Brandt conducted an informal interview with both Luana and Leilani in downtown Hilo, less than a quarter a mile southeast from the study area. Both Luana and Leilani conveyed the Hawaiian cultural significance of the river through the sharing of some legendary *mo‘olelo* of the Wailuku River, such as that of *mo‘o* Kuna and Hi‘iakaikapoliopele and her victory over the malevolent *mo‘o* spirits. Luana conveyed the cultural significance of *mo‘o* as these are not merely a reptile like creature, rather they have a very specific role and function in maintaining the integrity of waterways. Both Luana and Leilani also shared personal *mo‘olelo* that spoke to the notion of the river as a *living* [emphasis added] entity with the capability of taking life, which they remind, is a cultural understanding reinforced in the name of the river.

Although Luana and Leilani are in favor of generating energy from renewable sources, they both expressed some concerns specifically for hydropower. One such concern is what are and what have been the impacts of the hydropower plant on the quality and temperature of the water after being discharged from the plant? Both Luana and Leilani wish to see the water quality and integrity be maintained, especially after discharge lest additional harm be imposed on the various marine species living downstream of the hydropower plants. They also commented on the impacts that may result from the actual construction work, and propose that HEL develop a protocol to mitigate this issue. Luana and Leilani also emphasized the value of HEL being more transparent about their clean energy initiatives by hosting public meetings to engage with the community. They urge HEL to be a leader in moving Hawai‘i towards clean, renewable energy and in the process, continue to engage with the communities they currently serve in more meaningful ways. Both Luana and Leilani believe there are tangible ways that HEL can move forward with this proposed project in a manner that is *pono* (virtuous, beneficial) for the company, the Wailuku River, and community. They propose HEL come up with creative ways for community and environmental give back through forming partnerships and alliances that can aid in improving the health and condition of the river and Hilo Bay. They believe that if HEL can be consistent in their mission of moving towards clean energy that they will be able to build trust and credibility in the community.

CHEYENNE PERRY

Cheyenne Perry is a long-time Hilo resident and Native Hawaiian with an extensive background in watershed and land management. On July 10, 2017, Lokelani Brandt conducted an informal interview with Cheyenne at the USDA Forest Service Institute of Pacific Islands Forestry located in Hilo. Cheyenne is currently the Coordinator for the Mauna Kea Watershed Alliance and facilitates communication and watershed management on partnership lands of approximately 343,000 acres on Hawai‘i Island. Through his work, Cheyenne has spent time researching, surveying, and hiking along the entire length of Wailuku River. When asked about the cultural significance of the Wailuku River, Cheyenne recounted many legendary stories. In particular, Cheyenne noted the story of Hina, Māui and their battle with Mo‘o Kuna. Cheyenne attributes the battle between Māui and Mo‘o Kuna to the geological formation of the area known as Pe‘epe‘e (Boiling Pots). He also shared some stories that have been taught to him by Kumu Kekuhi Keliikanakaoleohaililani, which tell of Mo‘o Kuna being the guardian of the lower half of the Wailuku River, while another *mo‘o* named Wailuku was the guardian of the upper part of the river. Other stories referenced by Cheyenne is that of Maui and his kite, the story of Kana, as well as the story of Kamehameha and how Hilo received its name. He also noted the *heiau* of Kanoa that once stood near the mouth of the Wailuku River. Cheyenne also pointed out the presence of springs along the river, in addition to *‘āhiu* (wild) cultigens like *kalo* (*Colocasia esculenta*), *mai‘a* (*Musa* sp.) and *olonā* (*Touchardia latifolia*) planted in flats. Through his observations, Cheyenne is confident that in the past, Wailuku and the surrounding springs was an important source of food and fiber.

In looking at the river from a watershed management perspective, he reiterated the synergistic nature of Wailuku in relation to the neighboring lands and forests. He emphasized the importance of properly managing the nearby native forests through efforts such as reforestation, ungulate control, and preventing the spread of diseases like defoliation and Rapid ‘Ōhi‘a Death. He stressed how continued degradation of the native forest will affect the forests’ ability to capture water and prevent erosion. Additionally, he reminds how maintaining a healthy forest helps to cool the air temperature and slow the movement of water during large storm events. Cheyenne believes there is ample opportunity for HEL to develop partnerships with local agencies to improve and aid in the management of the Wailuku River watershed.

When asked specifically about his concerns, Cheyenne feels the project appears to be one with relatively low impact. However, he expressed concern for the wildlife in the river and would like to see steps taken that will reduce any impact on native river species. In particular, Cheyenne would like to ensure the technology used in the hydropower plants does not interfere with the natural migration of endemic river species. Another concern was with regard to any physical construction that may take place at the hydropower plants. Cheyenne, notes that ground disturbance may result in runoff that could have an adverse impact on the water and wildlife. Cheyenne would like to see the proper protocols developed to mitigate any impacts to the river.

HAWAIIAN HOMESTEAD COMMUNITY ASSOCIATIONS

On August 12, 2017, Robert Rechtman, Ph.D. and Lokelani Brandt, M.A. conducted a group interview with select members representing the Piʻihonua, Kaūmana, Keaukaha, and Panaʻewa Hawaiian Homes communities. After Lokelani made initial contact with Ron Kodani, he felt it was necessary to include other knowledgable individuals in the discussion. Ron and Doreen facilitated the meeting and invited individuals they felt could contribute valuable input to the discussion. Fifteen individuals were contacted, and thirteen individuals attended the meeting and shared their thoughts on the proposed project. The meeting was organized by Ronald Kodani, acting Vice president for the Piʻihonua Hawaiian Homes Community Association (PHHCA), and his wife Doreen Kodani, acting President for PHHCA. This conglomerate included Gerald “Jerry” Mauhili, James “Kimo” Laau, Skylark Rossetti, Alma Kukui Welborn, Duncan Seto, Kamuela Bannister, Maile Kalahiki, Shayle Ihilani Miyasato, Jeno Enocencio, Louis and Leifi Hao, and Ron and Doreen Kodani. The following section summarizes the key themes shared at the meeting.

When asked about the traditions and cultural uses associated with the river, Duncan Seto highlighted some of the *moʻolelo* associated with the Wailuku River, such as the *moʻolelo* of Moʻo Kuna and Maui. He emphasized that the tradition of orally transmitting these *moʻolelo* to his *moʻopuna* (grandchildren) lives on in his family. Both Alma Kukui Welborn and Jerry Mauhili spoke about their family traditions of offering a *pule* (prayer) upon entering and exiting the water to show respect for the river. In addition to the mythic beings associated with the Wailuku River, Jeno Inocencio provided some background on water use during the plantation era. Jeno recollected how the sugar companies tapped into the springs that were directly fed by the Wailuku River to supply water to the processing factories. Jeno shared that his grandfather assisted with the construction of the flume for the Hilo Sugar Company and Puna Sugar Company. He described how the flume diverted water from Wailuku River and transported it to Puna where it was used to process the cane. He remarked that many springs were covered up by the sugar companies so they could better manage the water. In addition to sugarcane, Jeno also described how the areas along the river were used for fishing and hunting. Jeno also noted the presence of *ʻōpae* (shrimp) in the river. Maile Kalahiki spoke about her family home located in Piʻihonua along the Wailuku River. She recalled their pasture located in the back of their home being filled with springs on a year-round basis, and that her sister planted *kalo* (taro) in their pasture. More recently, Maile has observed that these springs no longer emerge like they used to. Maile and Jeno commented that although we may not see changes on the surface, there are changes taking place underground that impacts the movement and flow of water.

Both Ron Kodani and Kamuela Bannister expressed some concern about the hydropower facilities. Ron would like to see the exterior of the Puʻueo plant repaired and or repainted. Kamuela expressed concern about whether any toxins are being introduced at the hydropower facilities and if there is any information about the current impacts of the hydropower plants.

Several members at the meeting spoke about the Hawaiian cultural significance of water. Jerry emphasized that traditionally water and springs was the key to life, because the springs held the water of life. Kamuela Bannister added that water was not traditionally viewed as a commodity. Jeno also made clear that in Hawaiʻi water is an inalienable resource. Although these verbal sentiments appear to be shared by a few individuals, nearly everyone in the room expressed sincere agreement. These thought provoking sentiments lent to a discussion about how contemporary laws and business practices are impacting and requiring Kanaka Maoli to alter their ethos to reflect western notions of commodifying natural resources.

A significant portion of this meeting focused on the collective concerns and questions. Louis Hao spoke about the history of water rights in Hawaiʻi, and why DHHL and its beneficiaries should be entitled to a portion of the revenue generated from the proposed project. Louis Hao spoke specifically about the 1959 Statehood Act and the subsequent compact agreement that outlined the benefits that were intended to improve the conditions of Native Hawaiians. Another question focucsed on HELCO’s ownership of a parcel surrounded by DHHL land. Jeno asked, how can HELCO own a property that should be a part of DHHL holdings? He argues that water is an inalienable resource, and since HELCO is profitting from their hydropower facilities, there should be a return to DHHL beneficiaries and or Native Hawaiians. In reflecting on his personal experience with water diversions, Jeno questions why large corporations like HELCO can divert water for profit, however, individuals/families are severely challenged when they divert to access water for subsistence purposes? Jerry shared that water rights and water use has been a long-standing issue with DHHL and its lessees. Jerry echoed Jeno’s sentiment and noted if HELCO is utilizing the water, then what are the benefits to the Native Hawaiian community? Jerry recounted his past experiences with airport expansion project in Keaukaha and remarked that in the past, the Hawaiian community was not compensated for what they lost. Jerry pointed out that prior to 1967 he was living in the Homestead of Keaukaha on a one acre parcel, but when he was relocated to the Homestead in Pana‘ewa, he was placed on ten thousand square feet parcel. He described that during those times, the Hawaiian community was ashamed to ask for compensation, and they were therefore not granted any. He pointed out that today, this is no longer the case and that Native Hawaiians need to be justly compensated. Jerry urged the assembled group to consider the matter being discussed, the options, and the benefit for the Hawaiian community? Skylark urged the group to consider developing a benefits package with HELCO and DHHL, so that the Native Hawaiians receives some benefit from HELCO’s undertaking. She recalled that a similar concept was developed for the Puna Geothermal project and the Thirty Meter Telescope project (TMT). Skylark reflected on the shortcomings of the education benefit package that was proposed for the TMT project. She wants to ensure that if a benefits package is developed that it be one that truly benefits the people. Skylark Rosetti, Jeno Inocencio, Jerry Mauhili, and Kamuela Bannister shared that this notion and practice of asking for benefits is not a traditional Hawaiian concept, but realize the importance of shifting this thought process. Jerry acknowledged that Native Hawaiian have a special interest in maintaining and preserving their water rights. He has observed that many entities, individuals, and organization disregard the rights of the indigenous inhabitants of Hawai‘i. He notes that after years of being disregarded, many Native Hawaiians are skeptical and have a distrust for the system.

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 nature 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.

A review of the culture-historical background material, and as expressed by all consulted parties, it is clear the Wailuku River as a whole should be considered a traditional cultural property as it is associated with traditional *moʻolelo* linked with various Hawaiian *akua* (deities), *kupua* (culture heroes), and *moʻo* (guardians of fresh water sources). The Wailuku is arguably one of the most storied water courses on Hawaiʻi Island and more importantly, these *moʻolelo* are the major contributing elements that make the Wailuku a culturally significant place. Collectively, these *moʻolelo* enhance our understanding of traditional practices like *kapa* making, kite flying, and cordage making; and of their association with Wailuku and the greater Hilo area. Some of these *moʻolelo*, especially those associated with *moʻo* culture (i.e. the *moʻolelo* of Moʻo Kuna and Hiʻiakaikapoliopele) are foundational cultural beliefs associated with the river. Both Luana Busby-Neff and Leilani Kaʻapuni expressed how the river is a living entity capable of taking life. This belief is also reinforced by the name of the river, *wailuku*—"destructive waters," and ultimately influences how certain people relate to the river. According to Cheyenne Perry, many of these *moʻolelo,* provide a cultural explanation for the geological formation and natural character of the river. Since many of these *moʻolelo* describe the unpredictable nature of the water or are concerned with specific rock outcrops and geologic formations, (some of which are explicitly identified and some remain unknown) the authors of this study feel that maintaining the natural character of the river is integral to maintaining healthy and vibrant oral traditions. Oral traditions that are tied to specific places are easily fractured when the physical place is altered, destroyed, or removed. We, therefore, recommend that HEL take steps to engage with and seek community input as they explore continued use of the river resources. We also recommend that they take the proper steps to ensure their proposed project and potential use of the water has as minimal an impact as possible on the natural character of the river. This could involve disguising any exposed man-made infrastructure to blend with the natural terrain, texture, and color of the nearby area.

Cheyenne along with members of the adjacent Hawaiian Homestead communities also identified several natural resources located along the embankments and within the river that may be impacted by the potential project. As such, they noted the presence of many fresh water springs throughout the river, and the presence of wild cultigens of *kalo* (*Colocasia esculenta*), *maiʻa* (*Musa* sp.) and *olonā* (*Touchardia latifolia*) growing in flats along the embankments of the river. Although the exact location of the springs and wild cultigens were not noted in this study, it is important that HEL remain mindful of the presence of such resources. If such resources are encountered, we recommend that HEL take steps to avoid disturbing these areas. If avoidance is not possible, we further recommend that HEL seek the assistance of experienced horticulturalists or local farmers who are interested in cultivating and re-domesticating these wild cultigens.

A major concern that was expressed by all consulted parties is ensuring that the technology used at the hydropower facilities has minimal or no impact to the water and wildlife within the river, with an emphasis on native river species. All consulted parties expressed sincere concern for maintaining the water's natural chemistry and temperature upon its return to the river. All parties cautioned that if the natural chemistry or temperature of the water is not properly monitored then it could result in further biological degradation. Leilehua Yuen noted that she believes the native river species are a *kinolau* (physical manifestation) of Moʻo Kuna. Therefore, further degradation to the native river species may be viewed as a degradation to Moʻo Kuna. All parties noted that the quantity of water drawn from the river should match the quantity that is discharged from the hydropower facility. As such, we recommend that HEL establish a data collection process to ensure the hydropower facilities are not interfering with the chemistry and temperature, and that the intake and output of water are equivalent. If it is found that the hydropower facilities are interfering with the concerns described above, we encourage HEL to take immediate action to mitigate or eliminate the effects.

Another concern that was mentioned by Luana, Leilani, and Cheyenne is that any proposed physical improvements/construction that might occur at the hydropower plants not lead to enhanced erosion of the river banks. Although no specific mitigation efforts were noted by the consulted parties, we recommend that environmentally sensitive steps be taken to prevent or lessen soil erosion such as limiting the removal of naturally occurring vegetation; maintaining a diversity of flora ensures root system diversity that is both shallow and deep, thus acting as a natural reinforcement for the embankments.

If HEL is awarded a long-term water lease, all consulted parties stressed the importance of HEL taking steps to care for Wailuku River and the greater riparian system. As noted in the culture-historical background section and emphasized in the interview with Leilehua, utilizing water in Hawaiʻi is a right that comes with *kuleana* (responsibility). As such, all consulted parties urge HEL to be proactive and creative in supporting water resource management efforts to ensure a healthy and continuous flow of water from which power can be generated for today and more importantly for generations to come. Cheyenne stressed that Wailuku must be viewed not as an isolated river, but one that is intimately connected to the neighboring lands of Pi‘ihonua, Pu‘u‘eo, Humu‘ula, and Mauna Kea, and therefore is an important component of our island’s ecosystems. All consulted parties noted that there are any number of conservation organizations that HEL could form partnerships with. Through forming partnerships, HEL can support new initiatives and/or further existing efforts geared towards conservation and watershed management on Hawai‘i Island. Both Cheyenne and Leilehua emphasized the importance of orienting their efforts towards watershed management, as this is important for HEL, and to the health of the river and island. We strongly recommend HEL work with other interested parties in their development and implementation of the Watershed Management Plan as they fulfill the requirements of HRS §171-58(f).

In addition to making environmental contributions, we strongly encourage HEL to work closely with DHHL and their beneficiaries who have a direct association with Wailuku River. As emphasized at the community meeting, the DHHL Homesteaders would like to co-develop a benefits package with HEL and DHHL. Given that DHHL is charged with managing land adjacent to the river, we strongly recommend that HEL develops a productive partnership and maintain open communication with DHHL and their beneficiaries, and seriously consider the impacts of this undertaking on Native Hawaiians. It is important that HEL be aware of the historical and contemporary injustices faced by Native Hawaiians, much of which has inflicted generational trauma that collectively contributes to the genuine mistrust and skepticism towards corporations, government agencies, and large institutions. We strongly recommend that HEL fulfill their due diligence to mitigate any social and cultural impacts towards Native Hawaiians and more specifically DHHL beneficiaries with immediate ties to Wailuku River.

In summary, the recommendations provided above are intended to ensure that the proposed water lease renewal and any proposed development by HEL considers the concerns and thoughts shared by consulted parties. While none of the consulted parties explicitly opposed the proposed water lease renewal or potential refurbishing of the existing hydropower plants, the concerns, and recommendations offered above are intended to support HEL in being mindful of the cultural, social, and environmental uniqueness of Hawai‘i. Conducting background research, consulting with community members, and taking steps towards mitigating any potential cultural impacts is done so in the spirit and practice of *Aloha ‘Āina*, a contemporary movement founded on traditional practices and beliefs that emphasize the intimate relationship that exists between Native Hawaiians and the *‘āina* (land). If HEL assumes ownership of their right and responsibility to utilize water from Wailuku River, we recommend it be done so in that same spirit and practice. Attention to, and implementation of the above described issues and measures relative to the above-identified Wailuku River-related cultural resources and cultural practices and beliefs will help to ensure that no such resources, practices, or beliefs will be adversely affected by the proposed renewal of the water lease.

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Appendix D

Socioeconomic Impact Assessment

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Modeling/Forecasting

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SOCIO-ECONOMIC IMPACT ASSESSMENT

1.0 INTRODUCTION

SMS Research & Marketing Services, Inc. conducted this socioeconomic assessment to evaluate the potential social and economic impacts of the proposed Wailuku – Waiau – Puu Eo Hydroelectric Facilities Renovations Project (WWPHFRP) may have on the County of Hawai'i and the communities Hawai'i Electric and Light Company (HELCO) currently provides service to.

The objectives of this socioeconomic assessment are to:

1. Describe the social and economic condition of the host community - and
2. Identify potential social and economic impacts of the proposed project.

The components of this socioeconomic assessment are a social impacts assessment (SIA) (Section 2.0), and an economic impact assessment (EIA) (Section 3.0).

1.1 PROJECT OVERVIEW

Hawai'i Electric Light Company, Inc. (HELCO) is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the Island of Hawai'i. HELCO is currently diverting and using water from the Wailuku River pursuant to Revocable Permit No.S-7463. On June 24, 2016, the Department of Land and Natural Resources' (DLNR) Revocable Permit Task Force recommended that DLNR works with holders of water revocable permits to initiate the process to convert to water leases (DLNR, 2016). On August 16, 2016, HELCO submitted their application for a long-term water lease to the Board of Land and Natural Resources (BLNR) (HELCO, 2016b). Specifically, HELCO has requested a 65-year lease to continue to divert water from the Wailuku River for a non-consumptive use to continue to operate the Waiau and Puueo hydroelectric facilities located alongside the Wailuku River in Hilo. In addition to the long-term water lease, HELCO is proposing to repower the Waiau Plant.

The purpose of the proposed project is to continue to operate the two hydropower projects on the Wailuku River: the Waiau Plant and the Puueo Plant. Renewable energy generated by hydropower projects reduces imports of oil for conventional diesel-electric power generation. The project will benefit customers by extending the service life of this cost-effective renewable project for many years and increasing the company's contribution to the state's renewable energy goal. The Waiau capacity would increase to over 2.5 MW that will produce ~10,000 MWH/year, more than twice the Waiau Plant current capacity of 1.1 MW.

2.0 SOCIAL IMPACTS ASSESSMENT

An SIA identifies potential project impacts on the social fabric of the host community, including social and fraternal life; traffic and mobility; delivery of public services (e.g., education, health, emergency medical services, police, fire); and commerce and, governance. Typically, an SIA is conducted to evaluate primary or direct impacts; however, Hawai'i law also requires assessment of secondary social effects such as population growth, population mix, and long-range changes to social and commercial practices. Social impacts are reflected in data that is gathered during an SIA to identify individuals' attitudes and opinions about the proposed WWPHFRP.

The major components of the SIA conducted for the Wailuku/Waiau Hydroelectric Re-Powering Project are:

1. Reviewing of secondary data and documents to establish a socioeconomic profile for the host community (Hawaiʻi County), and
2. A summary of the phone and in-person interviews conducted by SMS with community leaders in Hilo about the proposed project.

2.1 SOCIO-ECONOMIC CONTEXT

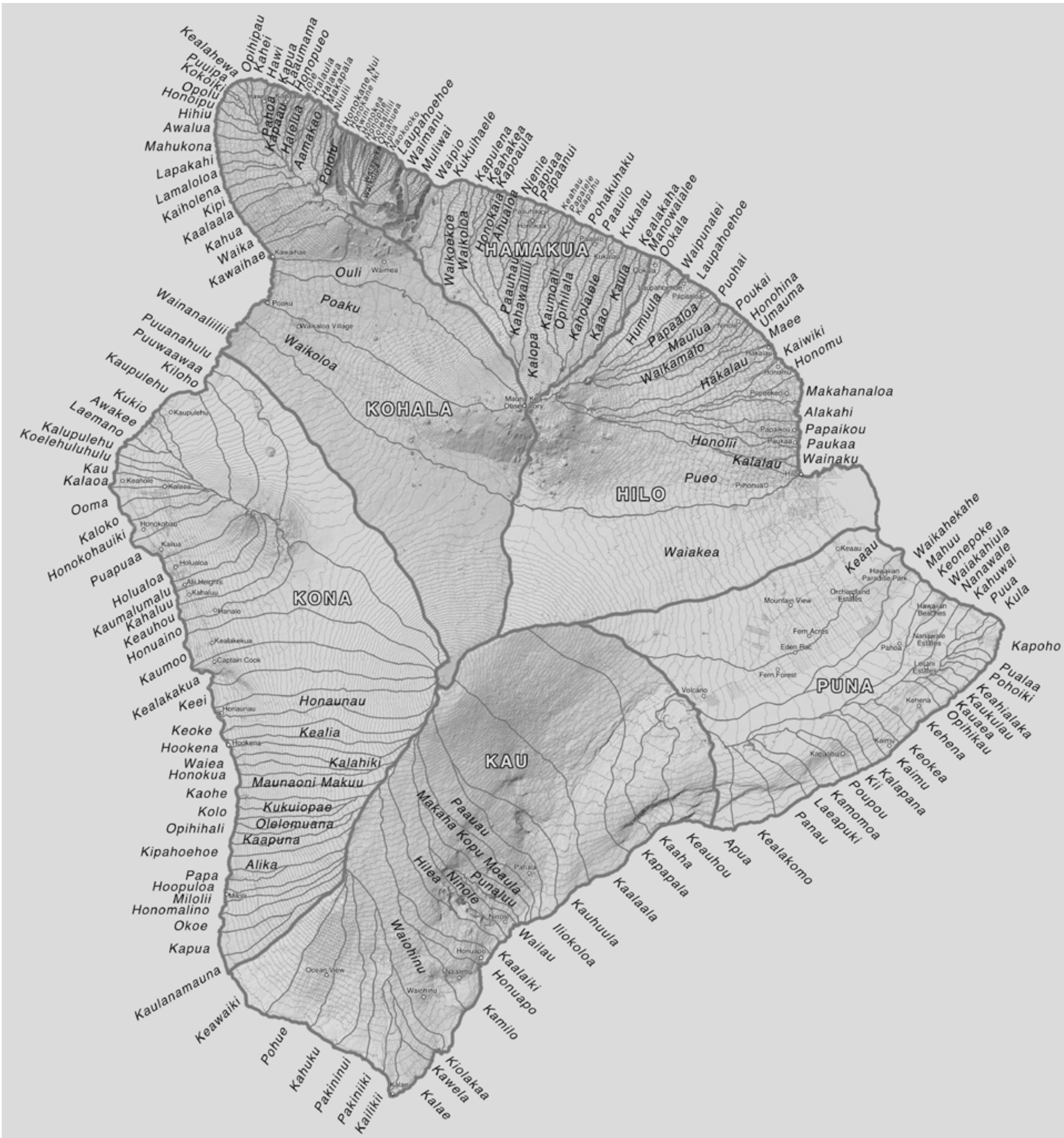
The renovation and operation of the proposed Project may impact the communities around the project sites and the entire island. Pre-project social and economic conditions make up the original conditions against which impacts must be measured. This section provides a description of the site and the host communities, demographic and housing characteristics of host communities, and economic conditions in the area.

2.2 THE STUDY AREA

This SIA considers three overlapping communities - the total political or geographic area affected by the proposed action, Moku Nui o Hawaiʻi (Hawaiʻi Island/County of Hawaiʻi), the Moku (district/region) of Hilo, and the Puu Eo Ahupua`a (land division/watershed) neighborhood in Hilo. The proposed project will have the most direct impacts on the Puu Eo Ahupua`a as both of the proposed project sites are located within its boundaries and will have more indirect impacts on the Moku of Hilo and the Moku Nui o Hawaiʻi as a whole.

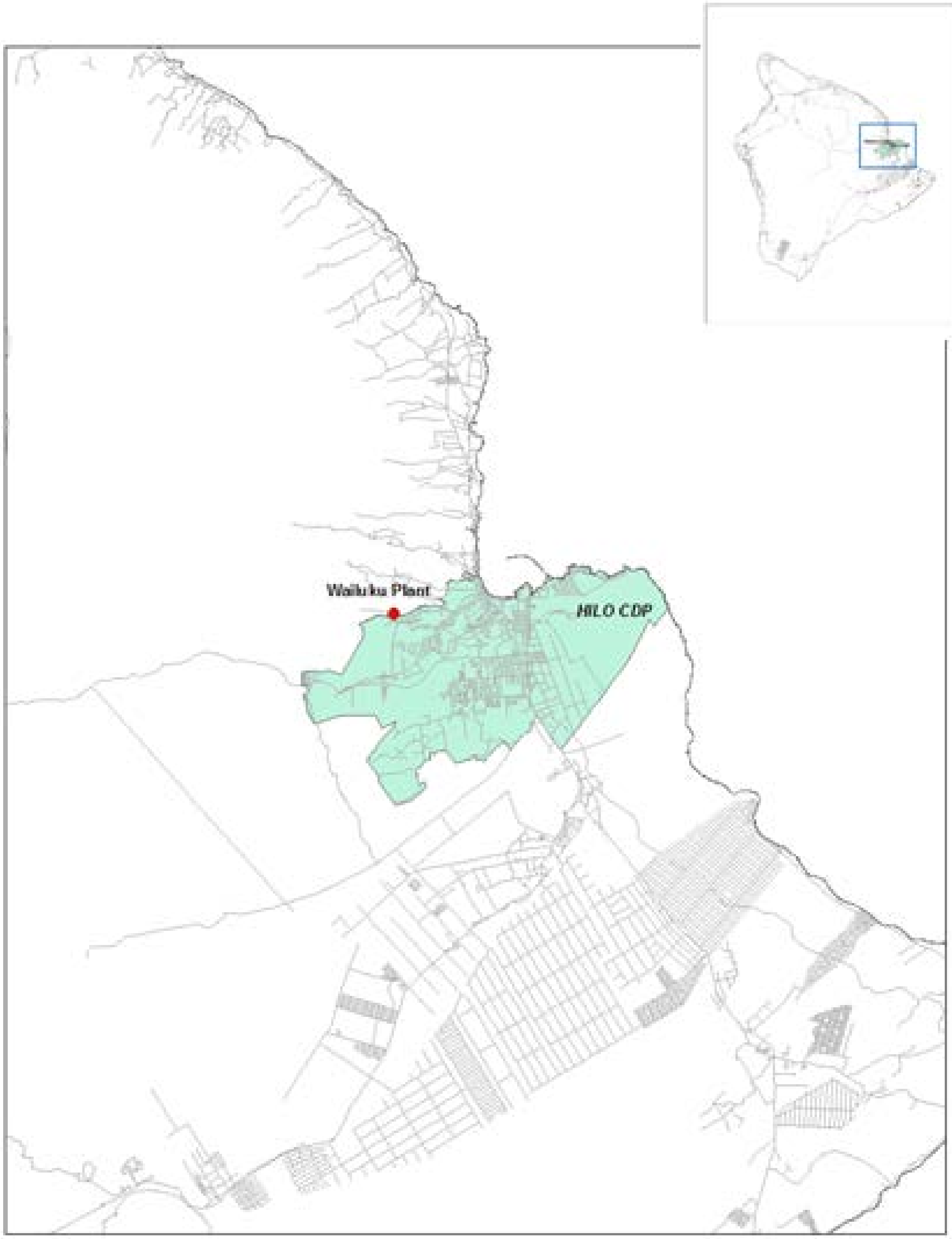
Hawaiʻi Island has several names. It is known as Ka Moku o Keawe or the island of Keawe. This name honors a chief, Keaweʻīkekahialiʻiokamoku, who was the great-grandfather of Kamehameha I. Because his reign over the island was peaceful and prosperous, the island bears his name: Moku o Keawe. This pays tribute to an aliʻi and the time of peace during his rule. Hawaiʻi is the largest moku nui (island) in the paeʻāina (island chain/archipelago) and another name, Hawaiʻi nui kuauli, celebrates its size, meaning "Hawaiʻi of the great green countryside." Hawaiʻi in other regions of Oceania means the ancestral homeland, but in Hawaiʻi nei it has no meaning other than the name of the island where Kamehameha I began the Kingdom of Hawaiʻi through his conquest of his neighboring moku, and eventually the entire moku nui followed by the kingdoms of Maui Nui Akea (Maui, Molokaʻi, and Lanai), ʻOahu and the eventual secession of Kauaʻi. As his ancestral homeland, he chose the name Hawaiʻi to represent the island and his kingdom.

Figure 1: Moku and Ahupuaʻa of Moku o Keawe



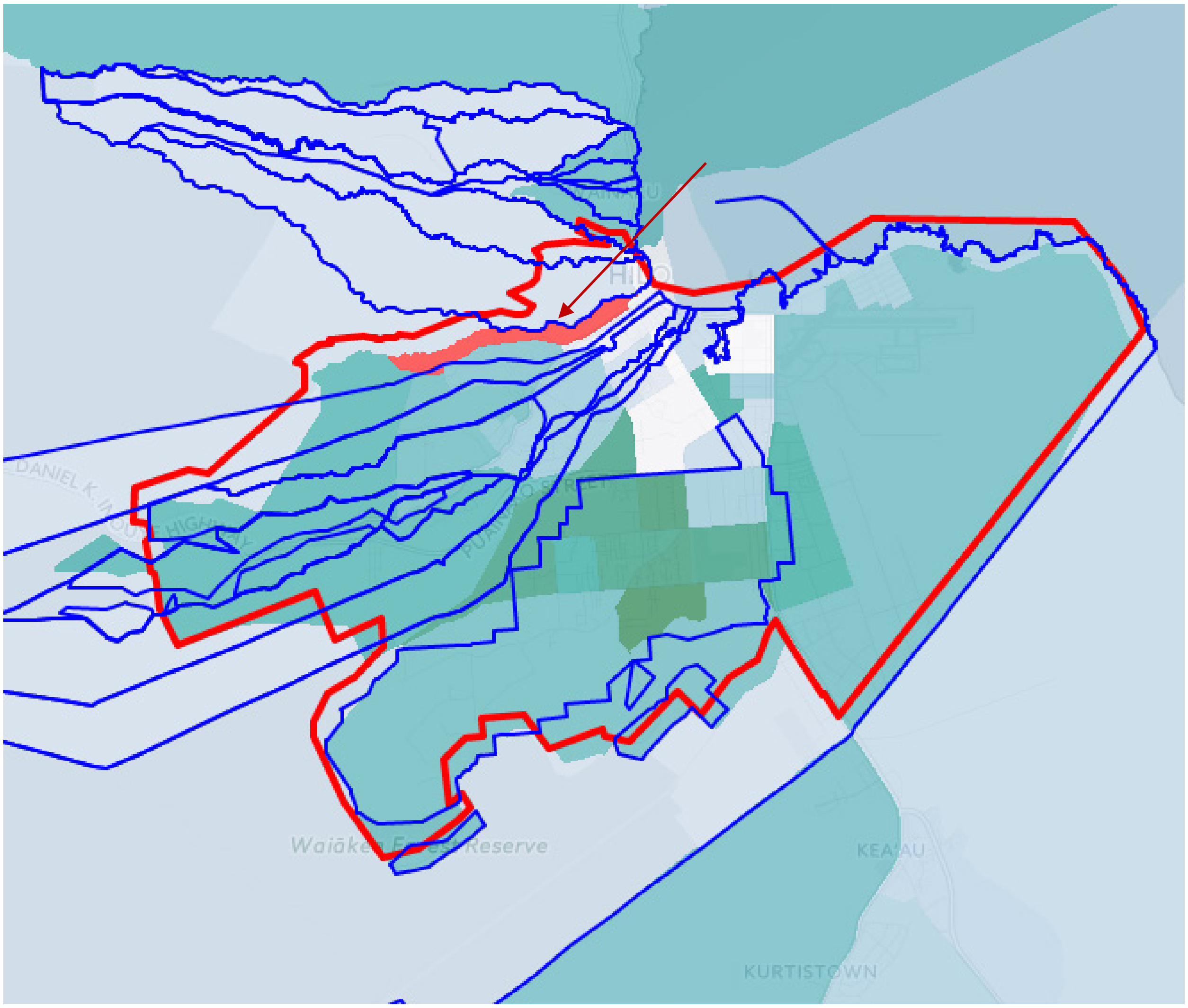
The Moku of Hilo is thought to have been named after a famous Polynesian navigator who guided his ʻOhana (family) there in ancient times. It is one of six moku that make up the island. It is bordered by the moku of Puna, Hāmākua, and Kaʻū which comprise the North to South East half of the island while the moku of Kona and Kohala comprise the bulk of the North to South Western half. Hilo is one of the largest moku of Hawaiʻi and spans the area between Mauna Loa and Mauna Kea out to the eastern shoreline.

Figure 2: Hilo City Boundaries



Puu Eo is thought to be a reference to an ancient cinder cone that is located at the apex of the ahupua'a at the base of Mauna Kea. The Puu Eo Ahupua`a neighborhood is bordered by the Wailuku River on the North East side and Waianuenue Avenue on the South West. It begins at the Wailuku River State Park and ends at the Wainaku Bridge near the Puu Eo Plant facility at the mouth of the Wailuku River at Hilo Bay.

Figure 3: Puu Eo Ahupuaʻa Neighborhood in Hilo (highlighted in light red, Hilo city limits outlined in red)



2.2.1 HAWAII COUNTY DEMOGRAPHIC FORECASTS

Overall the County of Hawaiʻi is forecast to continue increasing its population and households through 2026. This increase will continue to drive the need for more electricity in homes as well as businesses throughout the County. This Project will enable the contribution to the electrical grid to continue.

In 2015, there were 196,428 residents living in the County of Hawaiʻi. The *de facto* population or all persons (residents and visitors) present in the County at a given point in time, was approximately 220,342. The median age for all residents was 41.9 years. Nearly one-fifth of the County's population (18.8%) was age 65 or older.

During the last two decades, there has been an average of 2,428 births and 1,374 deaths per year in the County, resulting in a net increase of just over 1,050 people annually. Also contributing to population growth are the approximately 2,300 individuals, on average, who choose to move to Hawai‘i County each year.

Hawai‘i County’s current resident population lives in approximately 64,200 households, with an average household size of 3.01 persons. The number of households has increased by more than 22 percent over the past decade.

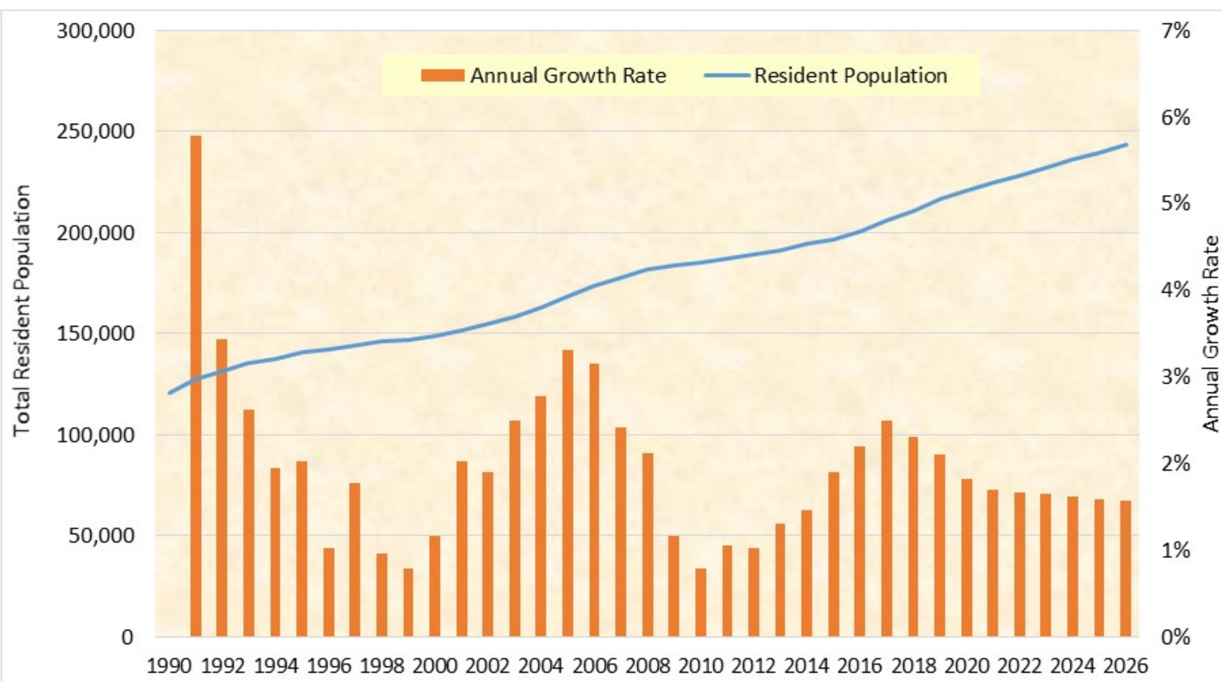
The County of Hawai‘i includes 87 square miles of urban land with an average of 1,300 people living in every square mile. It also has an average of 18 persons per square mile across its 3,942 square miles of rural land[1].

In the following sections, the demographic variables most relevant to a socio-economic understanding of the County of Hawai‘i are discussed in detail.

2.2.2 RESIDENT POPULATION

The resident population is the number of persons residing in the County of Hawai‘i in a given year. Persons are said to be residents if they live in the County for a minimum of five months of the year.- The term includes part-time residents but excludes visitors (tourists), students, and military personnel stationed in Hawai‘i who maintain a home of record outside the State of Hawai’i. The number of residents of the County may differ from time to time during the year and is usually presented as an average population for the year centered on July 1.

Figure 4: Resident Population, County of Hawai‘i, 1990 through 2026



1 *Urban and Rural Areas in the State of Hawai‘i, by County: 2010*. Hawai‘i State Data Center. Sept. 2013. http://files.hawaii.gov/dbedt/census/Census_2010/Other/2010urban_rural_report.pdf

Data for the years 1990, 2000, and 2010 was extracted from the U.S. Decennial Census. Non-census years 2005 through 2015 were compiled from the American Community Survey. Estimates for the years 2005 through 2014 are five-year combined files. Estimates for the years 2002 through 2004 and 2015 were one or three-year combined files as available. Estimates for some intercensal years between 1991 and 2002 were developed from data in the Hawai‘i Housing Planning Study, 2016.

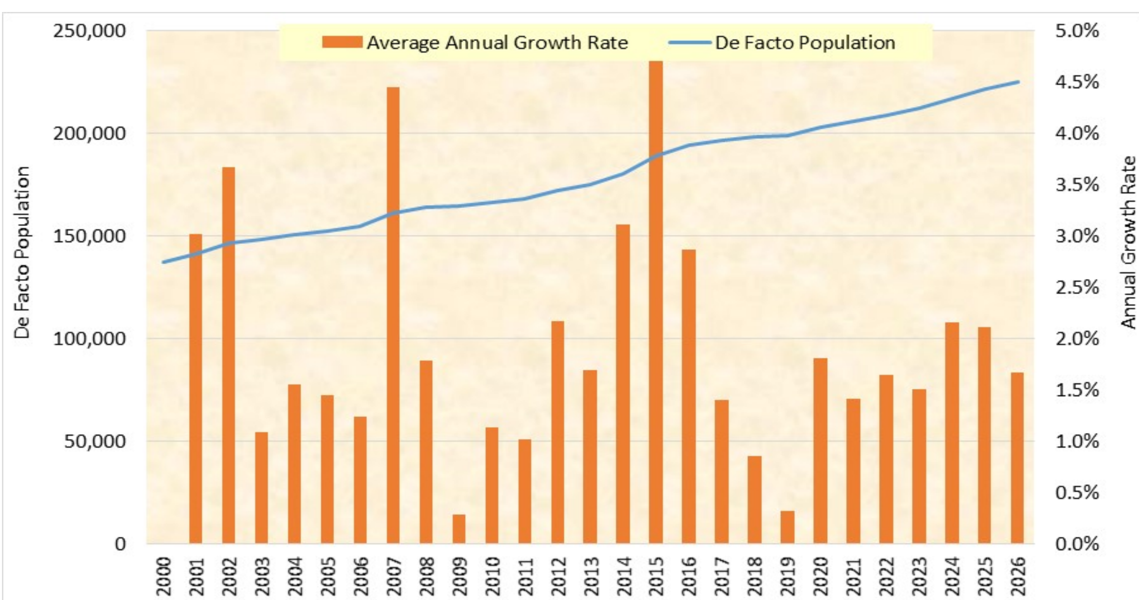
The forecast estimates were based on the Hawai‘i Department of Business, Economic Development and Tourism, Research and Economic Analysis Division, Population and Economic Projections for the State of Hawai‘i to 2040 (2040 Forecast). By 2013, the empirical data on the population of the County of Hawai‘i had already shown that the 2040 Forecasts were too high. The temporary solution was to use the trend data for 1990 through 2015, and the forecast data from 2016 through 2026. The interim years were estimated by fitting a third order polynomial curve to the data. While the resulting forecast is open to change and to interpretation, the forecast represents a reasonable estimate of future population change assuming that there are no serious changes in demographic, social, or economic factors underlying any population model.

The data can be interpreted as a three-cycle system with peaks in 1990, 2005, and 2016. The last of those peaks is actually an artifact of the smoothing process applied to join the empirical trend with the DBEDT forecast. The cycles happen to run a close parallel to economic growth trend for the County of Hawai‘i, as well

2.2.3 *DE FACTO* POPULATION

The *de facto* population is a count of all persons present in the County at a given point in time. It was estimated as the resident population, plus non-residents who are present in the County, minus residents who are temporarily absent. In practice in Hawai‘i, the *de facto* population is usually considered to be the sum of the resident population and the average daily visitor census.

Figure 5: *De Facto* Population, County of Hawai‘i, 2000 through 2026



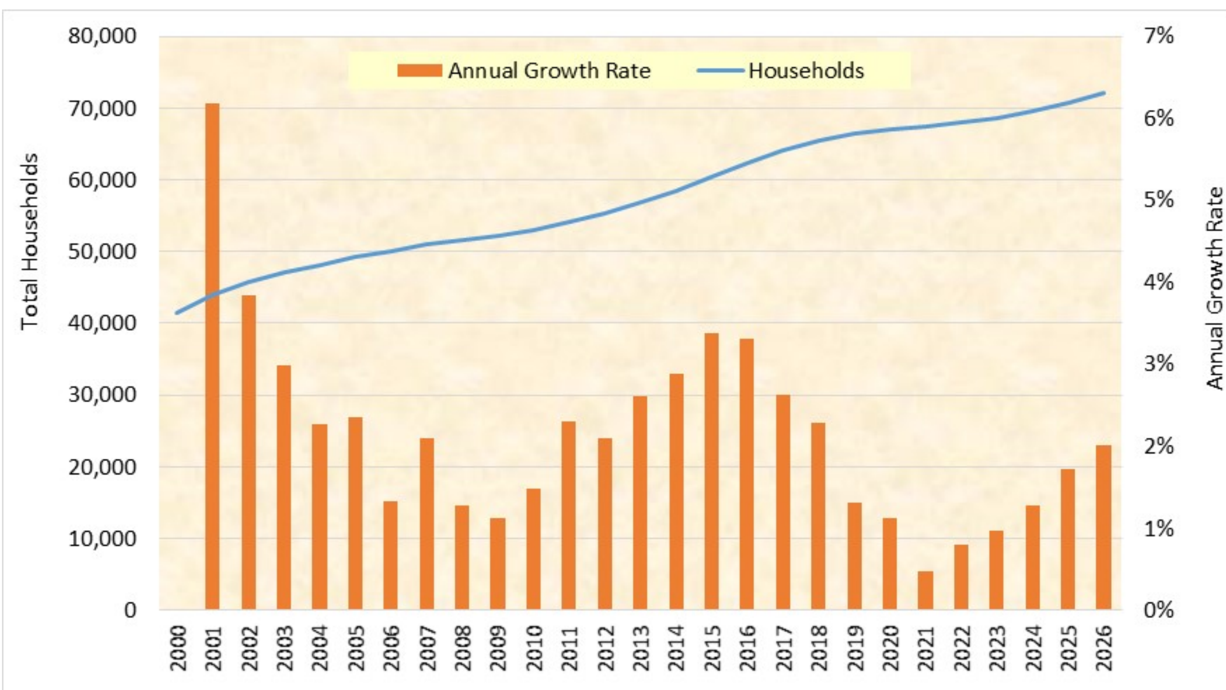
The *de facto* population data for the years 1990 through 2015 are taken from the U.S. Census, 1990, 2000, and 2010, as they appear in the DBEDT Hawai‘i Data Book Time Series, and also from the Hawai‘i County Data Book, 2010, Table 1.18. Forecast data were taken from DBEDT’s 2040 Forecast. Periods of population growth in the late nineties and between 2002 and 2007, occurred during periods of economic growth. They are a bit more obvious in *the de facto* population trend because growth resulted from an increase in visitors, net in-migration, and increased natural growth.

The forecasting method for the de facto population was more straightforward than for other series. The estimate was the sum of the forecasts for resident population and the average daily visitor census for each year. The average annual growth rate was calculated directly from the data.

2.2.4 NUMBER OF HOUSEHOLDS

A household consists of all people who occupy a housing unit regardless of relationship to each other. A household may consist of a person living alone or multiple unrelated individuals or families living together. The number of people in a household includes all persons residing there, related or unrelated.

Figure 6: Number of Households, County of Hawai‘i, 2000 through 2026



The data for the years 1990 through 2015 were taken from the U.S. Census, 1990, 2000, and 2010, as they appear in the DBEDT Hawai‘i Data Book Time Series, the ACS data for the years 2005 through 2015, and from the Hawai‘i County Data Book, 2010.

The number of households can be calculated as the total persons in households divided by persons per household[2]. Also by definition, the number of households in any Census geographic location is equal to the number of occupied housing units in the same geographic area.

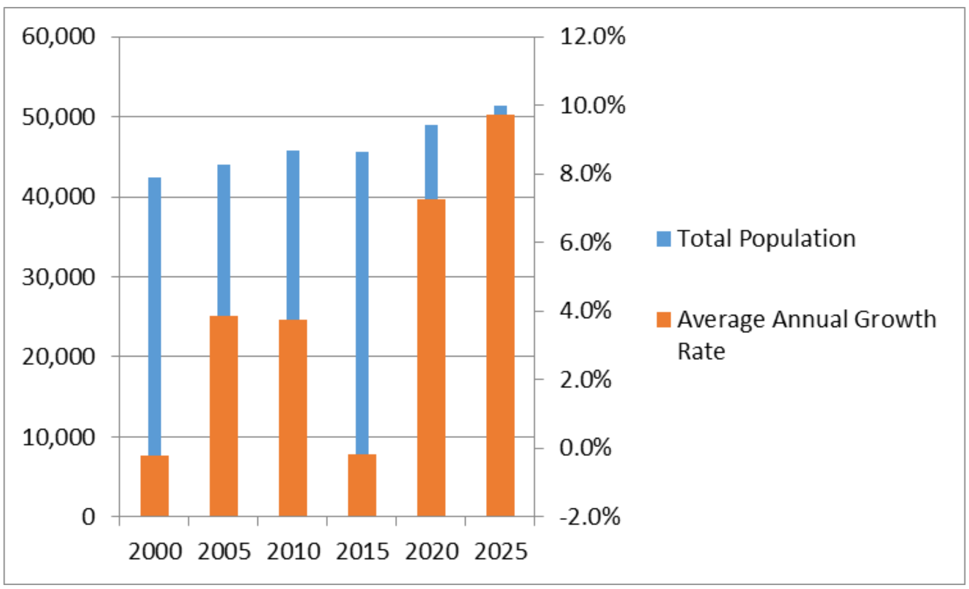
The household forecast reflects the 2040 Forecast in that it has the resident population as its base. As noted above, the household population forecast was developed in tandem with the forecasts for persons in households and the ratio of persons to households. All three variables use trend data from the same sources.

2.2.5 HILO DEMOGRAPHIC FORECAST

2.2.5.1 TOTAL POPULATION

The population of Hilo has not changed much in the past 15+ years and actually decreased between 2010 and 2015. The local growth was 3,202 persons, ~213 persons per year over the 15 year period from 2000 - 2015. There is a forecasted 7.3% increase over the next three years to 2020 with an additional forecasted increase of 9.7% by 2025 bringing the Hilo city population up to around 50,000 persons.

Figure 7: Hilo Total Population



2.2.5.2 *DE FACTO* POPULATION

The *de facto* population has continued to see regular increases that the total population has not. The recorded growth was 13,528 persons, ~902 persons per year over the 15 year period from 2000 - 2015. At the current forecasted rate there will be an additional 4,569 persons by 2020 and 9,336 persons by 2025.

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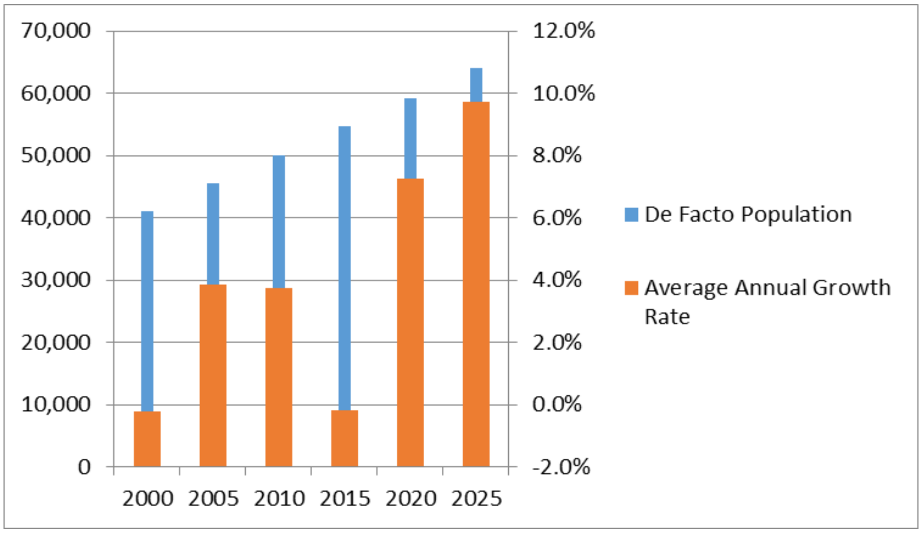
[2] Estimating Households by Household Size Using the Poisson Distribution. http://paa2013.princeton.edu/papers/130204

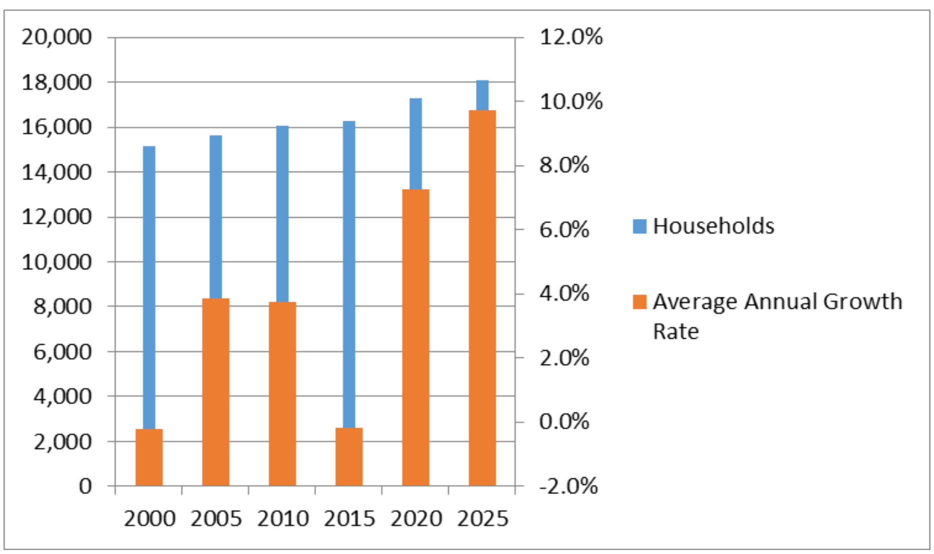
Figure 8: *De Facto* Population of Hilo



2.2.5.3 NUMBER OF HOUSEHOLDS

Unlike the *de facto* population, the households data very much mirrors the total population data as should be expected. The recorded growth was 1,154 additional homes, ~77 per year over the 15 year period from 2000 – 2015. What is surprising is the additional 967 households forecasted for 2020 and 1,811 households by 2025.

Figure 9: Number of Hilo Households



Of all the current housing in Hilo, less than 1 percent of homes in Hilo have been built since 2010 and fewer than 10 percent since 2000. The last big home construction boom in Hilo was between 1980 and 1989 producing 20.5 percent which was just shy of the largest on record during the 70's at 25.6 percent. To accommodate the projected forecasted increases there will need to be an additional 1,500 – 2,000 homes/residences built in Hilo over the next 8 years.

This translates to ~250 additional homes being built annually on average at a rate that is over three times the previous fifteen-year average.

2.2.6 PUU EO AHUPUA‘A NEIGHBORHOOD

The Puu Eo Ahupua`a neighborhood in Hilo is relevant to this project is several ways. Not only are both the Waiau and Puueo Plants and the proposed project sites located within its' boundaries, but the natural waterways and the pipelines that feed the facilities are as well. It is the area of Hilo that will experience the most direct impacts from the physical construction processes over the envisioned eight-month timeframe of the project. The following are statistics[3] representing the Puu Eo Ahupua`a neighborhood in Hilo taken from the city-data.com website:

The Puu Eo Ahupua‘a neighborhood has a total area of 4.759 square miles and a population of 14,388. It has a population density of 3,023 people per square mile compared to Hilo as a whole with a population density of 836 people per square mile. The Median household income in 2015 was $40,538 compared to $53,939 for Hilo. The median rent in in 2015 was $701 compared to $791 for Hilo proper. There were 8,108 males and 6,252 females in the neighborhood with a median age of 44.6 for males and 38.1 for females.

The most popular occupations of males were as follows: service occupations (35.5%); sales and office occupations (12.0%); construction, extraction, and maintenance occupations (10.5%); management occupations (except farmers) (5.3%); healthcare practitioners and technical occupations (5.3%); transportation occupations (4.1%); community and social services occupations (3.2%)

The most popular occupations of females were as follows: service occupations (41.1%); sales and office occupations (39.9%); education, training, and library occupations (12.2%); arts, design, entertainment, sports, and media occupations (6.6%); transportation occupations (4.5%)

There is only one Highway in this neighborhood: Hawaii Belt Rd (Bayfront Hwy, Kamehameha Ave, and State Hwy 19). The roads and streets in and through this neighborhood include: Amauulu Rd; Maikalani St; Puueo Mauka Dr; Kupulani St; Wainaku Ave; Waipahoehoe St; Puueo St; Pukihae St; Iliahi St; Lehua St; Kauila St; Kou Ln; Ohai St; Waihau Ln; Kanoa St; Puoio Ln; Wanaoa Ln; Ewaliko Ln; Waimalino St (Waimalino Ln); Iiwi Ln; Waianuenue Ave.

Some other notable features in this neighborhood include: Mokupau Stream; Kiohoole Gulch; Wailuku River; Pukihae Stream; Waiau Stream.

2.3 COMMUNITY STAKEHOLDER INTERVIEWS

To identify potential impacts and concerns related to the Project a series of interviews were conducted with key stakeholders. Stakeholders selected for the interviews were drawn from different segments of the community including county government and community organizations.

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[3] Puu Eo Ahupua`a neighborhood in Hilo statistics sourced from: http://www.city-data.com/nbmaps/neigh-Hilo-Hawaii.html#N10#ixzz4jMuYuP8K

SMS conducted structured phone and in person interviews with stakeholders. Phone interviews were conducted by SMS staff with community stakeholders in Hilo throughout February and March 2017 and in-person interviews were conducted on March 10, 2017, in Hilo.

A total of 10 interviews were completed: five by phone and five in person.

Overall the feedback from the community was that the Project was a non-event that would have no negative impacts and will have some positives in the continued and increased generation of green energy.

The majority of stakeholders were not aware of the project prior to receiving the information from SMS that had been provided by SSFM. The remaining stakeholders were aware of the general aspects of the project, but not the specifics.

Once additional information was shared, stakeholders supported the project and thought it would benefit the community. They believe that the project would enable electricity to continue to be generated from an environmentally sustainable source without a significant change to the sites or the river.

Overall stakeholders believed that there would be no negative impacts to the community. Likewise, they believed that the community would support the project because it was a replacement/renovation, not a new project. The key to support is to emphasize the refurbishing and/or repowering of existing systems.

Stakeholders noted that the community had a general mistrust of HELCO and that it was essential that the project work be done properly. In consideration of this, if road closures will be necessary, such as when equipment is to be delivered, this should take place at night or another time when traffic is light. One suggestion was that the water lease agreement should be contingent on use to enable the County to lease to other interested parties should HELCO cease operations and to avoid a potential monopoly of the resource.

There was some concern about unintended consequences to the Waiau River water levels and related habitat disruptions during the refurbishing. If this was a new project or one that was significantly changing existing infrastructure there would be more discussion on this.

In general there was overall support for the State Plan to reduce dependency on fossil fuels and improve community self-sufficiency. To that end, there was an appreciation for the sustainability of hydroelectricity and the need for these hydro-electric energy plants.

Interviews show very little negative social impact expected from this project. For the most part, interviewees agree that it should be viewed more as regular maintenance and upgrades as opposed to a new project that has potential for new impacts on the community. It is viewed as a positive step forward by all with minimal concerns toward social issues of any nature outside of the noted pre-existing mistrust of HELCO in general.

2.4 OTHER POSSIBLE SOCIAL IMPACTS

One possible impact related to the Project during the construction phase is the delivery of large repowering components and the 45”penstock pipes to their respective worksites during specific phases of the project. There is a total of 300’ of 45” penstock pipes required for the project (the largest of all the required components) which is typically shipped in 40’ lengths resulting in a total of 7.5 pieces needed to be delivered to the Waiau Powerhouse worksite. The IPS MI & E Truckload Table for Packing and Shipping allows a maximum of 4 – 45" pipes per truckload resulting in a total of two truckloads of pipe needing to be delivered. This is a relatively small delivery and should have minimal impact on traffic. As recommended in the interviews, the timing of the deliveries should be planned to minimize traffic impacts.

Another possible impact could be the reduction of electricity generation during the renovation process. Currently HELCO has more than sufficient capacity to meet the needs of the county and will be able to meet the demand while the refurbishment is underway.

3.0 ECONOMIC IMPACT ASSESSMENT

3.1 ECONOMIC FORECAST FOR HAWAI'I COUNTY

The County of Hawai'i's current labor force includes 90,595 persons age 16 or older. The labor force has grown at an average annual rate of 1.7 percent over the previous decade.

An estimated 90.4 percent of the labor force was employed (81,575 workers). The unemployment rate for Hawai'i County followed the overall economic trend. The unemployment rate was 3.5 percent in 1990 and then climbed to over 9 percent by the middle of the decade and dropped back down to 4.7 percent by 2000. The rate continued to decline until it reached an all-time low of 3.4 percent in 2007, just prior to the beginning of the Great Recession. After reaching close to 10 percent during the Recession, the County's economic recovery is evidenced by the current unemployment rate of 4.5 percent.

Among employed persons who worked outside their homes, roughly 40 percent lived and worked in the same place[4]. The average travel time to work for employees increased from 24.5 minutes in 2000 to 27.9 minutes in 2015 (+13.9%).

In 2016, there were an estimated 103,000 jobs in Hawai'i County. The average annual growth rate for jobs ranged from 1.6 to 1.9 percent since 1990, and was expected to remain at that level for the next several decades. Workers were most often employed in one of five key industries: educational service, healthcare, and social assistance; arts, entertainment, recreation, accommodation, and food services; retail trade; professional, scientific, management, administrative, and waste management; and construction.

The estimated 2015 median household income for Hawai'i County workers was $51,795. This represented a 1.9 percent decrease over the last ten years. The median household income peaked in 2008 at $58,500, and then dropped 4.9 percent in 2009 as a result of the Recession. Median household income is expected to increase steadily over the next several years and reach its pre-recession level by 2020.

In keeping with the other economic measures, the poverty status of individuals and families in the County increased over the past five to seven years. The percentage of persons in poverty was 15.7 percent in 2000 and was on a downward trend, falling to a low of 13.1 percent in 2007. Since that time, the percentage in poverty has increased to a record high of 18.8 percent for individuals and 13.2 percent among families.

[4] As defined by the U.S. Census Bureau; American Community Survey 2013 5-year Summary File: Technical Documentation, the same place refers to the same census block or, if the place of employment could not be geocoded to the block, in the same city, town or census designated place.

3.2 PROJECT IMPACT ON THE ECONOMY

This section describes the impacts that this project will contribute to the economic environment of the County. Technical terms are used here to distinguish the different types of impacts. In economic analysis, a distinction is made between impacts from actual construction and operations of a project, and the effects of project-related spending throughout the local economy. In discussions of jobs, earnings, and taxes, the three types of impacts are addressed:

- Direct jobs/earnings/taxes are immediately involved with the construction of a project or with its operations. It is important to note that direct jobs are not necessarily on-site: construction supports company personnel in offices and base yards, as well as on-site.
- Indirect jobs/earnings/taxes are created as businesses directly involved with a project purchase goods and services in the local economy.
- Induced jobs/earnings/taxes are created as workers spend their income for goods and services.

Direct, Indirect and induced economic impacts in Hawaii can be estimated using multipliers from a model of input-output (I-O) relations developed and refined by State researchers. The Inter-County I-O model allows for the estimation of impacts based on industries located in that county, without reference to inputs and output for any larger economic unit. Economic impacts of a proposed project can be estimated for the subject county.

Using this methodology and the proposed Project budget and timeframe, SMS generated Economic Impact Scenarios for Jobs (Section 3.2.1), Earnings (Section 3.2.2), and Taxes (Section 3.3.3).

It is important to note that this project is still in the planning phases and there is no complete project budget to date. As such the following scenarios are based on the total proposed project budget that accounts for all costs including the repowering components and other materials for this project that will be manufactured and shipped from out of state. With no currently available data on these budget items at present, the following potential impact scenarios are only representative of the current available data for project costs from planning through fruition.

For purpose of this analysis SMS used the estimated construction spending of $3,100,000 per year for two years.

3.2.1 JOBS

Table 5-E: Economic Impacts - Impact on Jobs

		Project Year		Cumulative
		2018	2019	
Construction spending		$ 3,100,000	$ 3,100,000	$ 6,200,000
	all jobs	39	38	77
Net job impact		39	38	77

Assuming construction spending is all within the County, Table 5-E shows the estimated number of jobs (direct, indirect, and induced) that would be created by the proposed project. In total the project would produce 77 person-years of employment (person-years of employment is the number of full-time equivalent positions required to complete the work defined by the estimated cost of construction during a specified period (~2080 hours per year) with 39 (81,120 hours) estimated for 2018 and 38 (79,040 hours) for 2019.

Given the nature and scope of this project (multiple job-sites, specific phases and types of specialized work needed to be completed) the range of direct job types will vary as the project progresses. Also, as a rule of thumb, approximately 20% of direct construction jobs are off-site.

To put this into context, this project is estimated to require 10-15 construction workers during peak construction phases during an estimated 9 month period. In a 10 worker scenario this translates to ~7 of the 77 person-years of employment projected for this project. Given the ~1/10 ratio of the of the estimated impact of the construction in terms of direct jobs the broad impacts of the remaining 9/10 of the direct, indirect and induced jobs that will potentially be created by this project to Hawaiʻi County's economy far exceed what many think of as the main impacts in terms of jobs related to a construction project. This emphasizes the potential impact of indirect and induced jobs on the economy as much further reaching and longer lasting than those of the actual direct construction portion of this project.

3.2.2 EARNINGS

Table 5-F: Economic Impacts - Impact on Earnings

		Project Year		Cumulative
		2018	2019	
Estimated Earnings (payroll)		$ 2,108,000	$ 2,108,000	$ 4,216,000
	all earnings impact	2,108,000	2,108,000	4,216,000
Net earnings impact		2,108,000	2,108,000	4,216,000

Given the employment projections, Table 5-F shows the estimated potential direct, indirect, and induced earnings from the project. In order to give this data some further context the model continues with the 10 worker scenario to highlight the different levels of impact with regards to payroll for direct, indirect, and induced jobs. Given the nature of the project and the different work sites, labor needs will shift over the projected 9 month time period and directly impact this highly generalized wage scenario.

No long term jobs are expected from this project

Estimated jobs and incomes to construction workers

- 2016 IUEC Construction Workers Average Annual Salaries (AAS):
    - Low-end (apprentice/general-laborer) $27,150.00 AAS / $14.14 H
    - Mid-range (journeyman/operators) $50,050.00 AAS / $26.07 H
    - High-end (Master/Foreman) $77,770.00 AAS / $40.51 H
- 10 Worker cost scenario:
    - 1 Foreman @ $40.51 for 9 months = $58,327.50

- 2 Journeymen/Operators @ $26.07 for 9 months = $75,075.00 ($37,537.50 individual)
- 7 Apprentices/General-Laborers @ $14.14 for 9 months = $183,262.50 ($20,362.50 individual)
- Approximate salaries total for 10 person construction crew - $316,665.00

This translates to ~7.5% of the cumulative projected earnings generated by the project for Hawai‘i County going toward direct jobs for the construction of the project with remaining 92.5% of the direct, indirect, and induced earnings going to jobs not involved with the physical construction processes. This parallels the previous section's findings in terms of impacts to Hawai'i County's economy. With direct construction jobs accounting for only 1/10 of the jobs created and less than 1/10 of the projected earnings the impacts of other direct, indirect, and induced jobs and potential earnings become especially relevant.

3.2.3 TAXES

Table 5-G: Economic Impacts - Impact on State Taxes

		Project Year		Cumulative
		2018	2019	
Construction spending		$ 3,100,000	$ 3,100,000	$ 6,200,000
	all State taxes	349,680	349,680	699,360
	estimated County taxes	12,938	8,392	16,785
Net State tax impact		349,680	349,680	699,360
	Net County tax impact	12,938	8,392	21,330

ratio of Hawaii County revenues to Hawaii State revenues is .037

Table 5-G relays the potential impacts on State and County taxes generated by the project. The $6.2 million forecasted budget would translate to $699,360.00 in State tax revenues and $21,330.00 in Hawai'i County taxes.

Under this scenario, assuming the total construction budget is spent within the county the overall economic benefit will be:

- 77 jobs over two years;
- Estimated earnings impact of $4.2 million; and
- An increase in State taxes of $700,000 and of County taxes of $21,000.

3.3 ADDITIONAL ECONOMIC IMPACTS

SMS also explored some of the possible economic impacts the proposed Project may have on the County of Hawai‘i and the communities HELCO serves. The primary focus will be on impacts in terms of Electricity Rates and Revenues, and Long Term Impacts with a focus on the 100 percent Renewable Portfolio Standard (RPS) by 2045 the Hawaii State Energy Office has established for the state with the Hawaii Clean Energy Initiative (HCEI).

3.3.1 IMPACTS ON ELECTRICITY RATES AND REVENUES

The following is a summary of the production potential of the proposed project and what that potential translates to in possible economic impacts to Hawai'i County.

> HELCO's current (June 2017) avoided cost[5] is 11.339 cents per KWH at on peak production.
> Waiau Hydroelectric revenue requirement[6] is forecast at about 0.06 cents per KWH.
>
> This translates to current HELCO oil energy production at ~189 times the cost of Hydro per KWH.
>
> Waiau hydroelectric post–upgrade is expected to produce about 10,000 MWH/year.
>
> Selling at revenue requirement rate = approximately
> $600,000.00 annually
> $24,000.00 in tax revenues
>
> Selling at the current "R" residential rate of 34.65 cents per KWH = approximately
> $34,650,000.00 annually
> $1,386,000.00 in tax revenues
>
> Alone this potential energy production would service 1,700 500 KWH/month/residential-customers (2%) of HELCO's 85,029 overall customers.

It will benefit 100% of HELCO customers as part of the HELCO grid in reducing the cost of energy production while increasing Hawai'i County's renewable energy percentage toward achieving the Hawaii Clean Energy Initiative 2045 goals.

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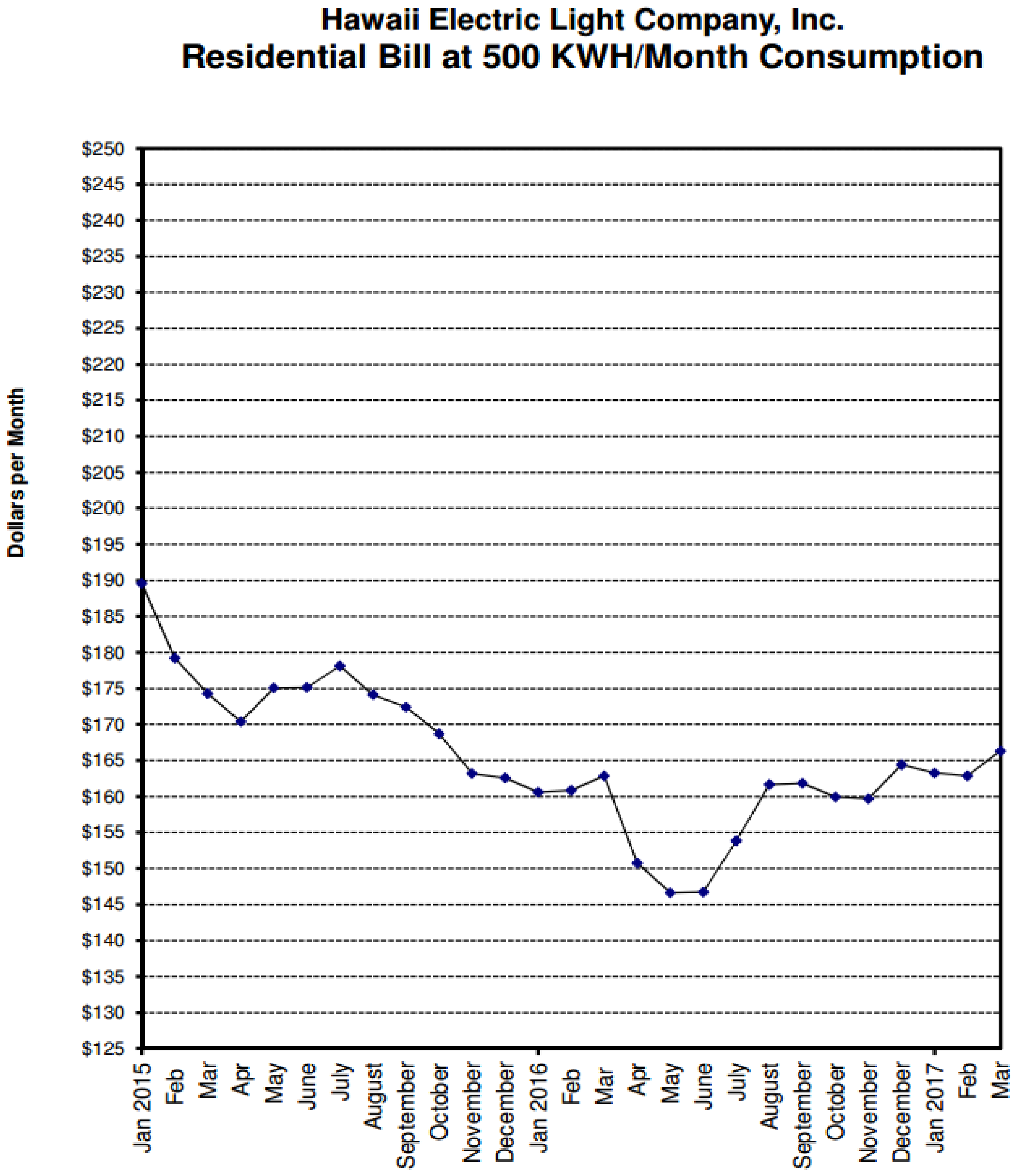
[5] Avoided cost is the cost that HELCO sustains to generate energy by burning oil.
[6] Revenue requirement is the cost of capital recovery, O&M, taxes, fees, and depreciation over equipment lifetimes

Figure 10: HELCO Residential Rate Over Time[7]



[7] This graphic was copied directly from the HELCO website

Table 5-H: HELCO Residential Rates

HELCO Schedule "R" – Residential Rates		
	Base Rates ($)	02/01/2017 Effective Rates ($)
Customer charge, per customer per month Single Phase service Three Phase Service	 10.50 15.00	 10.50 15.00
Energy charge (added to customer charge) First 300 KWH/month /KWH Next 700 All Over 1,000	 0.274506 0.308024 0.319016	 0.288789 0.322307 0.333299
Minimum charge, per customer per month Single Phase service Three Phase Service	 20.50 25.00	 20.50 25.00
Green Infrastructure Fee	1.27	1.27

[8]

Given the single phase baseline monthly charges of $32.27 and the current average monthly bill of approximately $167.00 the average 500 KWH/month/residential-customers are spending about $134.75 on actual energy charges at approximately 0.27 cents/KWH

3.3.2 LONG TERM IMPACTS

The only measurable long term impacts from this project will be the increase of Hawai'i County's renewable energy portfolio toward achieving the Hawaii Clean Energy Initiative HCEI 2045 goals. Since the establishment of the Hawaii Clean Energy Initiative (HCEI) in 2008, one of the most informative documents released to the public to date is the STATE OF HAWAII ENERGY RESOURCES COORDINATOR'S ANNUAL REPORT 2016 released in December, 2016. It puts forth the following statement for Hawaii's Clean Energy Vision:

THE HAWAII STATE ENERGY OFFICE'S (HSEO) mission is to maximize Hawaii's energy self-sufficiency and security by developing and utilizing local energy resources in a balanced way. In doing so, HSEO will guide our state toward the HCEI MAX goals to achieve 100 percent renewable energy in the electricity sector by 2045, reduce electricity consumption by 4,300 gigawatt-hours by 2030, and reduce petroleum use in transportation. To this end, HSEO works toward the deployment of clean energy infrastructure and serves as a catalyst for energy innovation and test bed investments. By achieving these goals, HSEO will grow the clean energy sector and transform Hawaii's economy.

Hawaii's clean energy goals are the most aggressive in the nation – and if we succeed, we will become a world leader in clean energy. Along the way, we'll begin to solve several core challenges:
1. We can be more independent and less reliant on other economies.

[8] Figures taken from January 31, 2017 HECO *Effective Rate Summaries* document

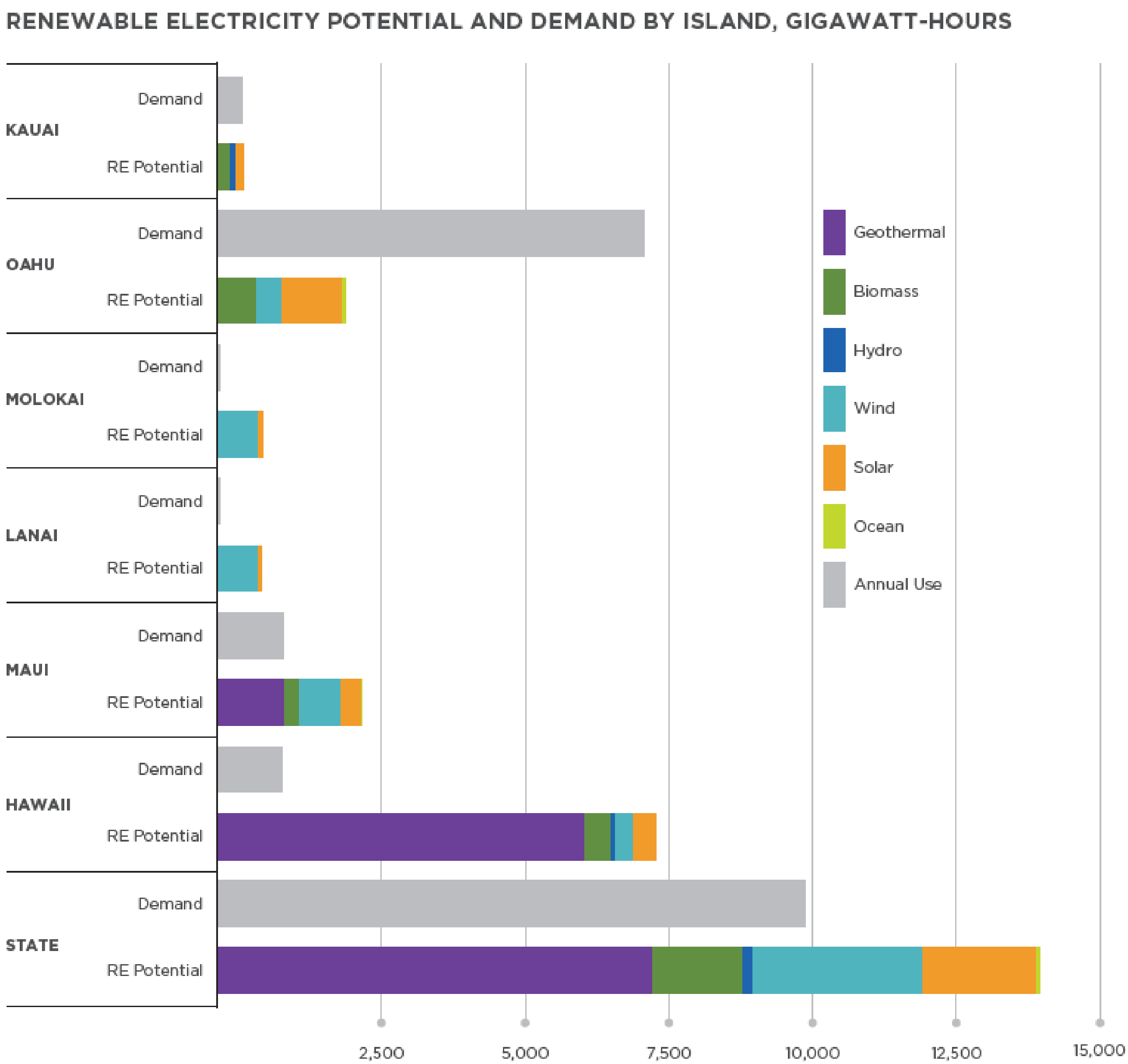
2. We can achieve greater security.
3. This will help Hawaii become more economically prosperous by keeping an estimated $3 billion in the state (annually) that would otherwise be spent on imported oil.
4. Establishing a new, green economic sector will counterbalance our reliance on tourism and the military.
5. We can position Hawaii as a worldwide leader in the clean energy category and that will attract more business and expertise to the region.

The HCEI goals require statewide participation and support. Renewable development and efficiency measures will need strong backing as will policy and planning agendas that support clean energy. Above all, we must all begin to think and act "green" in our daily lives

In terms of the proposed project itself being directly connected to the achievement of the state's 2045 plan and the options available to the Hilo community and County of Hawaiʻi as a whole to achieve those goals, we can see that the potential social and economic impacts outlined in the above section stretch far past this ahupuaʻa and moku to the entire paeʻāina of Hawaiʻi.

As the following graph displays, the renewable energy production potential of Hawaiʻi County vastly exceeds its' energy demands, but provides future employment and industry development potential for Hawaiʻi County as the key producer in getting the state to 100% renewable by 2045.

Figure 11: HCEI Renewable Energy Production Potential and Electricity Demand by Island



[9]

[9] This graph was copied from the HECO website

Appendix E

Waiau Penstock Right-of-Way Description

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DESCRIPTION

ROAD EASEMENT "R-1"

For Utility Access Purposes
affecting Tax Map Key Parcel (3)2-6-009:005
and in favor of
Hawaii Electric Light Company, Inc.

Land situated at
Piihonua, South Hilo
Island of Hawaii, Hawaii

Being a portion of the Government (Crown) Land of Piihonua
Land Patent (Grant) S-15,868

State of Hawaii Department of Hawaiian Home Lands – Owner

CENTERLINE DESCRIPTION

Being a strip of land twelve (12.00) feet wide and extending six (6.00) feet on each side of the following described centerline:

Beginning on the centerline at the Southwesterly end of this easement, on the most westerly corner of Grant 7587 from Territory of Hawaii to Hilo Electric Light Company (parcel referred to as the "Intake and Ditch Right-of-Way Site"); the coordinates of said point of beginning referred to Government Survey Triangulation Station "HALAI" being 418.64 feet South and 13,418.07 feet West, thence running by azimuths measured clockwise from True South:

1.	148° 46' 32"	45.79 feet	along remainder of the Government (Crown) Land of Piihonua;
2.	246° 55' 39"	61.23 feet	along same;
3.	257° 28' 32"	53.53 feet	along same;
4.	251° 44' 01"	176.08 feet	along same;
5.	248° 16' 07"	193.60 feet	along same;
6.	246° 37' 28"	150.35 feet	along same;
7.	242° 18' 05"	82.01 feet	along same;
8.	238° 59' 18"	153.95 feet	along same;

EXHIBIT "A"

9.			Thence continuing along same, on a curve to the left with a radius of 204.00 feet, the chord azimuth and distance being: 221° 56' 14" 119.64 feet
10.	204° 53' 06"	530.04 feet	along remainder of the Government (Crown) Land of Piihonua;
11.			Thence continuing along same, on a curve to the right with a radius of 193.00 feet, the chord azimuth and distance being: 223° 53' 04" 125.67 feet
12.	242° 53' 02"	180.11 feet	along remainder of the Government (Crown) Land of Piihonua;
13.			Thence continuing along same, on a curve to the left with a radius of 540.00 feet, the chord azimuth and distance being: 227° 29' 21" 286.71 feet
14.	212° 05' 38"	74.71 feet	along remainder of the Government (Crown) Land of Piihonua;
15.	207° 37' 23"	80.68 feet	along remainder of the Government (Crown) Land of Piihonua;
16.			Thence continuing along same, on a curve to the right with a radius of 748.00 feet, the chord azimuth and distance being: 217° 26' 44" 255.19 feet
17.	227° 16' 00"	62.65 feet	along remainder of the Government (Crown) Land of Piihonua;
18.			Thence continuing along same, on a curve to the right with a radius of 154.00 feet, the chord azimuth and distance being: 251° 41'32" 127.36 feet
19.	276° 07' 05"	462.58 feet	along remainder of the Government (Crown) Land of Piihonua;
20.			Thence continuing along same, on a curve to the left with a radius of 1816.00 feet, the chord azimuth and distance being: 271° 22' 52" 299.94 feet

21.	266° 38' 38"	538.14 feet	along remainder of the Government (Crown) Land of Piihonua;
22.	268° 53' 59"	1409.27 feet	along same;
23.	267° 04' 07"	437.68 feet	along same;
24.	269° 07' 45"	186.75 feet	along same;
25.			Thence continuing along same, on a curve to the left with a radius of 190.00 feet, the chord azimuth and distance being: 252° 46' 35" 106.99 feet
26.			Thence continuing along same, on a compound curve to the left with a radius of 55.00 feet, the chord azimuth and distance being: 206° 23' 54" 55.04 feet
27.			Thence continuing along same, along a non-tangent curve to the left with a radius of 319.00 feet, (a radial line to end of curve being 255° 00' 47"), the chord azimuth and distance being: 170° 36' 12" 63.14 feet
28.	148° 58' 11"	65.45 feet	to a point on the boundary of Grant 7587 to Hilo Electric Light Company (Power House Site), the side lines of said easement being shortened or lengthened to begin and terminate on said Grant 7587 boundary lines, and containing an area of 1.766 ACRES more or less.

BARBARA BREWER COOPER
LICENSED PROFESSIONAL LAND SURVEYOR
No. 10749
HAWAII, U.S.A.

ENGINEERING DEPARTMENT
HAWAII ELECTRIC LIGHT COMPANY, INC.

Description Prepared By:

Barbara Brewer Cooper

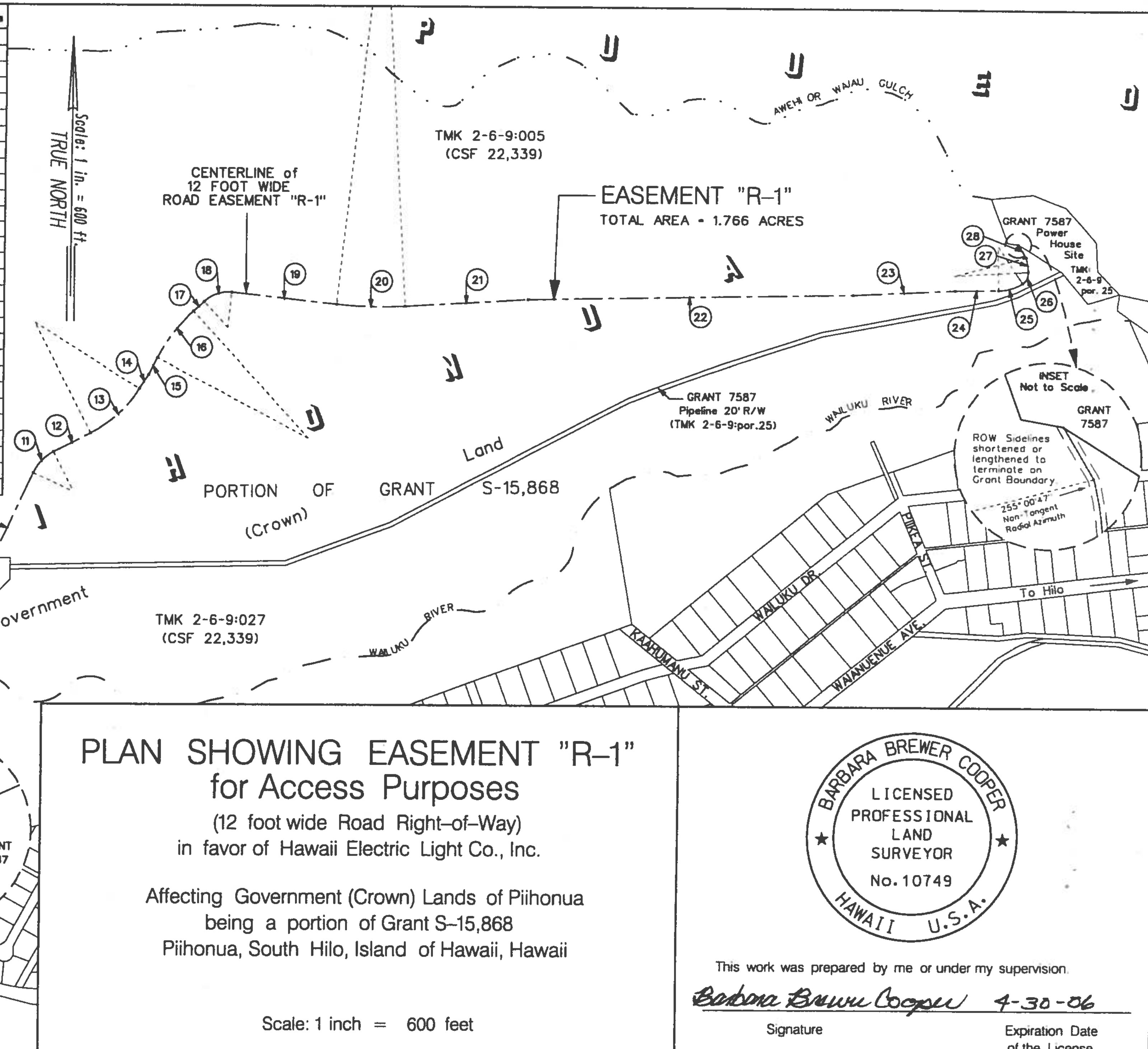
Barbara Brewer Cooper
Licensed Professional Land Surveyor
State of Hawaii Certificate No. LS – 10749

March 13, 2006
TMK: (3) 2-6-009:005

Table of Road Easement "R-1" Centerline Dimensions

Line	Azimuth	Distance	Curve Radius
1	148° 46' 32"	45.79	
2	246° 55' 39"	61.23	
3	257° 28' 32"	53.53	
4	251° 44' 01"	176.08	
5	248° 16' 07"	193.60	
6	246° 37' 28"	150.35	
7	242° 18' 05"	82.01	
8	238° 59' 18"	153.95	
9	221° 56' 14"	119.64 chord	204.00
10	204° 53' 06"	530.04	
11	223° 53' 04"	125.67 chord	193.00
12	242° 53' 02"	180.11	
13	227° 29' 21"	286.71 chord	540.00
14	212° 05' 38"	74.71	
15	207° 37' 23"	80.68	
16	217° 26' 44"	255.19 chord	748.00
17	227° 16' 00"	62.65	
18	251° 41' 32"	127.36 chord	154.00
19	276° 07' 05"	462.58	
20	271° 22' 52"	299.94 chord	1816.00
21	266° 38' 38"	538.14	
22	268° 53' 59"	1409.27	
23	267° 04' 07"	437.68	
24	269° 07' 45"	186.75	
25	252° 46' 35"	106.99 chord	190.00
26	206° 23' 54"	55.04 chord	55.00
27	170° 36' 12"	63.14 chord	319.00
28	148° 58' 11"	65.45	

Note: Azimuths and coordinates are referred to Government Survey Triangulation Station "HALAI" △



PLAN SHOWING EASEMENT "R-1"
for Access Purposes

(12 foot wide Road Right-of-Way)
in favor of Hawaii Electric Light Co., Inc.

Affecting Government (Crown) Lands of Piihonua
being a portion of Grant S-15,868
Piihonua, South Hilo, Island of Hawaii, Hawaii

Scale: 1 inch = 600 feet

BARBARA BREWER COOPER
LICENSED PROFESSIONAL LAND SURVEYOR
No. 10749
HAWAII U.S.A.

This work was prepared by me or under my supervision.

Barbara Brewer Cooper — 4-30-06

Signature — Expiration Date of the License

TAX MAP KEY: 2-6-009:005 (por.)

EXHIBIT "B"

HAWAII ELECTRIC LIGHT CO., INC.
ENGINEERING DEPARTMENT
54 HALEKAUILA ST
HILO, HAWAII 96720

March 10, 2006
$8\frac{1}{2}$" x 11"